GCSE

WJEC GCSE in SCIENCE (DOUBLE AWARD)

APPROVED BY QUALIFICATIONS WALES

SAMPLE ASSESSMENT MATERIALS

Teaching from 2016

This Qualifications Wales regulated qualification is not available to centres in England.

For teaching from 2016
For award from 2018

GCSE SCIENCE (Double Award)

SAMPLE ASSESSMENT MATERIALS

Contents

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 1: (Double Award) BIOLOGY 1
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**10**	
3.	**12**	
4.	**10**	
5.	**6**	
6.	**15**	
Total	**60**	

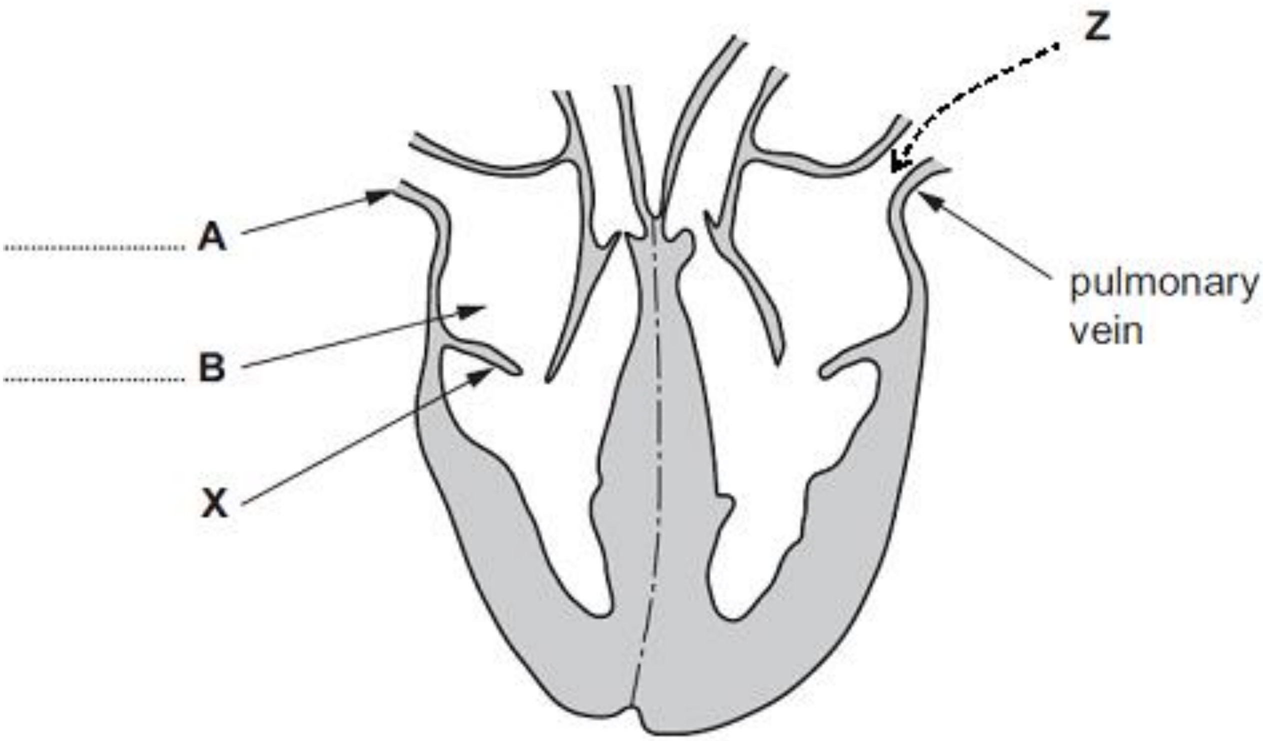
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **5** is a quality of extended response (QER) question where your writing skills will be assessed.

*Answer **all** questions*

1. (a) The diagram shows the human heart in section, seen from the front.



(i) Label structures **A** and **B** using some of the terms from the list below. [2]

aorta atrium vena cava ventricle

(ii) Arrow **Z** shows blood entering the heart.

I State the organ from which this blood has come. [1]

……………………………….

II Continue arrow **Z** to show the path of blood passing through and then leaving the heart. [1]

(iii) Name structure **X** and state its function. [2]

Name ……………………………….

Function…………………………………………………………………………….

……………………………………………………………………………………

(b) William Harvey was an English doctor in the 17th century. He discovered that blood is forced through the blood vessels by the action of the heart.

Harvey said that

'blood flows through blood vessels in a single circulatory system'.

Harvey's idea contains one error.

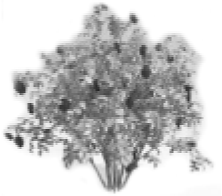
Rewrite Harvey's idea correcting the error. [1]

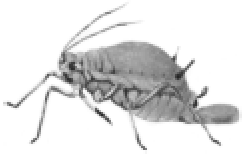
…………………………………………………………………………………………

…………………………………………………………………………………………

7

2. The diagram below shows a garden food chain.



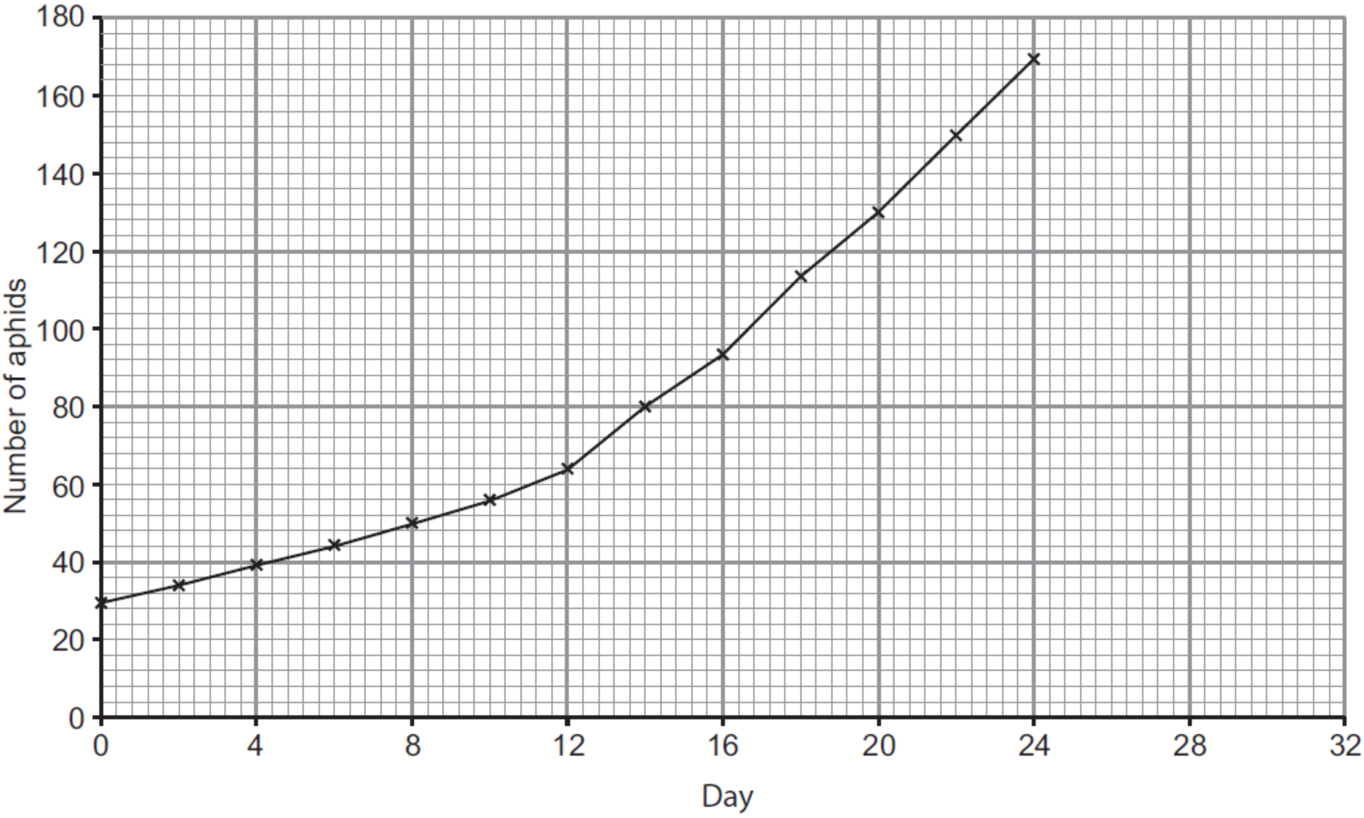


rose bush ⟶ aphid ⟶ ladybird ⟶ blue tit

(a) Name the second stage consumer in the above food chain. [1]

………………………………

(b) In an investigation into pest control, scientists monitored the number of aphids on a rose bush over 24 days. The results are shown in the graph below.



(i) At day 4, there were 40 aphids on the rose bush.
How many more days did it take for this number to double? [1]

………………………………

(ii) On day 24, the scientists added ladybirds to the rose bush. The number of aphids on the rose bush was counted for the next 8 days and is shown in the table below.

day	number of aphids
26	174
28	160
30	110
32	100

I Use the data in the table to plot the points for days 26 to 32. [1]

II Join all the plots with a ruler for days 24 to 32. [1]

(c) (i) From the graph, in which two day period was there the greatest change in aphid numbers? [1]

day ………… to day …………

(ii) Use the above information to suggest a reason for the change in aphid numbers between:

I day 0 to day 24 [1]

………………………………………………………………………………………

II day 24 to day 32 [1]

………………………………………………………………………………………

(d) The scientists used the following method to estimate the total number of aphids on the rose bush:

total number of aphids = number of aphids on one leaf x number of leaves on the rose bush

Suggest **one** improvement to their method of estimating the number of aphids on the rose bush. [1]

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…………………………………………………………………………………………………

(e) Explain how controlling aphids by using pesticides would affect the numbers of blue tits in the food chain above. [2]

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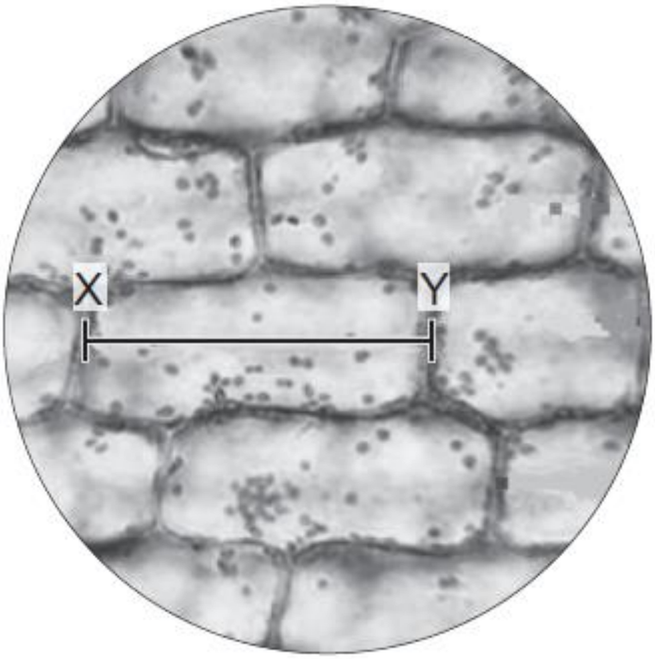
10

3. The photograph shows cells from a freshwater plant called *Elodea* viewed down a microscope.



(a) (i) The line **X – Y** shows the length of one cell.
Measure the line **X –Y** and write your answer in the space below. [1]

length of line **X – Y** = ……… mm

(ii) The photograph has a magnification of x100.
Calculate the actual length of the cell. [1]

actual length of cell = ……… mm

(b) Photosynthesis takes place in the chloroplasts.

(i) Underline the correct answer in the following sentence. [1]

Chloroplasts are found in the cytoplasm / vacuole / nucleus

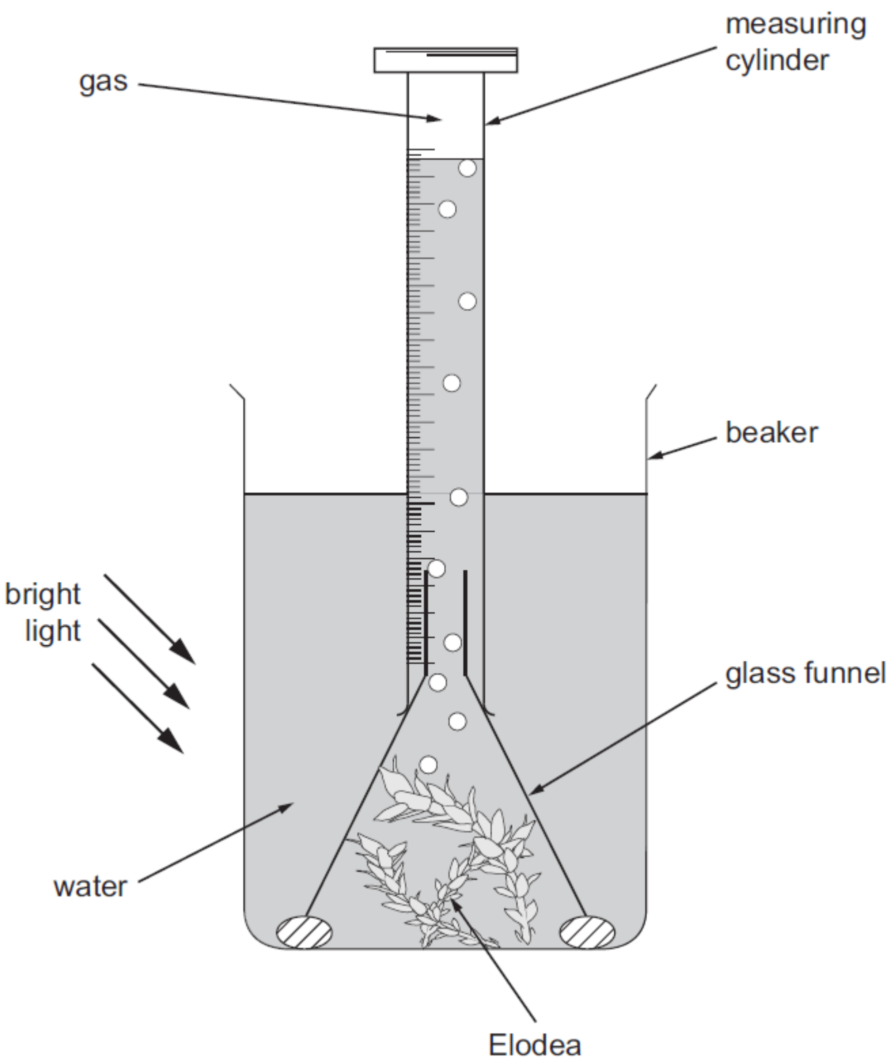
(ii) Chloroplasts contain chlorophyll.
State the function of chlorophyll. [1]

…………………………………………………………………………………………

(iii) Complete the word equation for photosynthesis. [1]

……………………….. + water ⟶ …………………….. + oxygen

(c) Bethan investigated the rate of photosynthesis in Canadian pondweed (*Elodea)* at three different temperatures using the apparatus shown below.



She counted the bubbles coming from the funnel every minute for ten minutes and recorded the results in the table below.

Temperature of water (^{o}C)	Number of bubbles in each minute											
	1st	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**	**10th**	**Total number of bubbles in ten minutes**	**Mean number of bubbles per minute**
5	1	2	1	2	2	1	1	1	2	2	15	1.5
15	2	3	2	3	4	3	3	3	3	3	……	……
25	3	6	3	6	7	7	8	8	6	6	……	……

(i) Calculate the total and mean number of bubbles per minute for *Elodea* in water at 15 ^{o}C and at 25 ^{o}C. **Write your answers in the table.** [1]

(ii) State the name of the gas in the bubbles. [1]

………………………………

(iii) What conclusions can you make about the effect of temperature on the rate of photosynthesis in this investigation? [2]

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……………………………………………………………………………………..

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(iv) Instead of counting the number of bubbles, Bethan could have measured the volume of gas collecting in the measuring cylinder. Explain which is the better method to use. [3]

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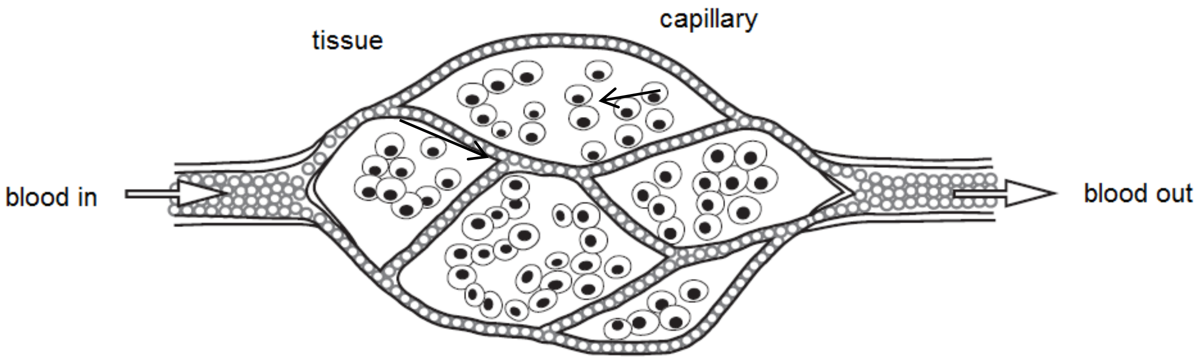
12

4. The diagram shows blood flowing through capillaries in a tissue.



(a) State the process by which molecules pass between the blood and tissue cells. [1]

………………………………

(b) (i) Megan wanted to test a sample of blood plasma for the presence of glucose.
Describe the method she should use and state the colour change that would be observed in a positive result. [4]

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(ii) Megan tested further samples of blood plasma for the presence of two other food molecules.

Complete the table below to show the expected results. [2]

reagent used	**molecule tested for**	**colour of reagent**	**colour of plasma after testing**	**positive result = ✔ negative result = ✗**
…………………	starch	…………………	brown	✗
Biuret	…………………	…………………	violet	………

(iii) The table shows that starch is not present in the blood plasma, even though starch is part of the human diet.
Explain why starch is not found in the plasma. [3]

……………………………………………………………………………………..

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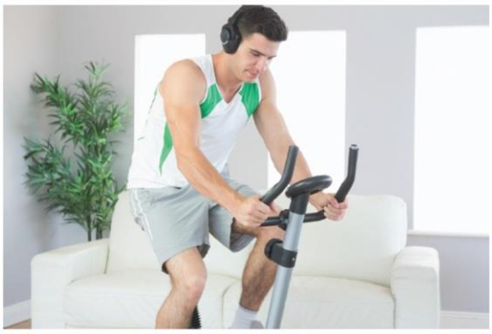
10

5. Dan works out on an exercise bicycle.



Dan says he is fitter than Alex because his breathing rate returns to normal after exercise sooner than Alex's. You decide to test Dan's claim by carrying out a comparison of the effect of exercise on the breathing rate (number of breaths per minute) of these two students.

Describe your investigation. Make sure that it is a fair test. [6 QER]

6

6. Read this newspaper article.

A daily dose of chocolate may be good for you.

A study in Cardiff University has found that eating up to two small bars of chocolate a day may help to protect against heart disease, possibly by supplying nutrients known as flavonoids.

Scientists examined the diets of 21 000 people over 18 years old and found that eating up to 100 g of chocolate a day lowered the risk of dying from heart disease by 25%. These findings are backed up by a review of published evidence involving 158 000 people from around the world, which also showed a significant reduction of heart disease amongst the regular chocolate eaters.

However, one scientist also said “many people eat food which is too high in sugar and fat, including chocolate. This can be very bad for health. We need to help people make informed choices.”

Telegraph 16/06/15
Sarah Knapton Science editor

(a) (i) The scientists used several research methods. Use the information in the article to decide which of these statements are true/false and **circle** your answers. [2]

		True or false	
1	The scientists did their own original work	true	false
2	The scientists used the findings from a number of studies.	true	false
3	The scientists did laboratory experiments	true	false
4	The scientists did a statistical analysis	true	false
5	The scientists used probability calculations	true	false
6	The scientists tested the ideas on volunteers	true	false

(ii) The scientists used:

- a large sample size
- results from people of different ethnicity.

Explain how each of these methods increased the strength of confidence in their conclusions? [2]

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(iii) Apart from heart disease, state some of the health risks of eating a diet that is too high in sugar and fat. [3]

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(iv) What information is given on packets of food to “help people make informed choices” about the ingredients in the food? [2]

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(v) The newspaper article suggests that nutrients called flavonoids found in chocolate help to protect against heart disease.

The table below gives five classes of flavonoid and foods rich in each one.

	Class of flavonoid				
	flavonol	**flavan-3-ol**	**flavone**	**flavonone**	**anthocyanidin**
Food source	onions apples lettuce tomatoes beans almonds	apples bananas blueberries peaches pears strawberries	parsley peppers celery apples oranges melon	oranges grapefruit lemons tomatoes	blueberries bananas strawberries cherries pears cabbage

From the table:

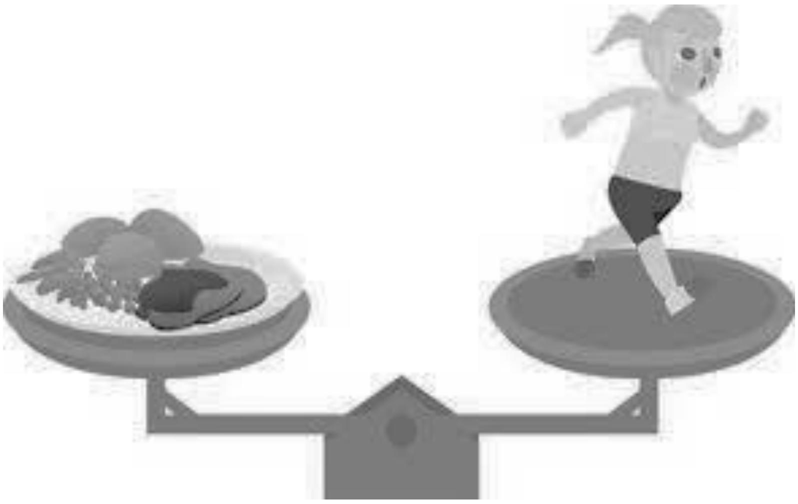
I which **one** of the foods gives the greatest variety of flavonoids? [1]

……………………………….

II which two flavonoids would be missing from a banana and melon smoothie? [1]

………………………………. and ……………………………….

(b) The poster below comes from a healthy eating campaign promoting a balanced diet.



What is meant by the term 'balanced diet'? [2]

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

(c) Some doctors want the government to put an extra tax on foods with a high sugar content and use the money from the tax to reduce the price of fruit and vegetables in the shops.
Suggest **one reason for** and **one reason against** doing this. [2]

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……………………………………………………………………………………………

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END OF PAPER

UNIT 1: (Double Award) BIOLOGY 1
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		A = vena cava (1) B = atrium (1)	2			2		
		(ii)	I	Lung(s)	1			1		
			II	Arrow in through atrium and out through aorta	1			1		
		(iii)		Valve (1) Prevent backflow (1)	2			2		
	(b)			Blood flows through blood vessels in a double circulatory system		1		1		
				Question 1 total	**6**	**1**	**0**	**7**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Ladybird	1			1		
	(b)	(i)		10 days		1		1	1	
		(ii)	I	All plots correct		1		1	1	
			II	Plots joined with a ruler		1		1	1	
	(c)	(i)		28-30		1		1	1	
		(ii)	I	Reproduction/ immigration		1		1		
			II	Predation (rate) greater than replacement (rate)/ eaten by ladybirds		1		1		
	(d)			Count more leaves/ count aphids on other parts of plant/ count aphids per unit area			1	1		1
	(e)			Fewer aphids, so fewer ladybirds (1) Fewer blue tits because they feed on ladybird (1) OR Blue tits would decrease (1) Because of bioaccumulation/ or description of (1)		2		2		
				Question 2 total	**1**	**8**	**1**	**10**	**4**	**1**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		46		1		1	1	
		(ii)		0.46		1		1	1	
	(b)	(i)		Cytoplasm	1			1		
		(ii)		Absorb light	1			1		
		(iii)		Carbon dioxide **and** glucose	1			1		
	(c)	(i)		30, 3 **and** 60, 6		1		1	1	
		(ii)		Oxygen		1		1		
		(iii)		Simple answer relating temperature to rate, e.g. the higher the temperature, the faster the rate (1) Quantitative answer relating temperature to rate, e.g.rate <u>doubles</u> for every 10 ^{o}C rise (2)			2	2	2	
		(iv)		Volume of gas (1) it is more accurate (1) the volume of bubbles varies (1)			3	3		3
				Question 3 total	**3**	**4**	**5**	**12**	**5**	**3**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td></td><td>Diffusion</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td></td><td>Test tube/boiling tube (1)
containing plasma and Benedict's solution (1)
Heat {strongly/to boiling} (1)
Blue to {brick red/ orange} (1)</td><td>4</td><td></td><td></td><td>4</td><td></td><td>4</td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>1 mark for each correct row (2)
<table>
<tr><th>reagent</th><th>molecule tested for</th><th>colour of reagent</th><th>colour after testing</th><th>✓ or ✗</th></tr>
<tr><td>iodine solution</td><td></td><td>brown</td><td></td><td></td></tr>
<tr><td></td><td>protein</td><td>blue</td><td></td><td>✓</td></tr>
</table></td><td>2</td><td></td><td></td><td>2</td><td></td><td>2</td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>Starch is too large to pass through the wall of the small intestine(1)
so is digested (1)
by an enzyme (1)</td><td></td><td>3</td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 4 total</td><td>7</td><td>3</td><td>0</td><td>10</td><td>0</td><td>6</td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5				***Indicative content*** Record Dan's (breathing) rate at rest then exercise (bike or other) exercise specified (distance/speed/load) for a certain time record rate after exercise rate must return to rest repeat with Alex – must ref to same exercise regime compare results to see which breathing rate returned to normal the fastest. **5 – 6 marks**: Detailed description of the entire investigation to include specified exercise regime and ref. to same exercise again with Alex and take rate till return to resting level. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks**: Outline general description of the investigation *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1 – 2 marks**: Ref only to counting breathing rate and then exercise by Dan and repeat with Alex + comparison *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks:** *No attempt made or no response worthy of credit.*			6	6		6
				Question 5 total	**0**	**0**	**6**	**6**	**0**	**6**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>6</td><td>(a)</td><td>(i)</td><td></td><td>6 correct (2)
3 correct (1)
<table><tr><td>1</td><td><u>true</u></td><td>false</td></tr><tr><td>2</td><td><u>true</u></td><td>false</td></tr><tr><td>3</td><td>true</td><td><u>false</u></td></tr><tr><td>4</td><td><u>true</u></td><td>false</td></tr><tr><td>5</td><td><u>true</u></td><td>false</td></tr><tr><td>6</td><td>true</td><td><u>false</u></td></tr></table></td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>More accurate reflection/closer to the mean/counter variability (1)
Confirm that the conclusions are common to all (genetic) groups/spot possible (genetic) differences between groups(1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td>2</td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>Any 3 × (1) from:
stroke/thrombosis
type 2 diabetes
tooth decay
mobility issues</td><td>3</td><td></td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iv)</td><td></td><td>How much fat/ sugar (1)
Is in each portion/ 100 g/ packet (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(v)	I	Apples		1		1		
			II	Flavonol **and** flavonone		1		1		
	(b)			Good range/variety/all the nutrient groups (1) {Volume/ mass/ in proportion} to appropriate for age/gender/activity (1)	2			2		
	(c)			For: to reduce consumption of sugary foods/drinks (1) Against: interference on individual choice/the market (1)		2		2		
				Question 6 total	**7**	**8**	**0**	**15**	**0**	**2**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	6	1	0	7	0	0
2	1	8	1	10	4	1
3	3	4	5	12	5	3
4	7	3	0	10	0	6
5	0	0	6	6	0	6
6	7	8	0	15	0	2
TOTAL	24	24	12	60	9	18

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 1: (Double Award) BIOLOGY 1
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**15**	
2.	**7**	
3.	**9**	
4.	**5**	
5.	**11**	
6.	**5**	
7.	**8**	
Total	**60**	

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INFORMATION FOR CANDIDATES
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Question **5** is a quality of extended response (QER) question where your writing skills will be assessed.

*Answer **all** questions*

1. Read this newspaper article.

A daily dose of chocolate may be good for you.

A study in Cardiff University has found that eating up to two small bars of chocolate a day may help to protect against heart disease, possibly by supplying nutrients known as flavonoids.

Scientists examined the diets of 21 000 people over 18 years old and found that eating up to 100 g of chocolate a day lowered the risk of dying from heart disease by 25%. These findings are backed up by a review of published evidence involving 158 000 people from around the world, which also showed a significant reduction of heart disease amongst the regular chocolate eaters.

However, one scientist also said “many people eat food which is too high in sugar and fat, including chocolate. This can be very bad for health. We need to help people make informed choices.”

Telegraph 16/06/15
Sarah Knapton Science editor

(a) (i) The scientists used several research methods. Use the information in the article to decide which of these statements are true/false and **circle** your answers. [2]

		True or false	
1	The scientists did their own original work	true	false
2	The scientists used the findings from a number of studies.	true	false
3	The scientists did laboratory experiments	true	false
4	The scientists did a statistical analysis	true	false
5	The scientists used probability calculations	true	false
6	The scientists tested the ideas on volunteers	true	false

(ii) The scientists used:

- a large sample size
- results from people of different ethnicity.

Explain how each of these methods increased the strength of confidence in their conclusions? [2]

…………………………………………………………………………………………

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(iii) Apart from heart disease, state some of the health risks of eating a diet that is too high in sugar and fat. [3]

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(iv) What information is given on packets of food to “help people make informed choices” about the ingredients in the food? [2]

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(v) The newspaper article suggests that nutrients called flavonoids found in chocolate help to protect against heart disease.

The table below gives five classes of flavonoid and foods rich in each one.

	Class of flavonoid				
	flavonol	**flavan-3-ol**	**flavone**	**flavonone**	**anthocyanidin**
Food source	onions apples lettuce tomatoes beans almonds	apples bananas blueberries peaches pears strawberries	parsley peppers celery apples oranges melon	oranges grapefruit lemons tomatoes	blueberries bananas strawberries cherries pears cabbage

From the table:

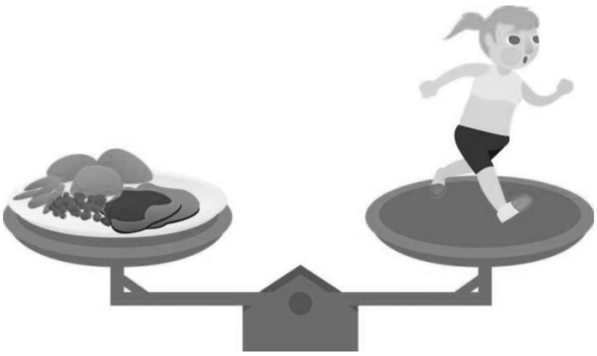
I which **one** of the foods gives the greatest variety of flavonoids? [1]

……………………………….

II which two flavonoids would be missing from a banana and melon smoothie? [1]

………………………………. and …………………………………

(b) The poster below comes from a healthy eating campaign promoting a balanced diet.



What is meant by the term 'balanced diet'? [2]

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(c) Some doctors want the government to put an extra tax on foods with a high sugar content and use the money from the tax to reduce the price of fruit and vegetables in the shops.
Suggest **one reason for** and **one reason against** doing this. [2]

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15

2. The photograph shows a peak flow meter.

A peak flow meter measures the rate at which air can be forced out of the lungs during expiration.

Caitlin, Megan and Lowri are three students. They take the peak flow test during their college course.

The results are shown in the following table.

student	**peak flow readings(litres/min)**					
	1	**2**	**3**	**4**	**5**	**mean**
Caitlin	400	380	430	320	400	386
Megan	390	330	390	380	290	356
Lowri	230	320	330	360	280	……….

(a) (i) **Complete the table** by calculating the mean peak flow for Lowri. [1]

(ii) One of the students is a regular cigarette smoker. Using only the data in the table, suggest which one and state the reason for your choice. [1]

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(iii) State **one** harmful effect of smoking on the lungs and explain how it would affect peak flow. [1]

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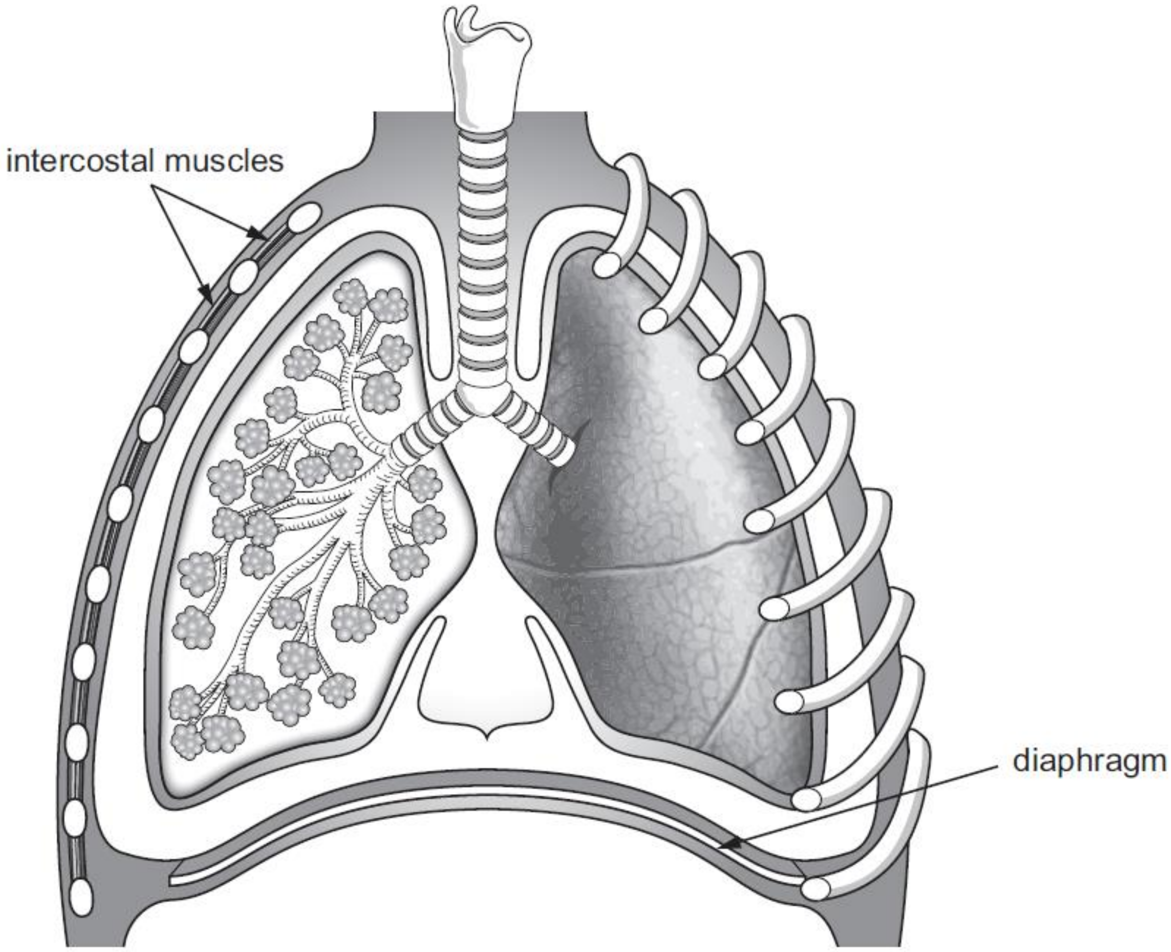
(b) The diagram shows the human respiratory system.



Explain how the intercostal muscles and diaphragm bring about **expiration** of breath from the lungs. [4]

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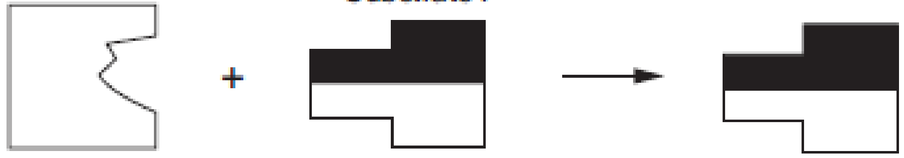
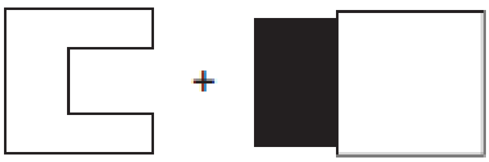
3. Diagrams (**A, B** and **C**) can be used to explain one model of enzyme action.

Diagram	Enzyme	Substrate	Outcome
A		Substrate P	
B		Substrate P	
C		Substrate Q	

(a) State the name of the model of enzyme action shown in the diagrams. [1]

……………………………………………

(b) Use the information in diagram **A** to explain this model of enzyme action. [3]

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(c) In diagram **B**, the enzyme had been heated strongly before adding the substrate.
Explain the outcome shown in the diagram. [3]

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(d) Predict the outcome in diagram **C** and explain your answer. [2]

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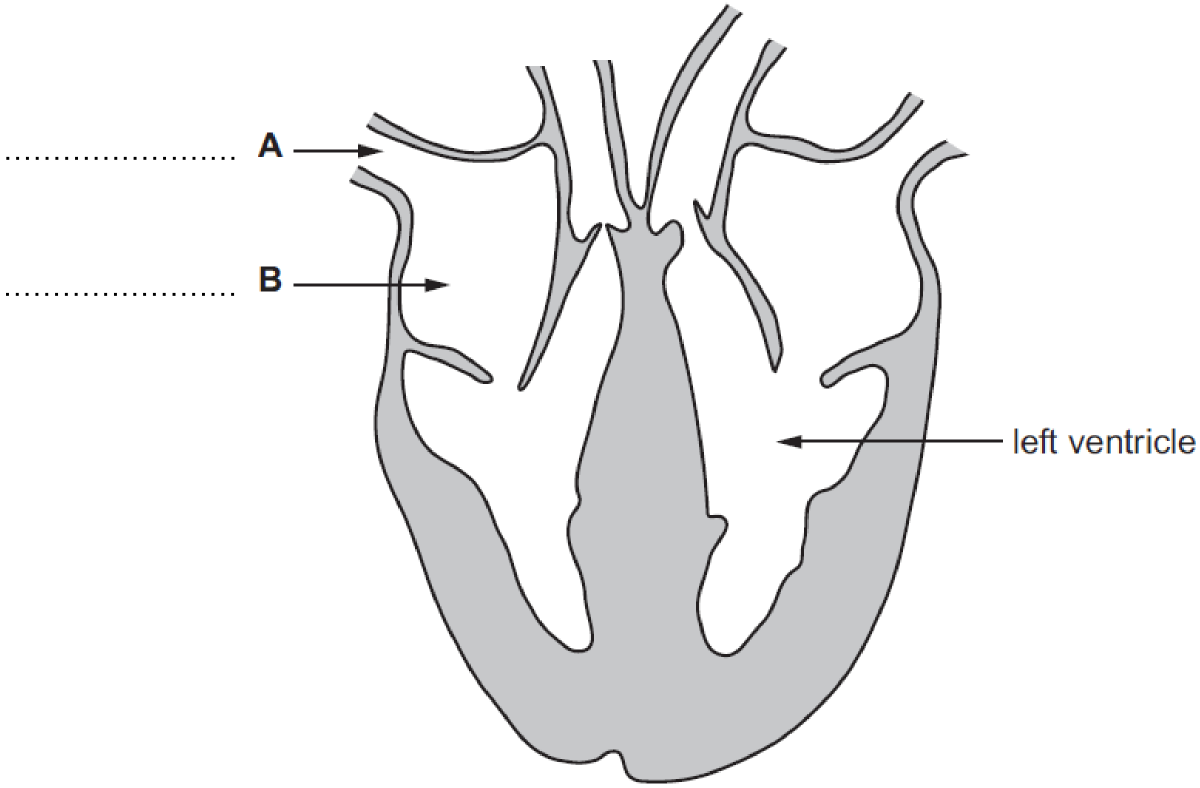
9

4. The diagram shows the heart in section, seen from the front.



(a) **On the diagram**, label structures **A** and **B**. [1]

(b) **Draw arrows on the diagram** to show the path taken by blood entering the heart from the lungs and leaving through the aorta. [1]

(c) The heart muscle is supplied with blood from three coronary arteries. Explain why heart action would stop if these blood vessels became blocked. [3]

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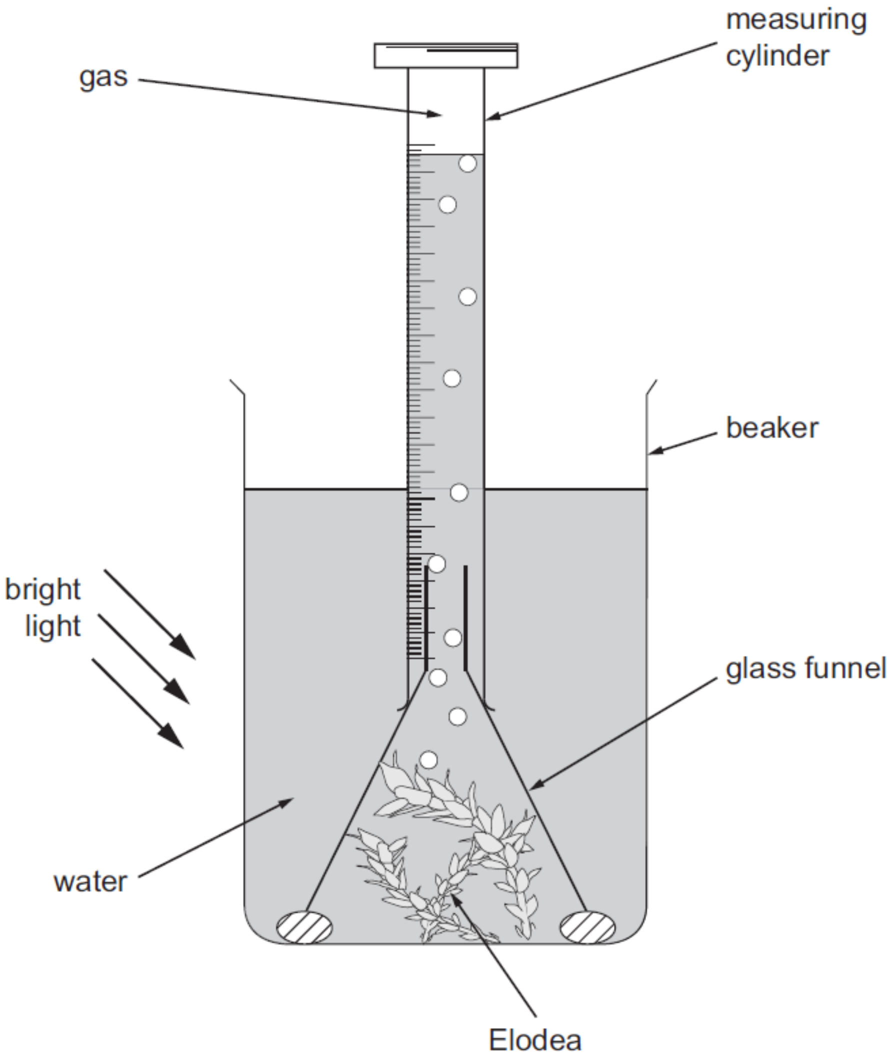
5

5. (a) Complete the word equation for photosynthesis. [1]

……………………….. + …………………….. ⟶ …………………….. + oxygen

(b) The diagram below shows apparatus used to investigate factors affecting the rate of photosynthesis in an aquatic plant called Canadian pondweed (*Elodea).*



Using the apparatus shown, design an experiment to investigate the effect of increasing light intensity on the rate of photosynthesis in *Elodea*. [6 QER]

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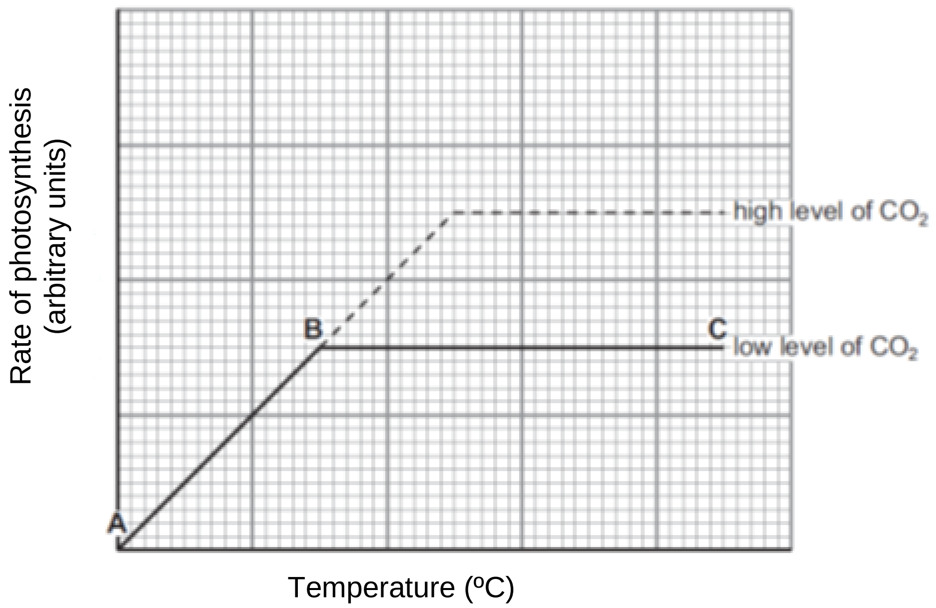
(c) The graph below shows the effect of certain limiting factors on the rate of photosynthesis.



(i) State the factor that is limiting the rate of photosynthesis from **A - B**. Give the evidence for your answer. [2]

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

(ii) State the factor that is limiting the rate of photosynthesis from **B - C**.
Give the evidence for your answer. [2]

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11

6. (a) The table shows the energy budget for a cow grazing on grass.

Input energy (food) (kJ)	**Losses (kJ)**		**Retained energy (kJ)**
	heat	**undigested food waste**	
2500	850	1520	…………….

(i) Calculate the retained energy for the cow. **Write your answer in the table.** [1]

(ii) The Energy Conversion Efficiency (ECE) is the % of input energy retained within the cow.
Calculate the ECE for the cow. [2]

ECE = ……………%

(b) Intensive farming methods aim to maximise the ECE.

Suggest **two** ways that intensive farming can reduce the energy lost as heat from the cows. [2]

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5

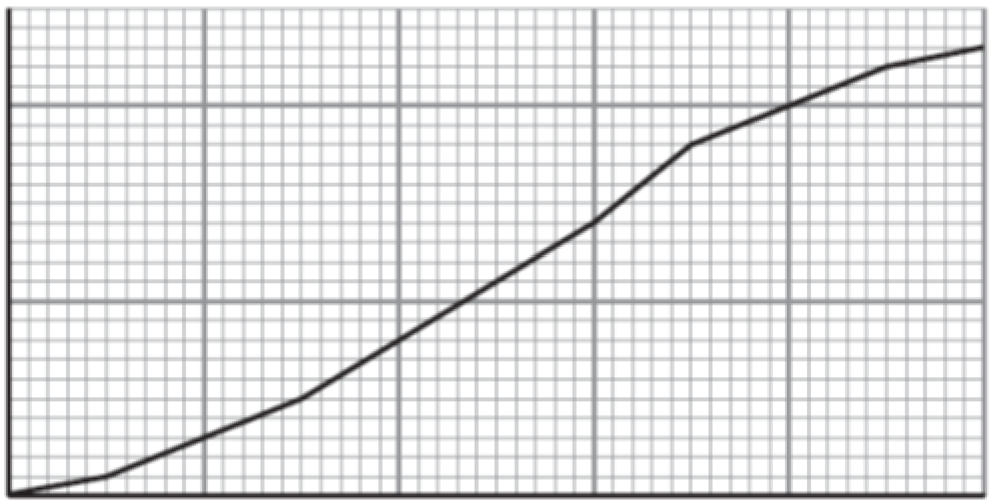
7. The photograph shows *Brassica juncea* plants growing in a greenhouse.

Read the following article.

How to harvest metal
Greenhouse trials have shown that *Brassica juncea* can take up heavy metals salts such as lead from the soil and concentrate them in its cells. The plants can then be harvested and the metals extracted.

The graph shows the rate of uptake of heavy metal salts by *Brassica juncea* during one trial.

Rate of uptake of heavy metal salts (arbitrary units)



Concentration of oxygen supplied to plant roots (arbitrary units)

(a) Explain the results shown in the graph. [4]

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(b) Conditions in the greenhouse were kept at the optimum for photosynthesis. Suggest **two** *other* advantages of doing the trials in a greenhouse rather than in the field. [2]

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(c) The article continued:

> Mining for heavy metals often results in waste tips in which the soil is heavily contaminated.
> Trials with *Brassica juncea* on old waste tips in Anglesey have shown that the plant can help to reduce heavy metal pollution in the soil. However it takes several years to bring about a significant reduction in contamination and it causes serious problems for local food chains – especially for the carnivores.

Explain why 'it causes serious problems for local food chains - especially for the carnivores.' [2]

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8

END OF PAPER

UNIT 1: (Double Award) BIOLOGY 1
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

<u>Marking rules</u>

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

<u>Extended response question</u>

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td></td><td>6 correct (2)
3 correct (1)
<table>
<tr><td>1</td><td><u>true</u></td><td>false</td></tr>
<tr><td>2</td><td><u>true</u></td><td>false</td></tr>
<tr><td>3</td><td>true</td><td><u>false</u></td></tr>
<tr><td>4</td><td><u>true</u></td><td>false</td></tr>
<tr><td>5</td><td><u>true</u></td><td>false</td></tr>
<tr><td>6</td><td>true</td><td><u>false</u></td></tr>
</table></td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>More accurate reflection/closer to the mean/counter variability (1)
Confirm that the conclusions are common to all (genetic) groups/spot possible (genetic) differences between groups(1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td>2</td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>Any 3 × (1) from:
stroke/thrombosis
type 2 diabetes
tooth decay
mobility issues</td><td>3</td><td></td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iv)</td><td></td><td>How much fat/ sugar (1)
Is in each portion/ 100 g/ packet (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1		(v)	I	Apples		1		1		
			II	Flavonol **and** flavonone		1		1		
	(b)			Good range/variety/all the nutrient groups (1) {Volume/ mass/ in proportion} to appropriate for age/gender/activity (1)	2			2		
	(c)			For: to reduce consumption of sugary foods/drinks (1) Against: interference on individual choice/the market (1)		2		2		
				Question 1 total	**7**	**8**	**0**	**15**	**0**	**2**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		304		1		1	1	
		(ii)		Lowri – <u>smallest/least</u> peak flow		1		1	1	
		(iii)		Excess mucus/tar **and** Restricts volume/ability to force air out (1) accept similar argument for emphysema, bronchitis, lung cancer	1			1		
	(b)			intercostal muscles relaxes and ribcage moves down and in (1) diaphragm relaxes and domes (1) reducing volume of thorax (1) {increasing internal air pressure/ greater pressure in than out}, so air forced out (1)	4			4		
				Question 2 total	**5**	**2**	**0**	**7**	**2**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			lock and key	1			1		
	(b)			substrate molecule fits/binds to active site (1) so reaction occurs (1) products are formed (1)	3			3		
	(c)			active site denatured/destroyed (1) substrate cannot fit (1) no reaction (1)		3		3		
	(d)			no reaction (1) substrate Q does not fit active site (1)			2	2		
				Question 3 total	**4**	**3**	**2**	**9**	**0**	**0**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			A = vena cava **and** B = right atrium	1			1		
	(b)			arrow(s) entering pulmonary vein, descending to l. ventricle and out through aorta	1			1		
	(c)			no oxygen/no glucose (1) no respiration (1) no contraction (1)	3			3		
				Question 4 total	**5**	**0**	**0**	**5**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			carbon dioxide + water ➔ glucose	1			1		
	(b)			***Indicative content*** Use low light intensity measure volume /count bubbles over a set period of time at least two controlled variables stated increase light intensity and repeat suitable method to increase light (move lamp/ change brightness of bulb) range of five light intensities plot results/compare **5 – 6 marks** : Detailed description of the entire investigation to include repeats and fair testing. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks** : Outline general description of the investigation *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1 – 2 marks** : Reference only to counting bubbles/measuring volume at different light intensities *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks:** *No attempt made or no response worthy of credit.*			6	6		6

	(c)	(i)		temperature; increasing the temperature results in increased rate of p/s;			2	2	1	
		(ii)		carbon dioxide; rate faster at the higher concentration;			2	2	1	
				Question 5 total	**1**	**0**	**10**	**11**	**2**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		130		1		1	1	
		(ii)		130/2500 x 100 (1) 5.2 (1)		2		2	2	
	(b)			restrict movement (1) maintain constant (high) temperature in building (1)		2		2		
				Question 6 total	**0**	**5**	**0**	**5**	**3**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			As oxygen concentration increases, the rate of heavy metal uptake increases (1) This shows that respiration is involved (1) Producing more energy/ more ATP released (1) And therefore more active uptake (1)		4		4	1	
	(b)			**Any 2 (x1) from:** reduce losses from pests/herbivores control oxygen level optimum water/nutrients more convenient for sampling		2		2		2
	(c)			passes up food chain (1) toxic levels in carnivores (1)	2			2		
				Question 7 total	**2**	**6**	**0**	**8**	**1**	**2**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	7	8	0	15	0	2
2	5	2	0	7	2	0
3	4	3	2	9	0	0
4	5	0	0	5	0	0
5	1	0	10	11	2	6
6	0	5	0	5	3	0
7	2	6	0	8	1	2
TOTAL	24	24	12	60	8	10

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 2: (Double Award) CHEMISTRY 1
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**8**	
3.	**7**	
4.	**7**	
5.	**9**	
6.	**6**	
7.	**9**	
8.	**6**	
Total	**60**	

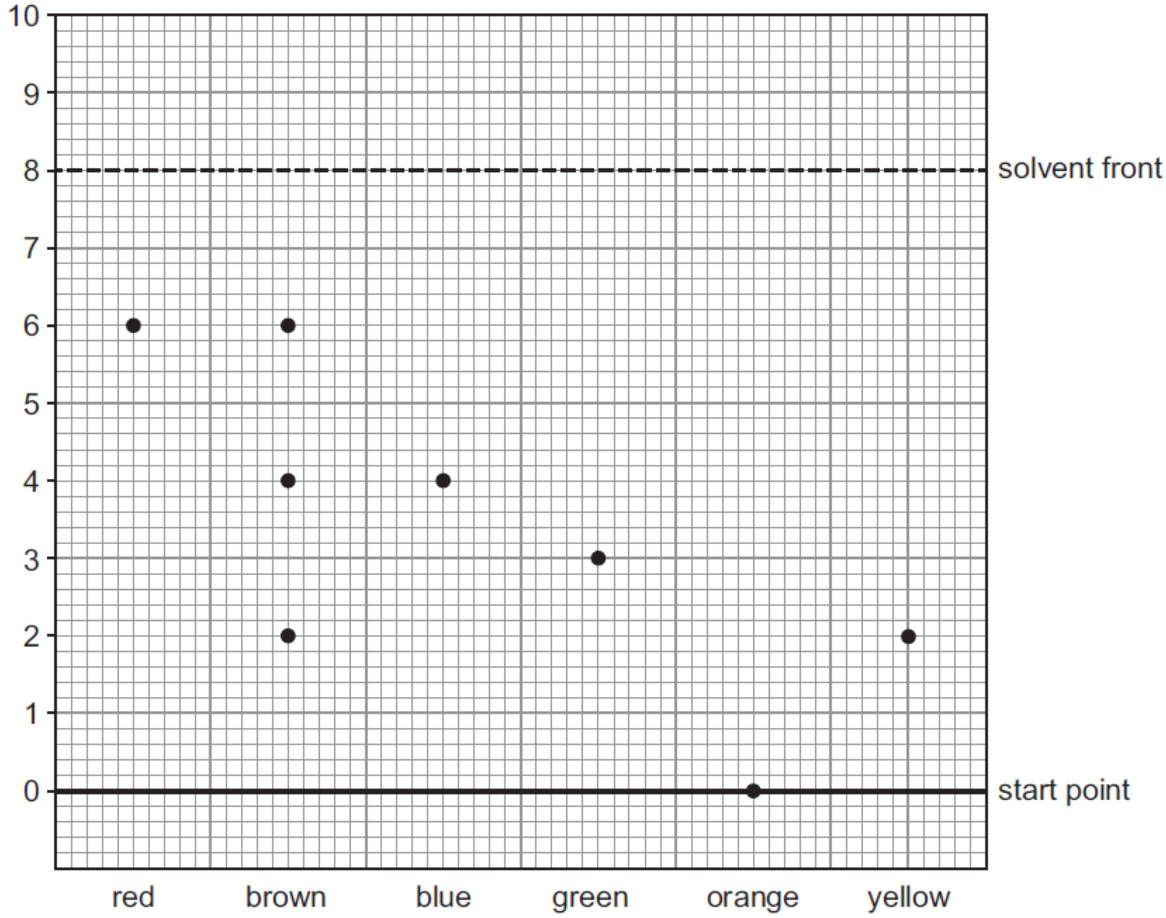
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **6** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions*.

1. (a) The diagram below shows the chromatogram of six different coloured dyes from felt-tipped pens.



(i) Give the **three** coloured dyes which are mixed to give the brown coloured felt tipped pen. [1]

....

....

....

(ii) Give the coloured dye which is insoluble in the solvent.
Give the reason for your choice. [1]

Dye ....

Reason ……………………………………………………………………….

……………………………………………………………………………….

(iii) The R_f value of a substance can be used to identify that substance.

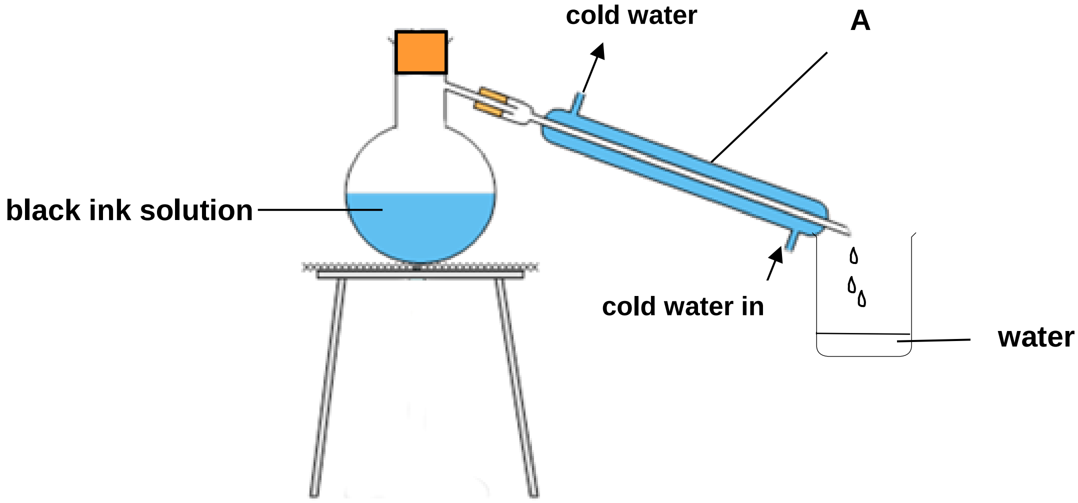
The R_f value is given by the formula:

$$R_f = \frac{\text{distance moved by the substance}}{\text{distance moved by the solvent front}}$$

Calculate the R_f value of the substance in the red pen. [2]

R_f = ...

(b) The diagram below shows the apparatus that can be used to obtain water from a black ink solution.



(i) The diagram is missing a piece of apparatus needed for the process to work. Draw the missing piece of apparatus onto the diagram. State the purpose of the missing piece of apparatus. [2]

....

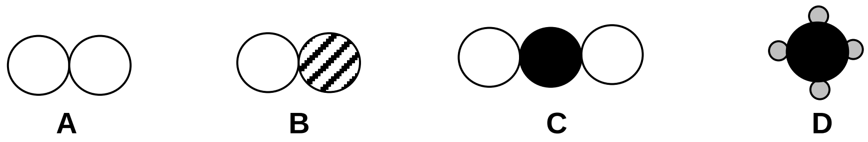
(ii) Describe the purpose of apparatus **A**. [2]

....

....

8

2. (a) The diagrams below represent carbon dioxide (CO_2), methane (CH_4), nitrogen oxide (NO) and oxygen (O_2) ***but not necessarily in that order***.



(i) Give the letter **A**, **B**, **C**, or **D** of the diagram which represents an element. Give the reason for your choice. [2]

Diagram …………………

Reason ……………………………………………………………….....

………………………………………………………………………………………

(ii) Which substance is represented by diagram **C**? [1]

…………………………………….

(iii) Using the information above draw a diagram which represents one molecule of nitrogen trioxide, NO_3. [1]

(b) (i) Sodium chlorate, $NaClO_3$, is used to bleach paper.

$A_r(O) = 16$ $\quad$ $A_r(Na) = 23$ $\quad$ $A_r(Cl) = 35.5$

Calculate the relative molecular mass, M_r, of sodium chlorate. [2]

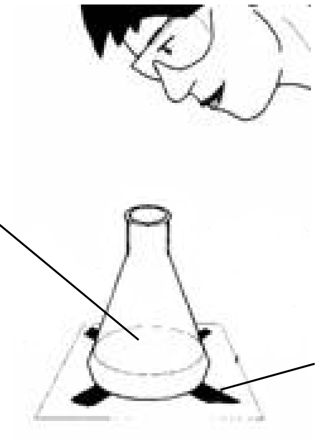
M_r = ………………………

(ii) Calculate the percentage of sodium in sodium chlorate. [2]

Percentage of sodium = …………….

8

3. Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction can be investigated using the ‘disappearing cross’ experiment. The yellow precipitate formed during the reaction causes the ‘X’ marked on a piece of white paper to disappear. The time taken for this to happen can be measured.



10 cm^3 of dilute hydrochloric acid were added separately to 50 cm^3 sodium thiosulfate solutions of five different concentrations. The results are shown below.

Concentration of sodium thiosulfate solution (g/dm^3)	**Reaction time (s)**			
	Run 1	**Run 2**	**Run 3**	**Mean**
40	6	7	5	6
32	7	7	7	7
24	10	9	11	10
16	19	17	18	18
8	37	38	39	38

(a) State whether you think the results are repeatable. Give the reason for your answer. [2]

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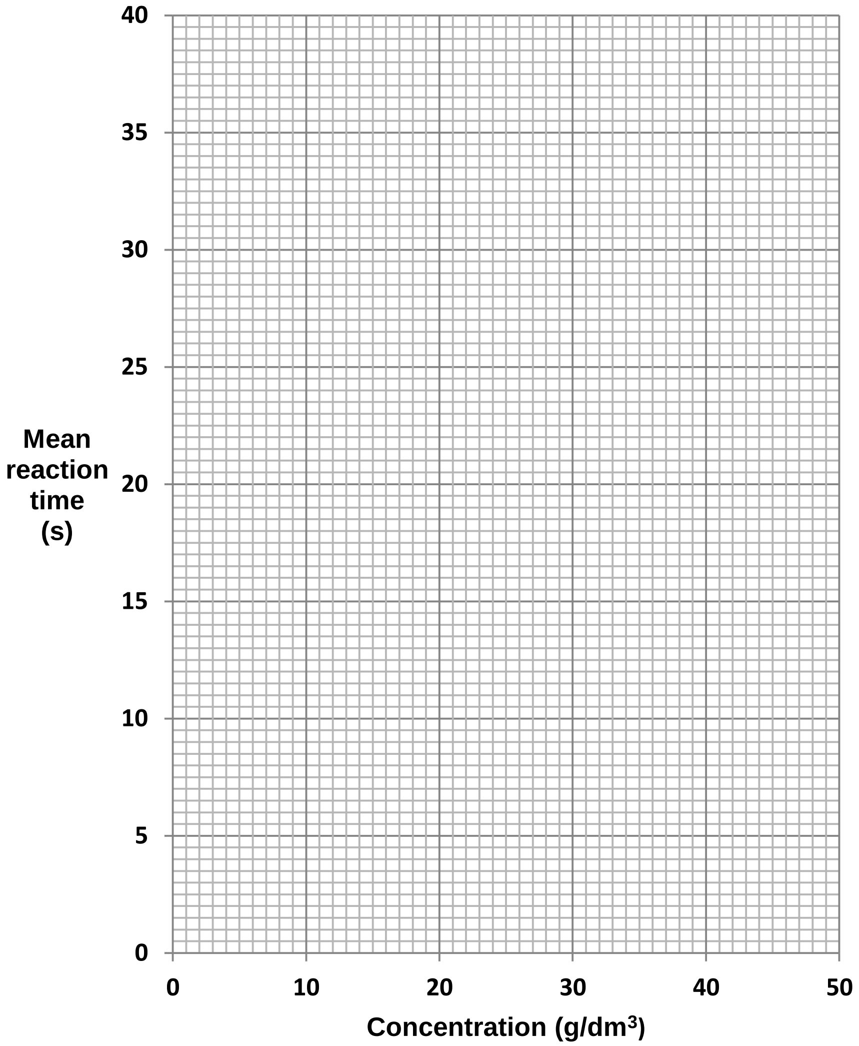
……………………………………………………………………………………………...

(b) Plot the results from the table on the grid below and draw a suitable line. [3]



(c) Put a tick (✓) next to the statement you agree with. [1]

Increasing the concentration, increases the reaction time ☐

Increasing the concentration, decreases the reaction time ☐

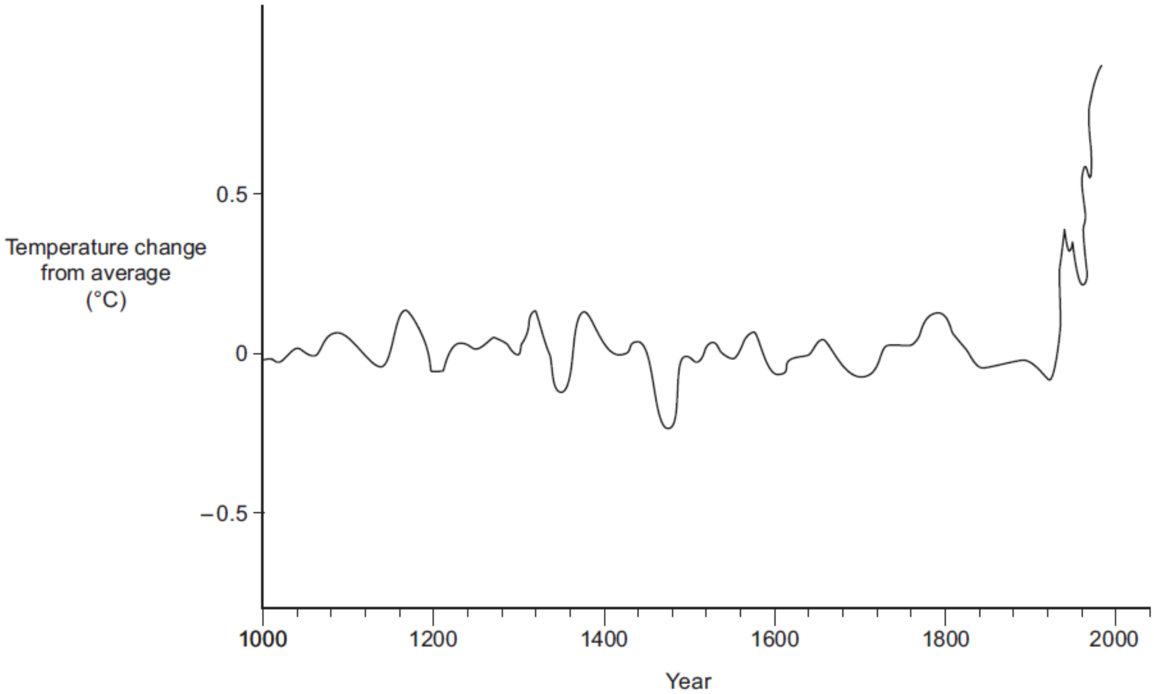
Increasing the concentration makes no difference to the reaction time ☐

(d) Apart from the volumes of both reagents and the concentration of the acid, name the **most** important factor which must be kept the same during each experiment. [1]

....

7

4. The graph below shows how the Earth's global air temperature has changed from its average value over the last 1000 years. This has been used as evidence that global warming is taking place. Scientists started to record the temperature of the atmosphere in England in 1659. Temperatures before 1659 are based on data collected from ice cores, tree rings, ocean sediments and rock layers.



(a) Describe the trend in global air temperature over the last 1000 years. [2]

....

....

(b) Put a tick (✓) in the box that best describes how scientists obtain data to show the temperature of the Earth's atmosphere is increasing. [1]

make and record observations ☐	research the internet ☐
computer modelling ☐	debate the issue ☐

(c) Between which **two** dates is the graph most reliable? Give the reason for your answer. [2]

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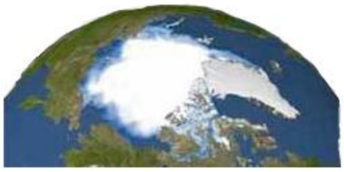
(d) The pictures below show the ice cap in the Earth's Arctic region.



Average extent of the ice during the month of September 1979, 1980 and 1981

Extent of ice in September 2000

Explain how these pictures support the information in the graph. [2]

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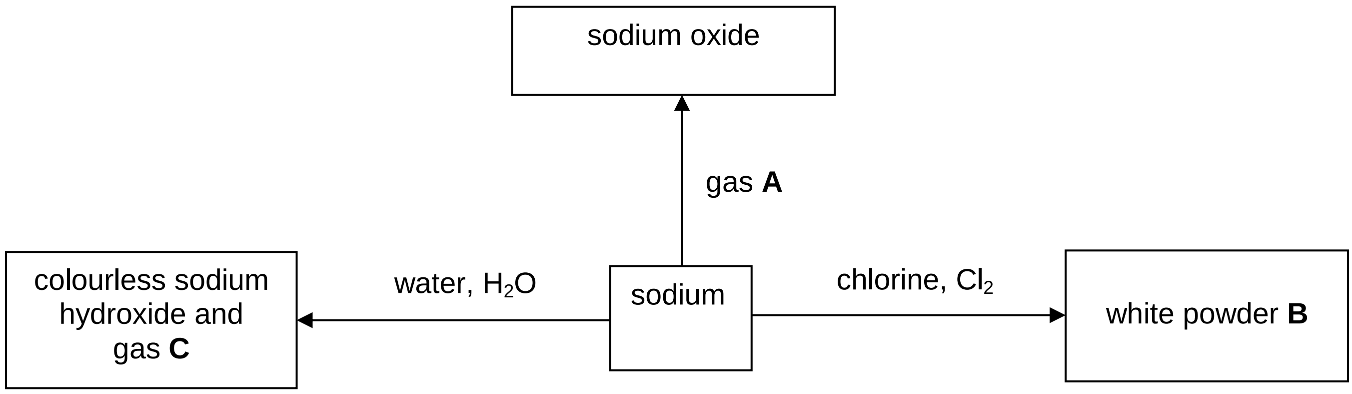
7

5. The diagram below shows some reactions of sodium.



(a) Give the chemical names for substances **A** and **B**. [2]

A ……………………..……………………..

B ……………………..……………………..

(b) Gas **C** 'pops' when tested with a lighted splint. Name gas **C**. [1]

……………………………………..

(c) Complete and balance the symbol equation. [2]

$2Na + 2H_2O \longrightarrow$ ………………..…… + ………………..……

(d) A flame test was carried out on the white powder **B**. Describe what you would expect to **see** during the flame test and give the reason for the observation. [2]

Observation ……………………………………………………………………………

Reason …...………………………………………………………………………………

(e) Lithium lies above sodium in Group 1.

Put a tick (✓) in the box which best describes how the reaction of lithium and water compares with that of sodium and water. Give the reason for your choice. [2]

more violent ☐ about the same ☐ less violent ☐

Reason ....

....

9

6. Describe the treatment of the public water supply.

Include in your answer the three main stages in the purification process and the reasons for each stage. [6 QER]

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7. (a) (i) Complete the following table that shows information about the atom of potassium. [2]

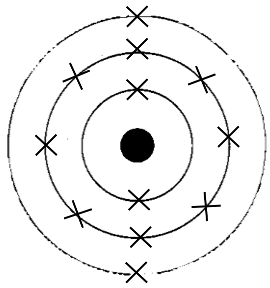
Element	Symbol	Number of protons	Number of neutrons	Number of electrons
potassium	${}^{39}_{19}K$	………………..	……………	…………….

(ii) Use the Periodic Table of Elements to give the element

I in Group 2 and Period 2 .... [1]

II which has electronic structure 2,8,6. ……………………… [1]

(iii) The diagram below shows the electronic structure of an element in the Periodic Table.



Using **X** to represent an electron, draw a similar style diagram to show the electronic structure of the element which lies directly **above** this one in the Periodic Table. [1]

(b) (i) The chemical formula of aluminium nitrate is $Al(NO_3)_3$. Give the number of nitrogen atoms in the formula $Al(NO_3)_3$. [1]

………………………………………

(ii) Give the chemical formula of potassium carbonate. [1]

………………………………………

(c) Boron has two isotopes, ${}^{11}_{5}\mathrm{B}$ and ${}^{10}_{5}\mathrm{B}$.

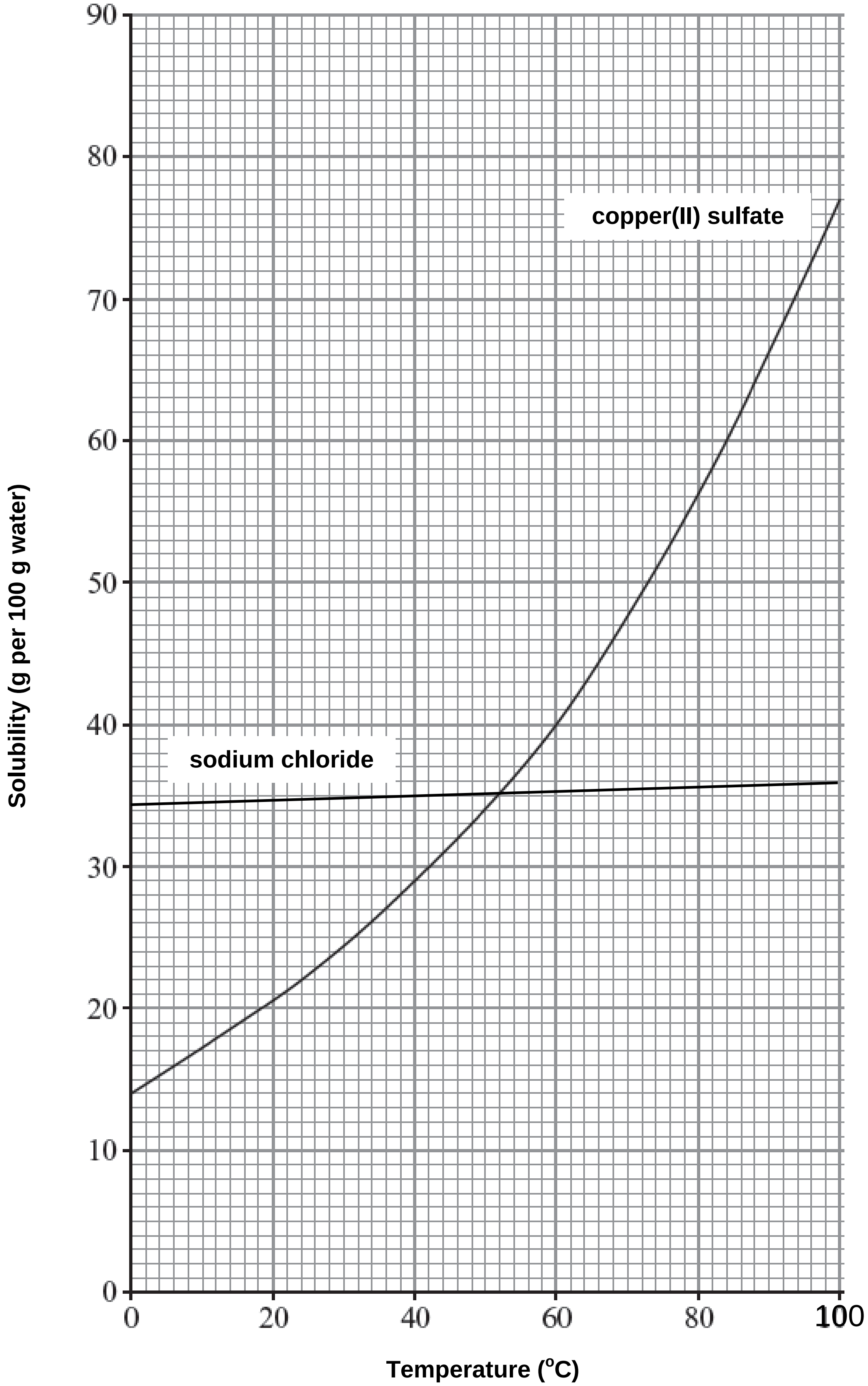
In terms of particles, give **one** similarity and **one** difference between the **nuclei** of these two boron atoms. [2]

Similarity …………………………………………………………………………....

Difference ………………………………………………………………………..

9

8. The graphs below show the solubilities of sodium chloride and copper(II) sulfate in water at different temperatures.



(a) Compare how the solubilities of copper(II) sulfate and sodium chloride change as temperature increases. [3]

....

....

....

....

(b) Calculate the mass of solid copper(II) sulfate that forms when a saturated solution in 50 g of water at 80 °C cools to 40 °C. [2]

Mass = …………………………. g

(c) State why the temperature scale on solubility graphs generally ranges from 0 °C to 100 °C. [1]

....

....

6

END OF PAPER

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2					Group						3	4	5	6	7	0
								$^{1}_{1}\mathrm{H}$ Hydrogen									$^{4}_{2}\mathrm{He}$ Helium
$^{7}_{3}\mathrm{Li}$ Lithium	$^{9}_{4}\mathrm{Be}$ Beryllium											$^{11}_{5}\mathrm{B}$ Boron	$^{12}_{6}\mathrm{C}$ Carbon	$^{14}_{7}\mathrm{N}$ Nitrogen	$^{16}_{8}\mathrm{O}$ Oxygen	$^{19}_{9}\mathrm{F}$ Fluorine	$^{20}_{10}\mathrm{Ne}$ Neon
$^{23}_{11}\mathrm{Na}$ Sodium	$^{24}_{12}\mathrm{Mg}$ Magnesium											$^{27}_{13}\mathrm{Al}$ Aluminium	$^{28}_{14}\mathrm{Si}$ Silicon	$^{31}_{15}\mathrm{P}$ Phosphorus	$^{32}_{16}\mathrm{S}$ Sulfur	$^{35}_{17}\mathrm{Cl}$ Chlorine	$^{40}_{18}\mathrm{Ar}$ Argon
$^{39}_{19}\mathrm{K}$ Potassium	$^{40}_{20}\mathrm{Ca}$ Calcium	$^{45}_{21}\mathrm{Sc}$ Scandium	$^{48}_{22}\mathrm{Ti}$ Titanium	$^{51}_{23}\mathrm{V}$ Vanadium	$^{52}_{24}\mathrm{Cr}$ Chromium	$^{55}_{25}\mathrm{Mn}$ Manganese	$^{56}_{26}\mathrm{Fe}$ Iron	$^{59}_{27}\mathrm{Co}$ Cobalt	$^{59}_{28}\mathrm{Ni}$ Nickel	$^{64}_{29}\mathrm{Cu}$ Copper	$^{65}_{30}\mathrm{Zn}$ Zinc	$^{70}_{31}\mathrm{Ga}$ Gallium	$^{73}_{32}\mathrm{Ge}$ Germanium	$^{75}_{33}\mathrm{As}$ Arsenic	$^{79}_{34}\mathrm{Se}$ Selenium	$^{80}_{35}\mathrm{Br}$ Bromine	$^{84}_{36}\mathrm{Kr}$ Krypton
$^{86}_{37}\mathrm{Rb}$ Rubidium	$^{88}_{38}\mathrm{Sr}$ Strontium	$^{89}_{39}\mathrm{Y}$ Yttrium	$^{91}_{40}\mathrm{Zr}$ Zirconium	$^{93}_{41}\mathrm{Nb}$ Niobium	$^{96}_{42}\mathrm{Mo}$ Molybdenum	$^{99}_{43}\mathrm{Tc}$ Technetium	$^{101}_{44}\mathrm{Ru}$ Ruthenium	$^{103}_{45}\mathrm{Rh}$ Rhodium	$^{106}_{46}\mathrm{Pd}$ Palladium	$^{108}_{47}\mathrm{Ag}$ Silver	$^{112}_{48}\mathrm{Cd}$ Cadmium	$^{115}_{49}\mathrm{In}$ Indium	$^{119}_{50}\mathrm{Sn}$ Tin	$^{122}_{51}\mathrm{Sb}$ Antimony	$^{128}_{52}\mathrm{Te}$ Tellurium	$^{127}_{53}\mathrm{I}$ Iodine	$^{131}_{54}\mathrm{Xe}$ Xenon
$^{133}_{55}\mathrm{Cs}$ Caesium	$^{137}_{56}\mathrm{Ba}$ Barium	$^{139}_{57}\mathrm{La}$ Lanthanum	$^{179}_{72}\mathrm{Hf}$ Hafnium	$^{181}_{73}\mathrm{Ta}$ Tantalum	$^{184}_{74}\mathrm{W}$ Tungsten	$^{186}_{75}\mathrm{Re}$ Rhenium	$^{190}_{76}\mathrm{Os}$ Osmium	$^{192}_{77}\mathrm{Ir}$ Iridium	$^{195}_{78}\mathrm{Pt}$ Platinum	$^{197}_{79}\mathrm{Au}$ Gold	$^{201}_{80}\mathrm{Hg}$ Mercury	$^{204}_{81}\mathrm{Tl}$ Thallium	$^{207}_{82}\mathrm{Pb}$ Lead	$^{209}_{83}\mathrm{Bi}$ Bismuth	$^{210}_{84}\mathrm{Po}$ Polonium	$^{210}_{85}\mathrm{At}$ Astatine	$^{222}_{86}\mathrm{Rn}$ Radon
$^{223}_{87}\mathrm{Fr}$ Francium	$^{226}_{88}\mathrm{Ra}$ Radium	$^{227}_{89}\mathrm{Ac}$ Actinium															

Key:

Mass number → A

X ← Element Symbol

Atomic number → Z

Name

UNIT 2: (Double Award) CHEMISTRY 1
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

<u>Marking rules</u>

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

<u>Extended response question</u>

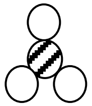
A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	*(a)*	(i)		Red, blue and yellow – all needed, any order			1	1		1
		(ii)		Orange Dye stays on start point / doesn't move Colour and reason must be correct			1	1		1
		(iii)		0.75 (2) If answer incorrect award (1) for: Distance moved by the substance = 6 or Distance moved by the solvent front = 8		2		2	2	
	(b)	(i)		Bunsen burner drawn (1) Accept heat arrow Heat / boil the solution / mixture (1) Accept evaporate the solution	2			2		2
		(ii)		Turn steam to water / condense the steam (1) By cooling (1)	2			2		2
				Question 1 total	**4**	**2**	**2**	**8**	**2**	**6**

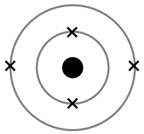
Question				**Marking details**	**Marks Available**					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
2	*(a)*	(i)		**A** (1) Contains only one type of atom (1)	2			2		
		(ii)		Carbon dioxide / CO_2		1		1		
		(iii)		 Do not accept 		1		1		
	(b)	(i)		106.5 (2) If answer is incorrect award (1) for indication that formula includes one atom of Na, one atom of Cl and three atoms of O e.g. $23 + 35.5 + (3 \times 16)$		2		2	2	
		(ii)		22 (2) error carried forward from (i) Accept any number of decimal places but rounding must be correct If answer is incorrect award (1) for $23/106.5 \times 100$		2		2	2	
				Question 2 total	**2**	**6**	**0**	**8**	**4**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*			Yes – results are repeatable (1) All runs have similar reaction times (for each concentration) (1) Accept all the results used to calculate the means			2	2		2
	(b)			All 5 points plotted correctly (2) [Credit (1) for 3 or 4 correct points] Smooth curve drawn (1)		2	1	3	3	3
	(c)			Increasing the concentration, decreases the reaction time ✓			1	1	1	1
	(d)			Temperature	1			1		1
				Question 3 total	**1**	**2**	**4**	**7**	**4**	**7**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*			Fairly constant / stable then sharp increase (1) Fairly constant / stable **until 1920** then sharp increase (2)			2	2		
	(b)			Make and record observations ✓	1			1		
	(c)			Between 1659 and 2000 / today (1) Temperature measured / recorded from 1659 / temperatures before 1695 are estimates (1)	2			2	2	
	(d)			Arctic ice cap has reduced in size (1) During time period when temperature has increased sharply (1)			2	2		
				Question 4 total	**3**	**0**	**4**	**7**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*			**A** oxygen / O_2 (1) do not accept 'O' / air **B** sodium chloride / NaCl (1)		2		2		
	(b)			**C** hydrogen / H_2 do not accept 'H'	1			1		1
	(c)			Formulae – NaOH and H_2 (1) both needed Balancing i.e. **2**NaOH (1) Both formulae must be correct to award balancing mark		2		2	1	
	(d)			Yellow / yellow-orange flame (1) Accept orange Sodium (ions) / Na^+ present (1)	2			2		2
	(e)			Less violent ✓ (1) Reactivity decreases up Group 1 / increases down Group 1 (1) Accept higher level answer explaining differences in reactivity e.g. lithium holds its outer electron more tightly than sodium	2			2		
				Question 5 total	**5**	**4**	**0**	**9**	**1**	**3**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
6				**Indicative content** Reference to water sources, sedimentation, filtration and chlorination together with the reasons for each stage • Sedimentation/settling tank – removal of large insoluble particles • Filtration/filter bed – removal of small insoluble particles, removal of bacteria/germs/micro-organisms • Chlorination/chlorine added – kills remaining bacteria, germs, micro-organisms **5–6 marks** At least one water source given, all three stages named with good description of purpose *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3–4 marks** At least two stages named with basic description of purpose *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1–2 marks** At least one stage named with attempt at description *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*	6			6		
				Question 6 total	**6**	**0**	**0**	**6**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*	(i)		Number of protons 19 Number of neutrons 20 Number of electrons 19 All three correct (2) Any two correct (1)		2		2		
		(ii)	I	Beryllium / Be	1			1		
			II	Sulfur / S		1		1	1	
		(iii)				1		1		
	(b)	(i)		3		1		1		
		(ii)		K_2CO_3		1		1		
	(c)			Similarity – both have 5 protons (1) Difference – one has 5 neutrons, the other has 6 (1) Accept same number of protons and different number of neutrons for (1) Do not accept reference to electrons, atomic number or mass number	1	1		2	1	
				Question 7 total	**2**	**7**	**0**	**9**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	*(a)*			Both increase as temperature increases (1) NaCl very slightly and $CuSO_4$ significantly (1) Any two of following (1) Solubilities the same at 52°C NaCl more soluble than $CuSO_4$ below 52°C NaCl less soluble than $CuSO_4$ above 52°C		 1	1 1	 3	 3	
	(b)			56 – 29 read from graph (1) Error carried forward $\frac{27}{2}$ = 13.5 (1) Award (2) for correct answer only		2		2	2	2
	(c)			Water freezes at 0°C and boils at 100°C – **both** needed Accept these are the freezing point and boiling point of water	1			1		1
				Question 8 total	**1**	**3**	**2**	**6**	**5**	**3**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	2	2	8	2	6
2	2	6	0	8	4	0
3	1	2	4	7	4	7
4	3	0	4	7	2	0
5	5	4	0	9	1	3
6	6	0	0	6	0	0
7	2	7	0	9	2	0
8	1	3	2	6	5	3
TOTAL	24	24	12	60	20	19

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 2: (Double Award) CHEMISTRY 1
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**6**	
3.	**7**	
4.	**6**	
5.	**5**	
6.	**6**	
7.	**10**	
8.	**11**	
Total	**60**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **8(a)** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions*.

1. (a) (i) Complete the following table that shows information about the atom of potassium. [2]

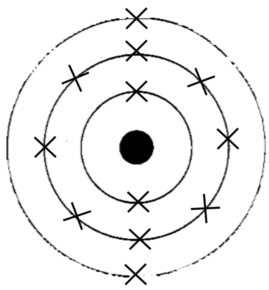
Element	Symbol	Number of protons	Number of neutrons	Number of electrons
potassium	$^{39}_{19}K$	………………..	……………	…………….

(ii) Use the Periodic Table of Elements to give the element

I. in Group 2 and Period 2 .... [1]

II. which has electronic structure 2,8,6. ……………………… [1]

(iii) The diagram below shows the electronic structure of an element in the Periodic Table.



Using **X** to represent an electron, draw a similar style diagram to show the electronic structure of the element which lies directly **above** this one in the Periodic Table. [1]

(b) (i) The chemical formula of aluminium nitrate is $Al(NO_3)_3$. Give the number of nitrogen atoms in the formula $Al(NO_3)_3$. [1]

………………………………………

(ii) Give the chemical formula of potassium carbonate. [1]

………………………………………

(c) Boron has two isotopes, $^{11}_{5}\mathrm{B}$ and $^{10}_{5}\mathrm{B}$.

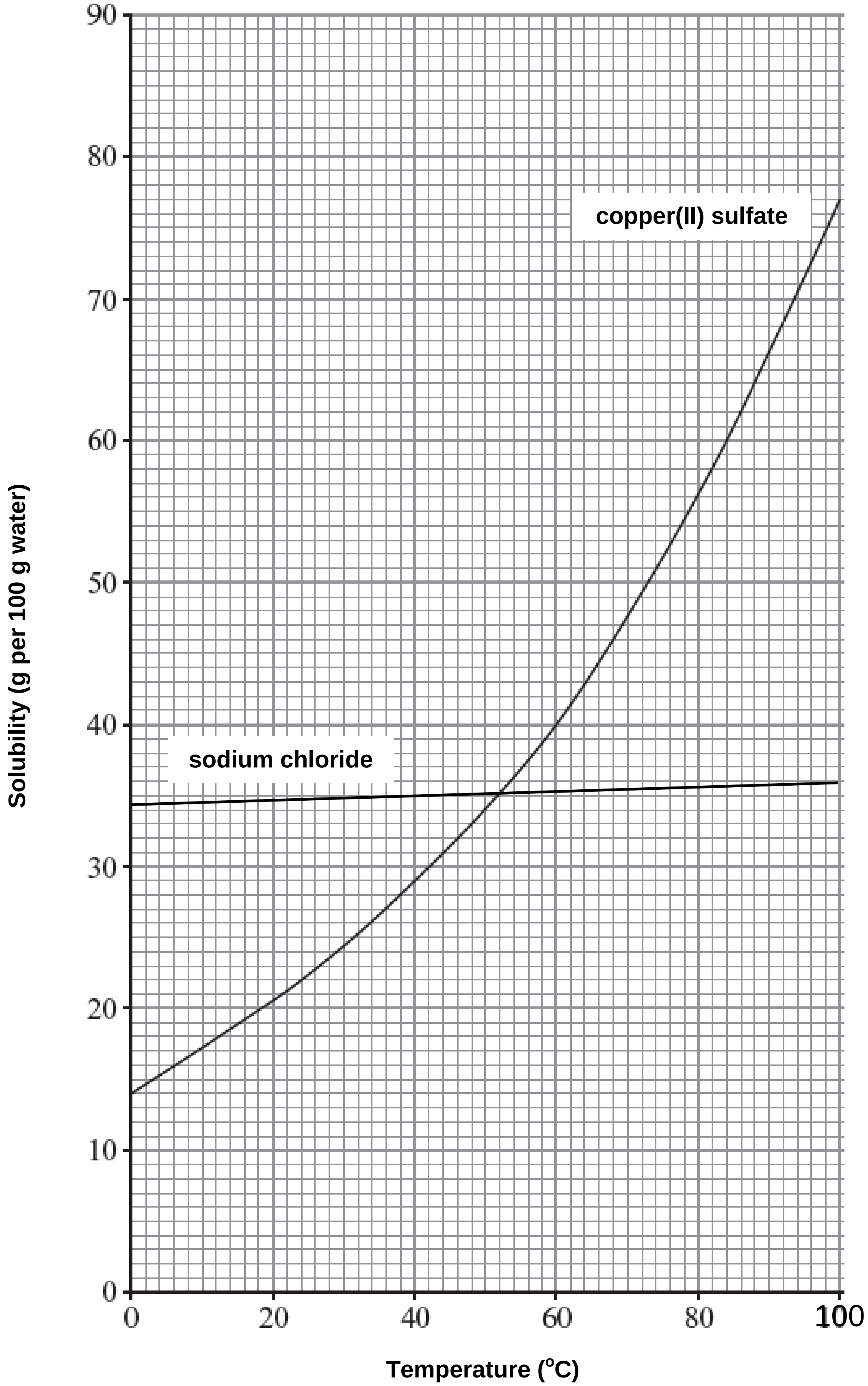
In terms of particles, give **one** similarity and **one** difference between the **nuclei** of these two boron atoms. [2]

Similarity ……………………………………………………………………………....

Difference ……………………………………………………………………………..

9

2. The graphs below show the solubilities of sodium chloride and copper(II) sulfate in water at different temperatures.



(a) Compare how the solubilities of copper(II) sulfate and sodium chloride change as temperature increases. [3]

....

....

....

....

(b) Calculate the mass of solid copper(II) sulfate that forms when a saturated solution in 50 g of water at 80 °C cools to 40 °C. [2]

Mass = …………………………. g

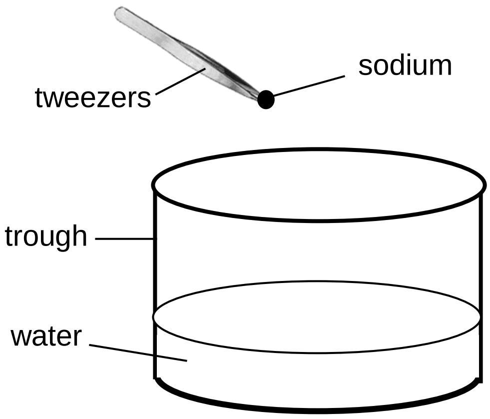
(c) State why the temperature scale on solubility graphs generally ranges from 0 °C to 100 °C. [1]

....

....

6

3. (a) A small piece of sodium is added to water.



(i) Describe **one** observation which shows that sodium lies below lithium but above potassium in Group 1. [1]

…………………………………………………………………………………………

…………………………………………………………………………………………

(ii) Complete and balance the symbol equation for the reaction between sodium and water. [2]

$2Na + 2H_2O \longrightarrow$ ………………….. + …………………

(b) The equation below shows the reaction between sodium and oxygen.

$$4Na + O_2 \longrightarrow 2Na_2O$$

0.46 g of sodium was burned in excess oxygen.

$A_r(O) = 16 \qquad A_r(Na) = 23$

(i) Calculate the number of moles in 0.46 g of sodium. [1]

Moles of sodium = …………………

(ii) Use the given symbol equation and your answer to part (i) to find the number of moles of sodium oxide formed from 0.46 g of sodium. [1]

………………………………………………………………………………………….

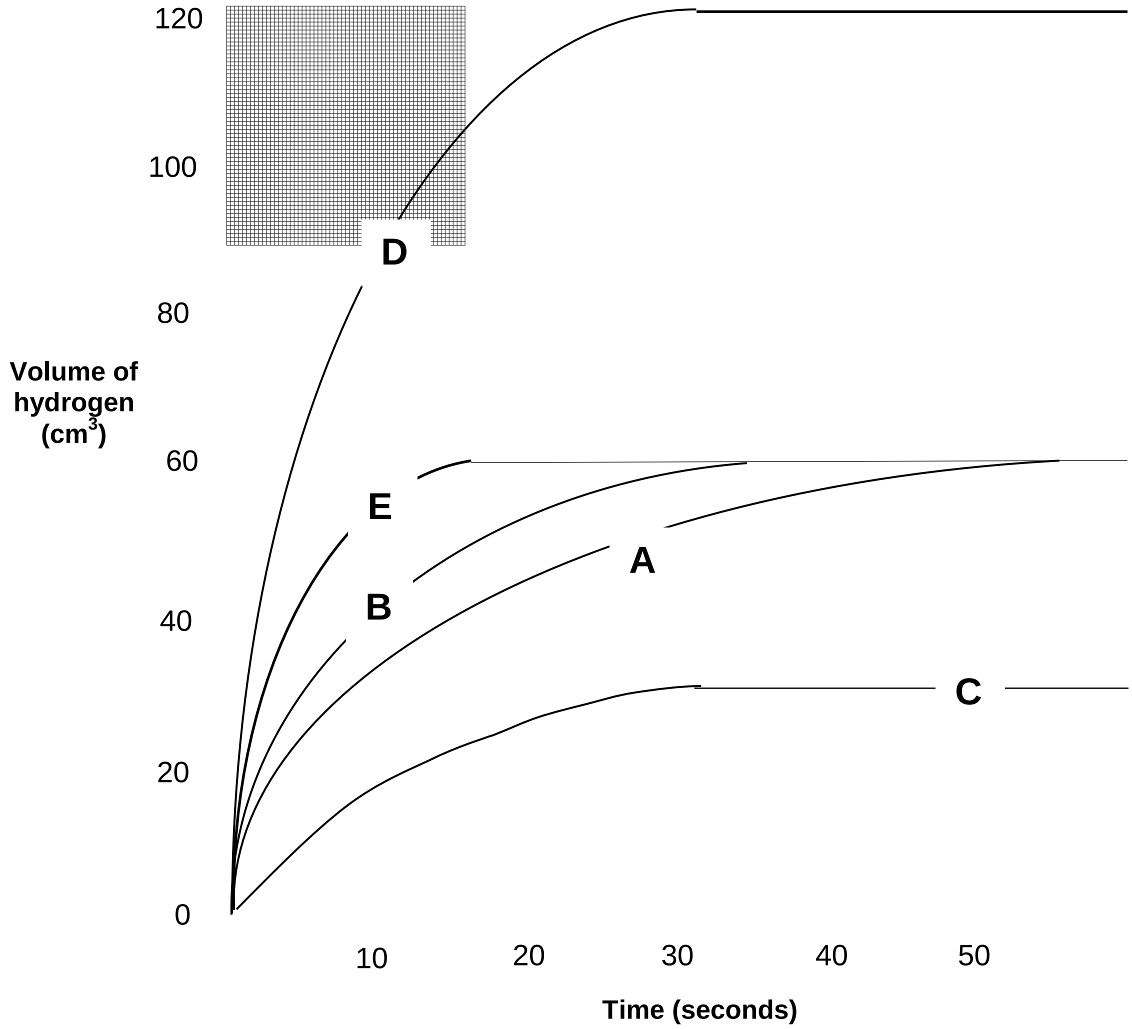
(iii) Use your answer from part (ii) to calculate the mass of sodium oxide formed. [2]

Mass of sodium oxide …………. g

7

4. Graph **A** below, shows the volume of hydrogen formed during the reaction between 0.06g of magnesium ribbon and ***excess*** dilute hydrochloric acid at 20 °C.

$$Mg + \underset{\textbf{\textit{excess}}}{2HCl} \longrightarrow MgCl_2 + H_2$$



(a) State which of graphs **B**, **C**, **D** and **E** represents the reaction using 0.06 g of magnesium ribbon and excess hydrochloric acid at **40 °C**. Explain your choice. [4]

Graph ………….

Explanation …………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

(b) State which of graphs **B**, **C**, **D** and **E** represents the reaction using **0.12 g** of magnesium ribbon and excess hydrochloric acid at 20 °C. Explain your choice. [2]

Graph ....

Explanation ....

....

....

6

5. A group of students were given three water samples labelled **A**, **B** and **C**.

They were told that one was temporary hard water, one was permanent hard water and one distilled water, but they were not told which was which.

Describe an investigation you would carry out using soap solution to identify each sample. [5]

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5

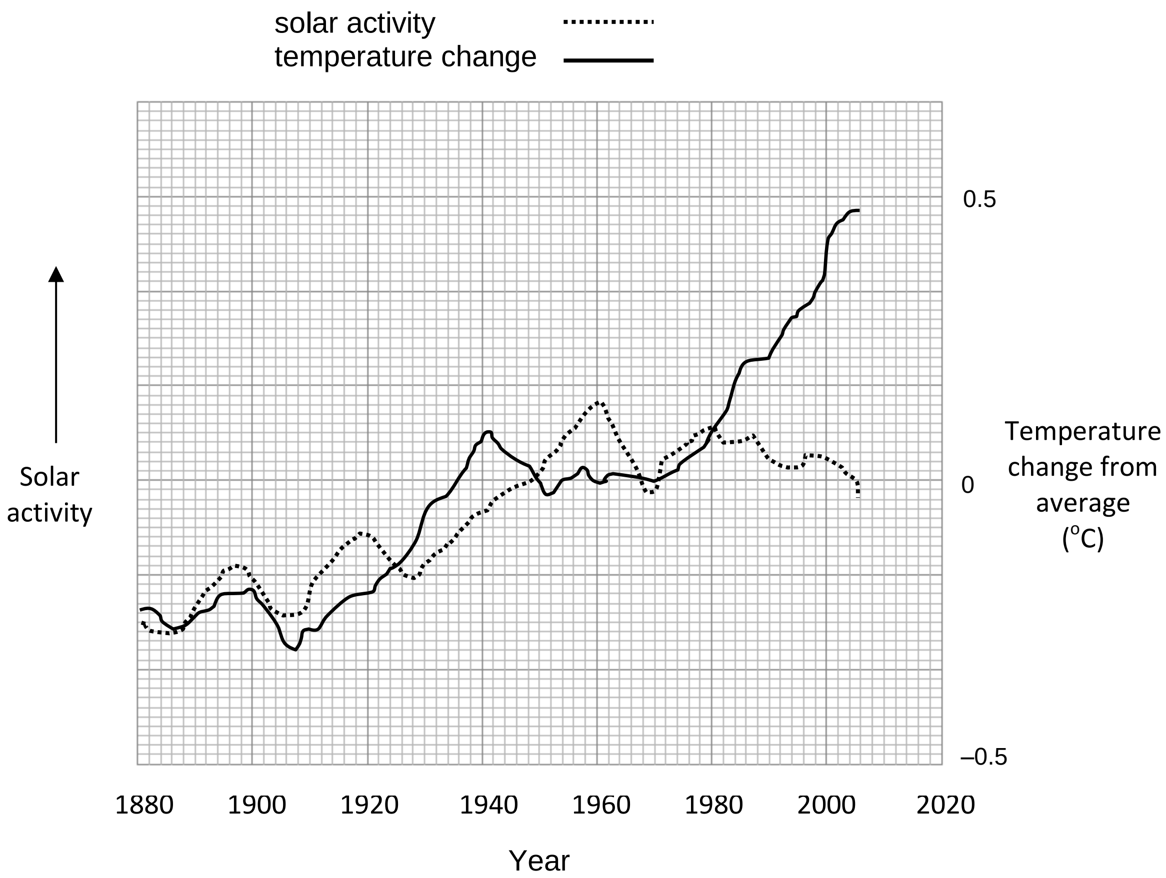
6. (a) During the last 250 years the level of carbon dioxide in the atmosphere has slowly increased. See Table 1.

Most scientists believe the increase in the concentration of carbon dioxide in the atmosphere has resulted in global warming.

	Year					
	1750	**1800**	**1850**	**1900**	**1950**	**2000**
Concentration of carbon dioxide in the atmosphere (% by volume)	0.0278	0.0282	0.0288	0.0297	0.0310	0.0368
Average global temperature (^{o}C)	13.3	13.4	13.4	13.6	13.8	14.4

Table 1

However, some scientists believe that changes in solar activity i.e. changes in the brightness and warmth of the sun, is the cause of global warming. Graph 1 shows the changes in solar activity and atmospheric temperatures since 1880.



Graph 1

(i) Using the information in Graph 1 discuss whether the evidence supports the argument that solar activity is the cause of global warming. [2]

....

....

(ii) Use the data in Table 1 to show that the **rate** of increase of carbon dioxide levels in the atmosphere is rising. [2]

....

....

(b) In Antarctica, scientists have drilled down two miles below the surface and brought up samples of ice which are hundreds of thousands of years old. These samples are called ice cores and contain trapped air bubbles.

Describe how these ice cores can be used in the study of global warming. [2]

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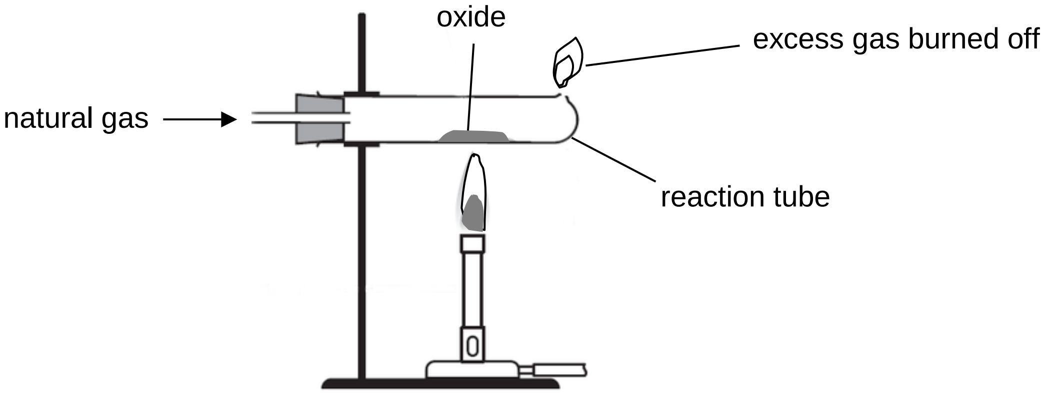
6

7. Four groups of students carried out an investigation to find the chemical formula of an oxide of copper. Each group was given a different known mass of the oxide. Each group carried out the same procedure.

Natural gas was passed over the heated oxide using the apparatus below.

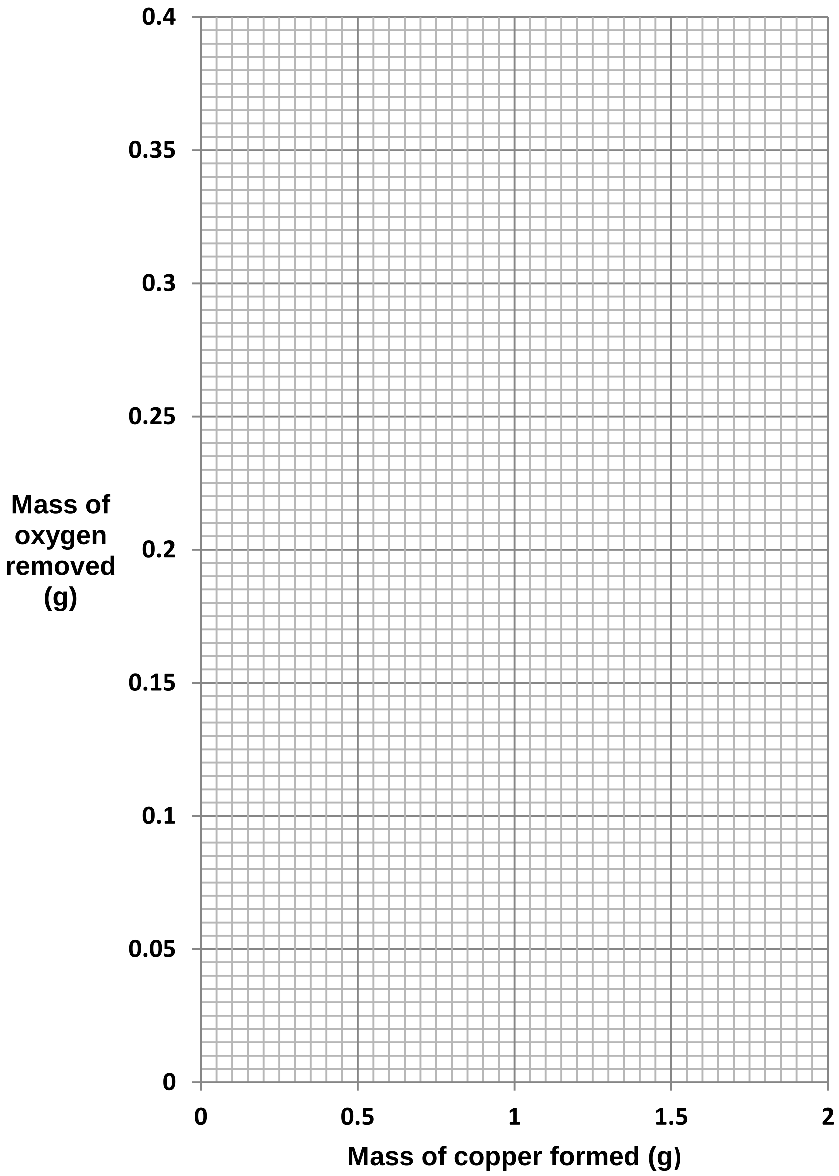


The reaction tube and oxide was weighed before heating and again at 5 minute intervals until the mass remained constant.

Their results are shown below.

Group	Mass of oxide used (g)	Mass of copper formed (g)	Mass of oxygen removed (g)
1	0.50	0.39	0.11
2	1.00	0.81	0.20
3	1.50	1.20	0.30
4	2.00	1.63	0.37

(a) On the grid plot the mass of copper formed against the mass of oxygen removed. Draw a suitable line starting at the origin (0,0). [3]



(b) (i) Use your graph to predict the mass of oxygen removed to form 1.00 g of copper. [1]

Mass of oxygen = ……….. g

(ii) Using the masses of copper and oxygen from part (i), calculate the simplest formula of the oxide of copper. [2]

$A_r(O) = 16$ $A_r(Cu) = 63.5$

Simplest formula ………….…………….

(c) State and explain **two** ways the design of the experiment helped the students obtain accurate results. [4]

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10

8. (a) Group 1 metals react with Group 7 non-metals to form halide compounds.

Group 1
lithium
sodium
potassium

Group 7
fluorine
chlorine
bromine

Explain, in terms of electronic structure, which Group 1 and Group 7 elements, from the tables above, would react together the most violently.

[6 QER]

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(b) Silver nitrate solution can be used to detect the presence of aqueous halide ions.

(i) Give the observations made when silver nitrate solution is added in turn to solutions containing chloride ions, bromide ions and iodide ions. [2]

Ion	**Observation**
chloride	………………..………………..
bromide	………………..………………..
iodide	………………..………………..

(ii) When silver nitrate solution is added to calcium chloride solution a white precipitate is formed.

Write the balanced **symbol** equation for this reaction. [3]

……………….. + ……………….. $\longrightarrow$ ……………….. + ………………..

11

END OF PAPER

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2					Group						3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:

Mass number → A

X ← Element Symbol

Atomic number → Z

Name

UNIT 2: (Double Award) CHEMISTRY 1
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

<u>Marking rules</u>

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

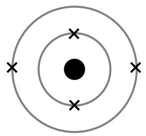
<u>Extended response question</u>

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	*(a)*	(i)		Number of protons 19 Number of neutrons 20 Number of electrons 19 All three correct (2) Any two correct (1)		2		2		
		(ii)	I	Beryllium / Be	1			1		
			II	Sulfur / S		1		1	1	
		(iii)				1		1		
	(b)	(i)		3		1		1		
		(ii)		K_2CO_3		1		1		
	(c)			Similarity – both have 5 protons (1) Difference – one has 5 neutrons, the other has 6 (1) Accept same number of protons and different number of neutrons for (1) Do not accept reference to electrons, atomic number or mass number	1	1		2	1	
				Question 1 total	**2**	**7**	**0**	**9**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*			Both increase as temperature increases (1) NaCl very slightly and $CuSO_4$ significantly (1) Any two of following (1) Solubilities the same at 52°C NaCl more soluble than $CuSO_4$ below 52°C NaCl less soluble than $CuSO_4$ above 52°C		1	1 1	3	3	
	(b)			56 – 29 read from graph (1) Error carried forward $\frac{27}{2} = 13.5$ (1) Award (2) for correct answer only		2		2	2	2
	(c)			Water freezes at 0°C and boils at 100°C – **both** needed Accept these are the freezing point and boiling point of water	1			1		1
				Question 2 total	**1**	**3**	**2**	**6**	**5**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*	(i)		Must compare with lithium **and** potassium e.g. Moves about more quickly than lithium but less quickly than potassium / more bubbles than lithium but fewer than potassium	1			1		1
		(ii)		Formulae – NaOH and H_2 (1) both needed Balancing i.e. **2**NaOH (1) Both formulae must be correct to award balancing mark		2		2	1	
	(b)	(i)		0.02	1			1	1	
		(ii)		0.01		1		1	1	
		(iii)		0.62 (2) If answer incorrect award (1) for 0.01 × M_r		2		2	2	
				Question 3 total	**2**	**5**	**0**	**7**	**5**	**1**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*			Graph **B** (1)			1			
				Higher temperature therefore faster reaction (1)		1				
				Faster reaction shown by steeper curve / final volume of gas being reached in less time (1)			1			
				Same mass used therefore same final volume of gas (1)			1	4		4
	(b)			Graph **D** (1)			1			
				Twice the number of magnesium particles present therefore twice the volume of gas formed (1)			1	2	1	2
				Question 4 total	**0**	**1**	**5**	**6**	**1**	**6**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
5				Step 1 Use of soap solution to identify distilled water, needs **fair testing** element for both marks Add 1 cm^3 soap solution to 5 cm^3 of each of samples A, B and C (1) Shake for 1 minute/shake for the same time (1) [Accept add soap to each water sample and shake for (1)] Distilled water most froth (1) Step 2 Boil unidentified samples and repeat step 1 (1) Temporary hard water lathers after boiling; permanent hard water still does not lather after boiling (1) Credit alternative methods – up to (3) for method/fair test and up to (2) for conclusions	5					5
				Question 5 total	**5**	**0**	**0**	**5**	**0**	**5**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*	(i)		Must state that evidence partially supports the argument in order to gain any credit Solar activity and temperature change correlate up to 1980 (1) But temperature increases as solar activity decreases after 1980 (1)			2	2	2	
		(ii)		Increase over each 50 year period given i.e. 0.0004, 0.0006, 0.0009, 0.0013 and 0.0058 (1) Greater increase in carbon dioxide levels over every 50 year period (1)			2	2	2	
	(b)			Allows the amount of carbon dioxide in the atmosphere at the time that the ice formed to be measured (1) Provides data which pre-dates that which was measured at the time / goes back much further in time (1)	1	1		2		
				Question 6 total	**1**	**1**	**4**	**6**	**4**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*			All 4 points plotted corrected (2) [Credit (1) for 2 or 3 correct points] Straight line drawn through (0,0) and reasonable effort at best fit (1)		2	1	3	3	
	(b)	(i)		Correct value read from graph – approximately 0.24 (1) Tolerance ± 0.005	1			1	1	
		(ii)		$\frac{1}{63.5}$: $\frac{0.24}{16}$ (1) 0.0157 : 0.015 → 1:1 CuO (1) No error carried forward possible		2		2	2	
	(c)			Any two of following for up to (2) each Heated until mass remained constant (1) all oxygen removed (1) Weighed in the reaction tube (1) no oxide lost in transfer (1) Used 2 decimal place balance (1) minimise error when very small masses are measured (1)	4			4		4
				Question 7 total	**5**	**4**	**1**	**10**	**6**	**4**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="4">Marks Available</th><th></th><th></th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>8</td><td>(a)</td><td></td><td></td><td>Indicative content

Potassium and fluorine will react most violently; Group 1 more reactive down group and Group 7 less reactive down group; bottom of Group 1 and top of Group 7 are most reactive
Electronic structures – K (2,8,8,1) and F (2,7)
Outer electron to be lost is further from nucleus in K than it is in Li and Na therefore less strongly held / more easily lost
Outer shell is closer to nucleus in F than it is in Cl and Br therefore electron is more strongly attracted / more easily gained

5–6 marks: Correct elements selected, trend in reactivity clearly explained in terms of ease of electron loss/gain and how that is related to distance from the nucleus
There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.

3–4 marks: Correct elements selected, good attempt at explanation of trend in terms of electron loss/gain
There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.

1–2 marks: Correct elements selected, correct electronic structures
There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.

0 marks: No attempt made or no response worthy of credit.</td><td>6</td><td></td><td></td><td>6</td><td></td><td>1</td></tr>
</table>

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>8</td><td>(b)</td><td>(i)</td><td></td><td>
<table>
<tr><th>Ion</th><th>Observation</th></tr>
<tr><td>chloride</td><td>white precipitate</td></tr>
<tr><td>bromide</td><td>cream / off-white precipitate</td></tr>
<tr><td>iodide</td><td>yellow precipitate</td></tr>
</table>
Must include precipitate
All three correct (2)
Any two correct (1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>$2AgNO_3 + CaCl_2 \rightarrow 2AgCl + Ca(NO_3)_2$ (3)

If equation not correct award (1) for each of following
$CaCl_2$ on reactant side
$AgCl$ and $Ca(NO_3)_2$ on product side
Award (1) for ionic equation – $Ag^+ + Cl^- \rightarrow AgCl$</td><td></td><td>3</td><td></td><td></td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 8 total</td><td>8</td><td>3</td><td>0</td><td>11</td><td>1</td><td>3</td></tr>
</table>

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	7	0	9	2	0
2	1	3	2	6	5	3
3	2	5	0	7	5	1
4	0	1	5	6	1	6
5	5	0	0	5	0	5
6	1	1	4	6	4	0
7	5	4	1	10	6	4
8	8	3	0	11	1	3
TOTAL	24	24	12	60	24	22

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 3: (Double Award) PHYSICS 1
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**11**	
3.	**10**	
4.	**9**	
5.	**6**	
6.	**6**	
7.	**9**	
Total	**60**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **5** is a quality of extended response (QER) question where your writing skills will be assessed.

Equations

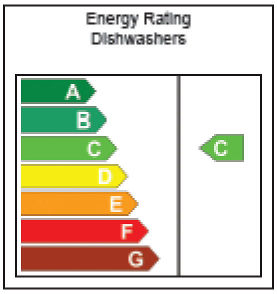
$\text{current} = \dfrac{\text{voltage}}{\text{resistance}}$	$I = \dfrac{V}{R}$
total resistance in a series circuit	$R = R_1 + R_2$
energy transferred = power × time	$E = Pt$
power = voltage × current	$P = VI$
$\%\ \text{efficiency} = \dfrac{\text{energy [or power] usefully transferred}}{\text{total energy [or power] supplied}} \times 100$	
$\text{density} = \dfrac{\text{mass}}{\text{volume}}$	$\rho = \dfrac{m}{V}$
units used (kWh) = power (kW) × time (h) cost = units used × cost per unit	
wave speed = wavelength × frequency	$v = \lambda f$
$\text{speed} = \dfrac{\text{distance}}{\text{time}}$	

SI multipliers

Prefix	Multiplier
m	1×10^{-3}
k	1×10^{3}
M	1×10^{6}

Answer ***all*** questions

1. Dishwashers are rated by the amount of energy they use. Dishwashers rated **A** use less energy and are cheaper to run than those rated **G**.



For the following questions assume that all dishwashers are used for the same amount of time.

The following table gives information about dishwashers rated **A**, **B** and **D.**

Dishwasher energy rating	Voltage (V)	Current (A)	Units of energy used per year (kWh)
A	230	4	210
B	230	6	315
D	230	8	420

(a) Use the equation:

$$\text{power} = \text{voltage} \times \text{current}$$

to calculate the power of dishwashers rated **D**. [2]

power = …………….. W

(b) **Circle** from the list below, the energy used per year (kWh) by a dishwasher rated **C**. [1]

200 310 350 430

(c) A homeowner buys a dishwasher rated **D**.

(i) Use the equation:

cost = units used × cost per unit

to find the cost of using this dishwasher for a year. One unit of electricity costs 20 p. [2]

cost = £ ……………..

(ii) Complete the following sentence by underlining the correct words in the brackets. [1]

The dishwasher rated **A** costs (**half as much as** / **the same as** / **more than**) the dishwasher rated **D** to run.

(iii) The homeowner could have bought a dishwasher rated **A** that cost £35 more than the one rated **D**. State **one** reason why the dishwasher rated **A** would have been more cost effective. [1]

…………………………………………………………………………………………

…………………………………………………………………………………………

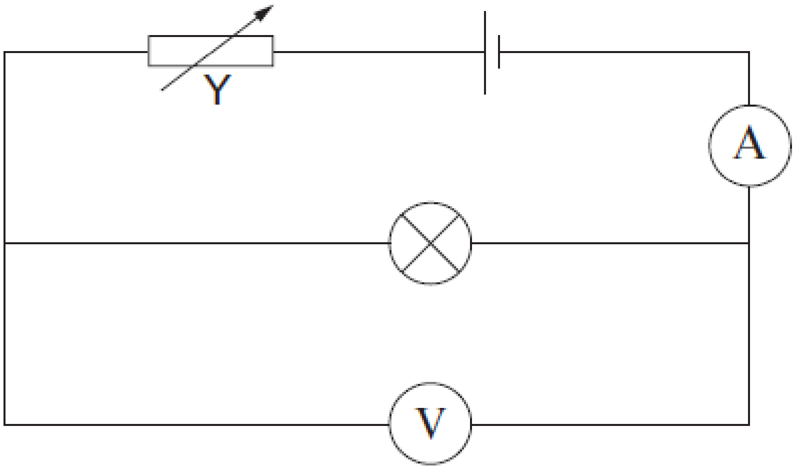
(d) Use the information in the table and your answer to part (a), to calculate the time that the dishwasher rated **D** was used during a year. [2]
Use the equation below:

$$\text{time(h)} = \frac{\text{units used(kWh)}}{\text{power(kW)}}$$

time = …………….. h

9

2. A group of students set up the circuit below to investigate how the current in a lamp changes with the voltage across it.



(a) (i) Name component **Y**. .... [1]

(ii) State the purpose of **Y**. [1]

....

(iii) Describe how a set of results are obtained. [2]

....

....

....

(b) They connect an identical lamp in series between the cell and the ammeter.

(i) State how this affects the resistance of the circuit. [1]

....

(ii) State how this affects the current in the circuit. [1]

....

(iii) State how this affects the reading on the voltmeter. [1]

....

(c) They connect an identical lamp in parallel with the first lamp.

(i) **Add** this lamp to the circuit diagram above. [1]

(ii) State how this affects the resistance of the circuit. [1]

....

(iii) State how this affects the current in the circuit. [1]

....

(iv) State how this affects the current in the first lamp. [1]

....

11

3. Homeowners who generate electricity from solar power get paid for energy they produce under a scheme called 'Feed-in Tariff' (FIT). They are paid for all the energy they produce (the FIT). They are also paid an export tariff for any electricity they do not use but instead they put into the National Grid. They will also see their energy bills fall slightly.

The FIT return for a typical household installation is 12 p/kWh.
The export tariff is 5 p for every kWh fed into the National Grid.
The householder also saves 16 p from every kWh produced by the panels which they use and do not need to get from the National Grid.

Domestic systems tend to range from 1 kW to 5 kW in size. The Energy Saving Trust estimates that a typical 3-bedroom house in the UK uses just over 3 000 kWh in a year.

Roof area (m^2)	**Typical system maximum power output (kW)**	**Estimated cost (£)**	**Estimated annual energy output (kWh)**
7	1	3 500	840
14	2	5 000	1 680
21	3	6 000	………
28	4	7 000	3 360

Use the information above to answer the following questions.

(a) (i) **Complete the table**. [1]

(ii) Calculate the annual energy output for each m^2 of the panel with an area of 7 m^2. [2]

energy output = ……..…… kWh

(b) A householder installs 28 m^2 of panels. During the first year, they use 3 000 kWh themselves and export the remainder to the National Grid.

(i) How much energy is exported to the National Grid? [1]

energy = …………… kWh

(ii) Calculate the income the householder receives from the export tariff. [2]

income = ……………….

(iii) Calculate the money saved by the householder by generating this amount of energy. [2]

money saved = ……………….

(c) Give **two** reasons why the annual energy output from a particular solar panel can only be estimated. [2]

1 ………………………………………………………………………………………

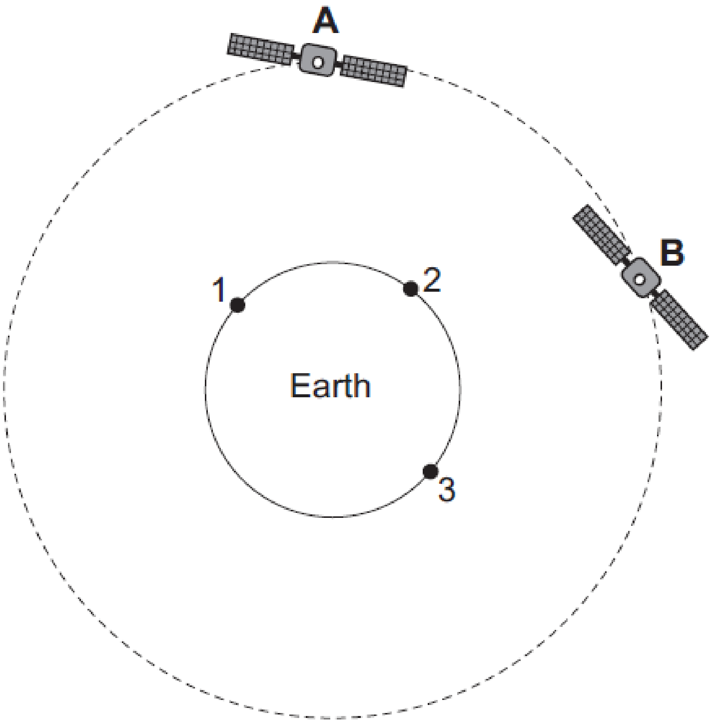
……………………………………………………………………………………….

2 ………………………………………………………………………………………

……………………………………………………………………………………….

10

4. The diagram below shows two communications satellites **A and B** in geosynchronous (geostationary) orbit around the Earth. The diagram is not to scale.



(a) Underline the correct word(s) in the brackets to complete the sentences. [3]

(i) A geosynchronous satellite orbits the Earth once every (**24 h** / **month** / **year**).

(ii) A geosynchronous satellite orbits above the (**North Pole** / **UK** / **equator**).

(iii) Satellites communicate using (**infra-red** / **visible light** / **microwaves**).

(b) **Show on the diagram** the path taken by the signal, via the satellites A and B, when radio station **1** communicates with radio station **3**. [2]

(c) Communications between geosynchronous satellites and the Earth are made using electromagnetic waves of wavelength 0.20 m that travel at 300 000 000 m/s.

(i) Calculate the frequency of these waves using the equation: [2]

$$\text{frequency} = \frac{\text{velocity}}{\text{wavelength}}$$

frequency = ………………. Hz

(ii) The time delay between sending a signal from radio station **1** to satellite A is 0.12 s. Calculate the height of satellite A above the Earth using the equation: [2]

distance = velocity $\times$ time

height above Earth = ………………. m

9

5. **Generators** produce electricity in coal, gas, oil, nuclear and hydroelectric power stations and wind farms. Electricity can't be stored efficiently so is generated as needed. When we watch television, turn the lights on or charge our smartphone, we rely on electricity that has passed across the National Grid. Once electricity is generated and enters the National Grid, the network needs to 'balance', ensuring supply and demand are matched second by second. As older power stations are decommissioned then new ones need to be developed.

The table shows some of the information planners use to help them decide on the type of power station they will allow to be built.

How they compare		
	A wind turbine	A nuclear power station
Maximum power output (MW)	3.6	3 600
Lifetime (years)	15	50
Commissioning cost (£ millions)	4	4 000
Waste	none	Radioactive waste
Lifetime carbon footprint (g of CO_2 / kWh)	4.8 onshore and 5.2 offshore	5

Use the information in the table and your knowledge to decide which method of generating electricity they should recommend. [6 QER]

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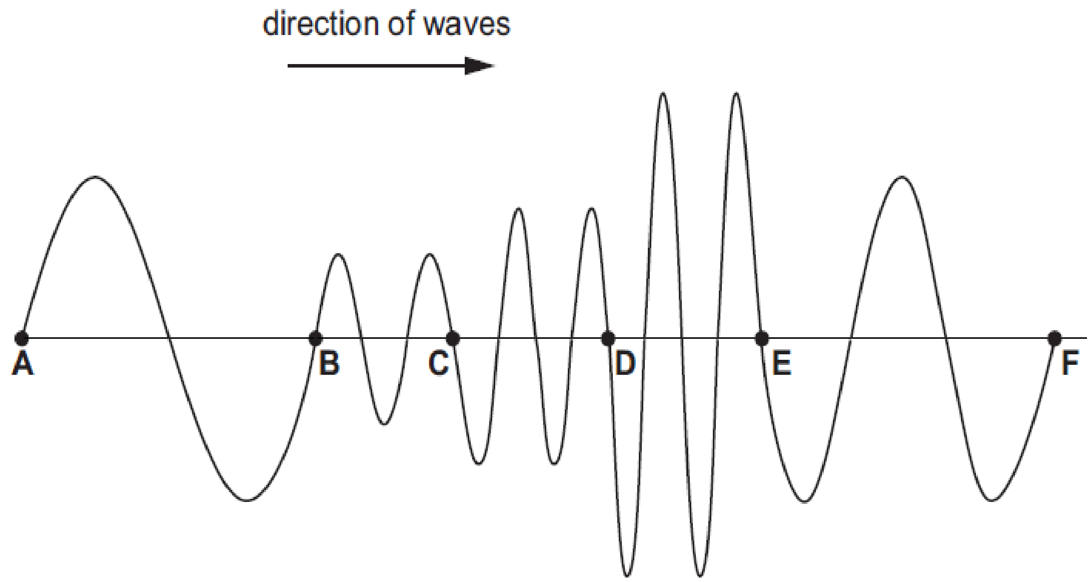
6. The diagram shows a train of waves.



(a) How many waves are shown between **A** and **C**? [1]

…………………………….

(b) Between which **two** of the points, A, B, C, D, E and F is:

(i) the wavelength longest? **……………………………** [1]

(ii) the amplitude smallest? **……………………………..** [1]

(c) The eight waves between **A** and **F** cover a distance of 240 cm.
Calculate the mean wavelength of the waves. [1]

mean wavelength = **…………..** cm

(d) The diagram shows transverse waves. Describe what a transverse wave is. [2]

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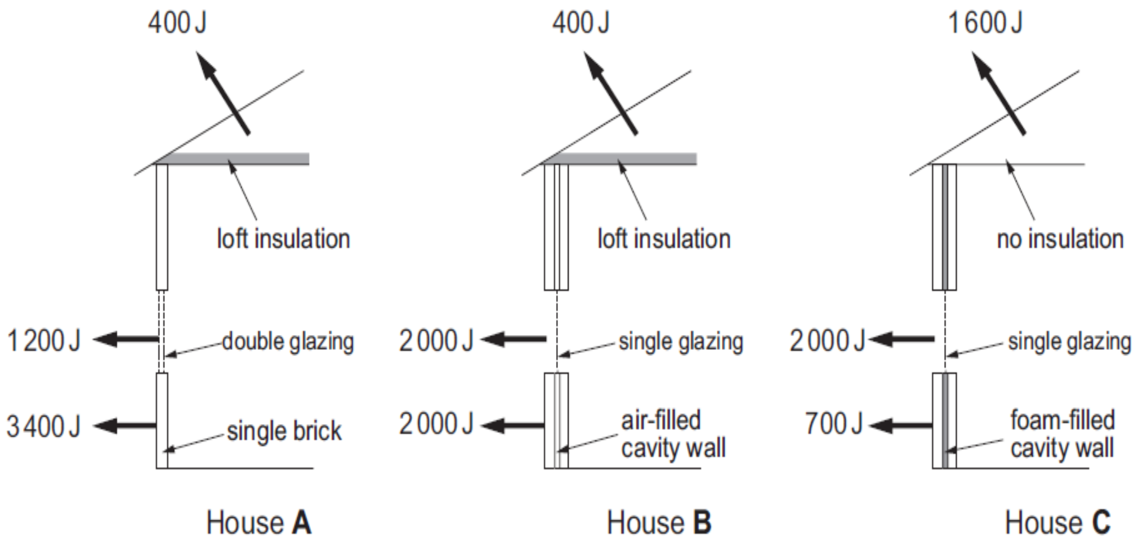
7. There are several factors to consider when you are looking at choosing the best heating system for your home. These include the amount of heating needed, the running costs and the environmental impact of the different heating options. Before looking at your heating, get your insulation sorted. Good quality, well installed insulation helps keep the heat in during winter. This makes your house easier and cheaper to heat properly.

The diagrams show 3 houses of identical size. None of the houses is fully insulated. The diagrams also show how much heat is lost per second from the windows, walls and roof of each house when a temperature difference of 20 °C is kept between the inside and the outside.



(a) Use the information in the diagram to tick (✓) the correct statements in the list below. [3]
Space for workings if needed.

A single brick wall loses the least energy per second	☐
House **B** loses the least energy per second	☐
Adding loft insulation reduces heat loss by 1 200 J/s	☐
Before house **C** had its cavity walls filled with foam it was losing 5 600 J/s	☐
The most effective method of reducing energy loss is to install double glazing	☐
If house **C** had double glazing installed its energy loss would reduce to 3 500 J/s	☐

(b) (i) Name the process by which heat is lost through the brick walls of a house. [1]

…………………………………………………

(ii) Name the **two** processes by which heat is lost through the ceiling and the roof space. [2]

…………………………………………………………..

(c) (i) Give a reason why house **A** requires the most heat energy per second from its heating system to keep a 20 °C temperature difference between inside and outside. [1]

……………………………………………………………………………………………

……………………………………………………………………………………………

(ii) Explain the advantages to the environment of adjusting the heating system so that the temperature difference between the inside and outside is reduced from 20 °C to 18 °C. [2]

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9

END OF PAPER

UNIT 3: (Double Award) PHYSICS 1
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

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Marking abbreviations

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cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Substitution: 230 × 8 (1) = 1 840 [W] (1)	1	1		2	2	
	(b)			350 indicated		1		1		
	(c)	(i)		Substitution: 420 × 20 (1) = [£]84 (1)	1	1		2	2	
		(ii)		Half as much as		1		1		
		(iii)		Saving of <u>£42</u> in running costs per <u>year</u> **OR** save <u>more</u> in running costs per <u>year</u>			1	1		
	(d)			Substitution: $\frac{420}{1.84}$ (**ecf**) (1) = 228.26 / 228.3 (1) Award 1 mark only for: $\frac{420}{1840}$ = 0.228 / 0.23 / 0.2	1	1		2	2	
				Question 1 total	**3**	**5**	**1**	**9**	**6**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Variable resistor / rheostat	1			1		1
		(ii)		To vary the current / vary voltage across the lamp	1			1		1
		(iii)		Y is set so current is at its lowest / highest value and a pair of readings are taken (1) The setting of Y is varied at intervals and another pair of readings are taken at each setting (1)	2			2		2
	(b)	(i)		Increases	1			1		1
		(ii)		Decreases	1			1		1
		(iii)		Decreases	1			1		1
	(c)	(i)		Additional lamp in parallel to existing lamp	1			1		1
		(ii)		Decreases	1			1		1
		(iii)		Increases	1			1		1
		(iv)		Stays the same	1			1		1
				Question 2 total	**11**	**0**	**0**	**11**	**0**	**11**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		2 520 [kWh]		1		1	1	
		(ii)		$\frac{840}{7}$ (1) = 120 [kWh] (1)		1 1		2	2	
	(b)	(i)		360 [kWh]		1		1		
		(ii)		360 (**ecf**) × 5 (1) = 1 800 p OR £18 (answer & unit required) (1)		2		2	2	
		(iii)		3 000 × 16 (1) = 48 000 p OR £480 (answer & unit required) (1)		2		2	2	
	(c)			**Any 2 × (1) from:** • Hours of sunshine / year will vary • Angle of panel / Sun will vary • Direction of roof will vary / not all roofs face directly south		2		2		
				Question 3 total	**0**	**10**	**0**	**10**	**7**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		24 h	1			1		
		(ii)		equator	1			1		
		(iii)		microwaves	1			1		
	(b)			Rays from radio station 1 to satellite A to radio station 2 (1) Rays from radio station 2 to satellite B to radio station 3 (1) Award 1 mark for 1 $\rightarrow$ A $\rightarrow$ B $\rightarrow$ 3		2		2		
	(c)	(i)		Substitution of: $\frac{300\,000\,000}{0.2}$ (1) = 1 500 000 000 [Hz] (1)	1	1		2	2	
		(ii)		Substitution of: 300 000 000 $\times$ 0.12 (1) = 36 000 000 [m] (1)	1	1		2	2	
				Question 4 total	**5**	**4**	**0**	**9**	**4**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5				**Indicative content:** A wind turbine does not produce harmful waste and does not need a supply of fuel. Radioactive waste needs to be stored safely for a very long time. The output from a wind turbine is variable due to changes in wind speed. Even at maximum power output, 1 000 turbines are required to equal the reliable output from a nuclear power station. During the lifetime of a nuclear power station, each wind turbine will need replacing three times. The commissioning cost of 4 000 wind turbines is £16 000 million which is four times greater than one nuclear power station. Both types of generation have a comparable carbon footprint. Based on the above, the planners should recommend nuclear power. **5 – 6 marks:** Detailed comparison including arguments for and against both types of generation. Data is used to compare cost and numbers involved. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks**: A detailed qualitative comparison with calculation of either cost or number present. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks**: A basic qualitative comparison is given. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks***: No attempt made or no response worthy of credit.*			6	6		
				Question 5 total	**0**	**0**	**6**	**6**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			2.5		1		1		
	(b)	(i)		A and B		1		1		
		(ii)		B and C		1		1		
	(c)			30 [cm]		1		1	1	
	(d)			Vibration / oscillations (1) [in transverse waves] are at right angles to wave motion (1)	2			2		
				Question 6 total	**2**	**4**	**0**	**6**	**1**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			Ticks in boxes 3, 4 and 6 i.e. Adding loft insulation reduces heat loss by 1 200 J/s (1) Before house **C** had its cavity walls filled with foam it was losing 5 600 J/s (1) If house **C** had double glazing installed its energy loss would reduce to 3 500 J/s (1)			3	3	1	
	(b)	(i)		Conduction	1			1		
		(ii)		Conduction (1) Convection (1)	2			2		
	(c)	(i)		Because it loses the most heat per second			1	1		
		(ii)		Rate of heat loss decreases <u>so</u> heat supply decreases (1) less fuel used means less carbon emissions (1)		1	1	2		
				Question 7 total	**3**	**1**	**5**	**9**	**1**	**0**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	5	1	9	6	0
2	11	0	0	11	0	11
3	0	10	0	10	7	0
4	5	4	0	9	4	0
5	0	0	6	6	0	0
6	2	4	0	6	1	0
7	3	1	5	9	1	0
TOTAL	24	24	12	60	19	11

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 3: (Double Award) PHYSICS 1
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**12**	
3.	**12**	
4.	**11**	
5.	**11**	
6.	**8**	
Total	**60**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **6(i)** is a quality of extended response (QER) question where your writing skills will be assessed.

Equations

current = $\dfrac{\text{voltage}}{\text{resistance}}$	$I = \dfrac{V}{R}$
total resistance in a series circuit	$R = R_1 + R_2$
total resistance in a parallel circuit	$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$
energy transferred = power × time	$E = Pt$
power = voltage × current	$P = VI$
power = current^2 × resistance	$P = I^2R$
% efficiency = $\dfrac{\text{energy [or power] usefully transferred}}{\text{total energy [or power] supplied}} \times 100$	
density = $\dfrac{\text{mass}}{\text{volume}}$	$\rho = \dfrac{m}{V}$
units used (kWh) = power (kW) × time (h) cost = units used × cost per unit	
wave speed = wavelength × frequency	$v = \lambda f$
speed = $\dfrac{\text{distance}}{\text{time}}$	

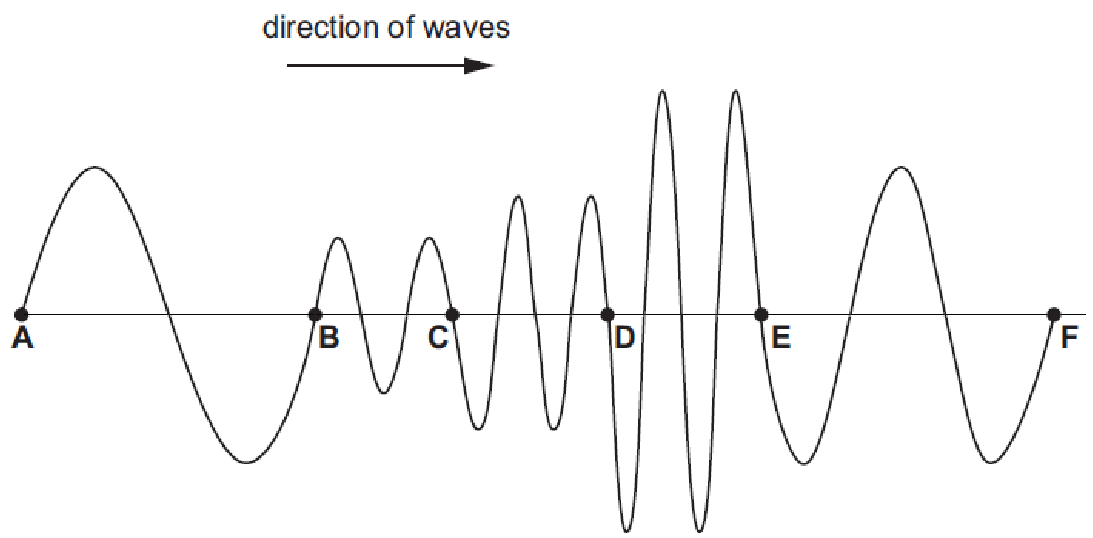
SI multipliers

Prefix	Multiplier
p	1×10^{-12}
n	1×10^{-9}
μ	1×10^{-6}
m	1×10^{-3}

Prefix	Multiplier
k	1×10^{3}
M	1×10^{6}
G	1×10^{9}
T	1×10^{12}

*Answer **all** questions*

1. The diagram shows a train of waves.



(a) How many waves are shown between **A** and **C**? [1]

……………………………

(b) Between which **two** of the points, A, B, C, D, E and F is:

(i) the wavelength longest? ……………………………. [1]

(ii) the amplitude smallest? …………………………….. [1]

(c) The eight waves between **A** and **F** cover a distance of 240 cm.
Calculate the mean wavelength of the waves. [1]

mean wavelength = ………….. cm

(d) The diagram shows transverse waves. Describe what a transverse wave is. [2]

…………………………………………………………………………………………..

…………………………………………………………………………………………..

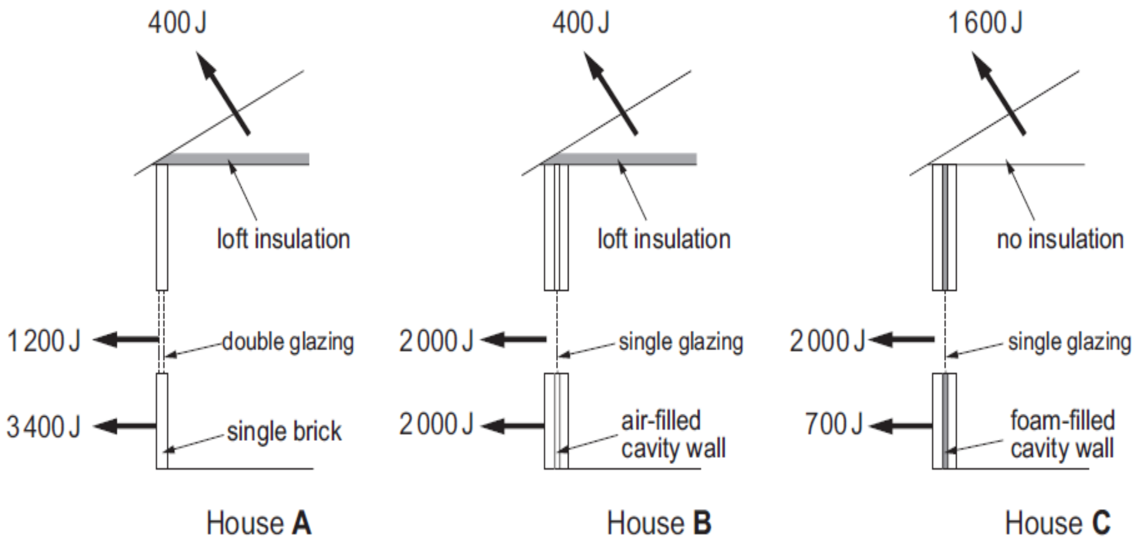
…………………………………………………………………………………………..

…………………………………………………………………………………………..

6

2. There are several factors to consider when you are looking at choosing the best heating system for your home. These include the amount of heating needed, the running costs and the environmental impact of the different heating options. Before looking at your heating, get your insulation sorted. Good quality, well installed insulation helps keep the heat in during winter. This makes your house easier and cheaper to heat properly.

The diagrams show 3 houses of identical size. None of the houses is fully insulated. The diagrams also show how much heat is lost per second from the windows, walls and roof of each house when a temperature difference of 20 °C is kept between the inside and the outside.



(a) Use the information in the diagram to tick (✓) the correct statements in the list below. [3]
Space for workings if needed.

A single brick wall loses the least energy per second	☐
House **B** loses the least energy per second	☐
Adding loft insulation reduces heat loss by 1 200 J/s	☐
Before house **C** had its cavity walls filled with foam it was losing 5 600 J/s	☐
The most effective method of reducing energy loss is to install double glazing	☐
If house **C** had double glazing installed its energy loss would reduce to 3 500 J/s	☐

(b) (i) Name the process by which heat is lost through the brick walls of a house. [1]

…………………………………………………………………………………

(ii) Name the **two** processes by which heat is lost through the ceiling and the roof space. [2]

………………………………………………………………..

(iii) Explain how loft insulation reduces heat loss through the roof of houses **A** and **B**. [3]

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………………………………………………………………………………………….

(c) (i) Give a reason why house **A** requires the most heat energy per second from its heating system to keep a 20 °C temperature difference between inside and outside. [1]

………………………………………………………………………………………….

………………………………………………………………………………………….

(ii) Explain the advantages to the environment of adjusting the heating system so that the temperature difference between the inside and outside is reduced from 20 °C to 18 °C. [2]

………………………………………………………………………………………….

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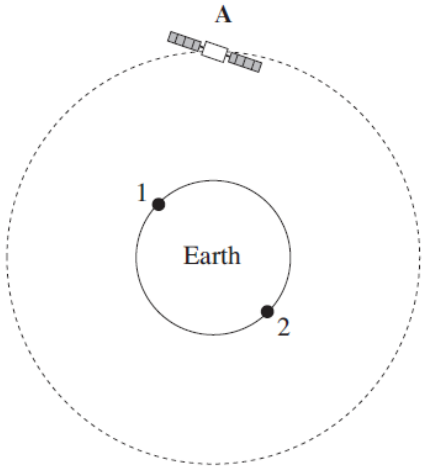
12

3. A satellite is an object that *orbits* a larger object in space. The Earth has many artificial satellites in orbit around it. These have been built by people and launched into orbit using rockets. Some very large artificial satellites were put into orbit by the American Space Shuttle. Artificial satellites have different orbits. Satellites in lower orbits travel faster than those in higher ones. The higher the orbit of a satellite, the longer its 'period' (time to make one orbit).

Geostationary satellites are in orbit above the *equator*. Geostationary satellites have uses such as communications including satellite TV and global positioning or GPS - which is used for satellite navigation systems. A single geostationary satellite is on a line of sight with about 40% of the Earth's surface. Three such satellites, each separated by 120^{o} of longitude, can provide coverage of the entire planet, with the exception of small circular regions centered at the north and south geographic poles.

The diagram shows a communications satellite **A** in geosynchronous (geostationary) orbit around the Earth. The diagram is not to scale.



(a) (i) Explain the advantages of placing communications satellites in geosynchronous orbit. [3]

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(ii) **Add to the diagram** another satellite, labelled **B** that will enable radio station 1 to communicate with radio station 2. [1]

(iii) **Show on the diagram** the path taken by the signal, via the satellites A and B, when radio station 1 communicates with radio station 2. [2]

(b) (i) Communications between geosynchronous satellites and the Earth are made using microwaves of wavelength 20 cm that travel at 3×10^{8} m/s.
Use an equation from page 2 to calculate the frequency of the microwaves. [3]

frequency = …………………………Hz

(ii) The time delay between sending a signal from radio station 1 and its reception at radio station 2 is 0.48 s.
Use an equation from page 2 to find the approximate height of geostationary satellites above the Earth. [3]

height above Earth = ………………………… m

12

4. Homeowners who generate electricity from solar power get paid for energy they produce under a scheme called 'Feed-in Tariff' (FIT). They are paid for all the energy they produce (the FIT). They are also paid an export tariff for any electricity they do not use but instead they put into the National Grid. They will also see their energy bills fall slightly.

The FIT return for a typical household installation is 12 p/kWh.
The export tariff is 5 p for every kWh fed into the National Grid.
The householder also saves 16 p from every kWh produced by the panels which they use and do not need to get from the National Grid.

Domestic systems tend to range from 1 kW to 5 kW in size. Each 1 kW system can produce roughly 850 kWh per year so a 2 kW system would create around 1 700 kWh and a 5 kW system would create 4 500 kWh. The Energy Saving Trust estimates that a typical 3-bedroom house in the UK uses 3 000 kWh in a year.

Roof area (m^2)	**Typical system maximum power output (kW)**	**Estimated cost (£)**	**Estimated annual energy output (kWh)**
7	1	3 500	840
14	2	5 000	1 680
21	3	6 000	2 520
28	4	7 000	3 360

Use the information above to answer the following questions.

(a) (i) Calculate the annual energy output per m^2 of panel. [2]

energy output = ………… kWh

(ii) Describe the relationship between the roof area and estimated annual energy output. [2]

…………………………………………………………………………………………..

…………………………………………………………………………………………….

(iii) A householder installs 28 m^2 of panels. During the first year, they use 3 000 kWh themselves and export the remainder to the National Grid. Calculate the money gained. [4]

saving ……………………….

(b) A solar panel manufacturer claims that their solar panels always produce an annual energy output of 200 kWh per m^2. Discuss why this claim cannot be true. [3]

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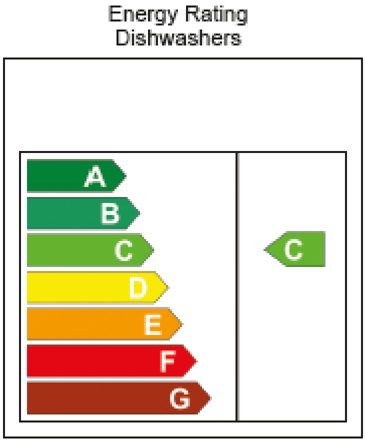
11

5. Dishwashers are rated by the amount of energy they use. Dishwashers rated **A** use less energy and are cheaper to run than those rated **G**.



For the following questions assume that all dishwashers are used for the same amount of time.

The following table gives information about dishwashers rated **A**, **B** and **D**.

Dishwasher energy rating	Voltage (V)	Current (A)	Units of energy used per year (kWh)
A	230	4	210
B	230	6	315
D	230	8	420

(a) Use an equation from page 2 to calculate the power of dishwashers rated **D**. [2]

power = ……….. W

(b) Estimate the units of energy used per year by a dishwasher rated **C**. [1]

………………………………….. kWh

(c) A homeowner buys a dishwasher rated **D**.

(i) Use an equation from page 2 to find the cost of using this dishwasher for a year. One unit of electricity costs 20 p. [2]

cost = £ …………………………………..

(ii) The homeowner could have bought a dishwasher rated **A** that was £35 more than the one rated **D**. Explain why the dishwasher rated **A** would have been more cost effective. [3]

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(d) Use an equation from page 2 and the information in the table opposite and your answer to part (a), to calculate the time that the dishwasher rated **D** is used during a year. [3]

time = ……………………

11

6. (i) Describe how you would investigate the current-voltage (I-V) characteristics for a diode. [6 QER]

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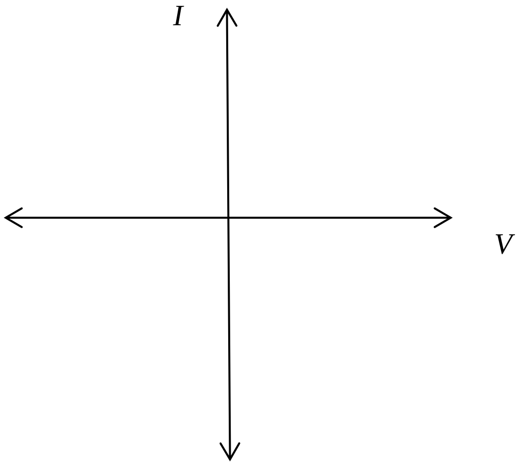
(ii) Sketch the I-V graph for a diode on the axes below that you would expect from the results. [2]



8

END OF PAPER

UNIT 3: (Double Award) PHYSICS 1
HIGHER TIER

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bod	=	benefit of doubt

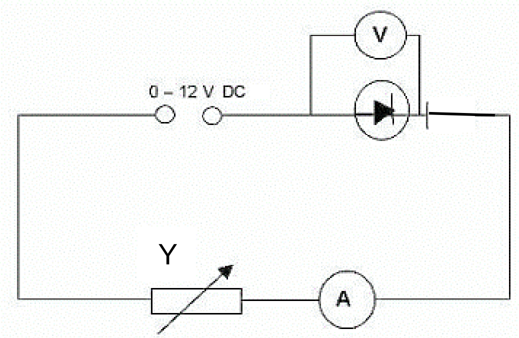
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			2.5		1		1		
	(b)	(i)		A and B		1		1		
		(ii)		B and C		1		1		
	(c)			30 [cm]		1		1	1	
	(d)			Vibration / oscillations (1) [in transverse waves] are at right angles to wave motion (1)	2			2		
				Question 1 total	**2**	**4**	**0**	**6**	**1**	**0**

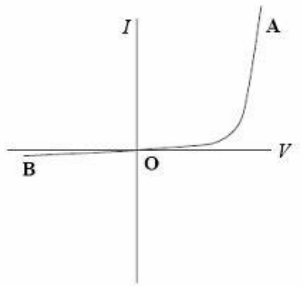
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Ticks in boxes 3, 4 and 6 i.e. Adding loft insulation reduces heat loss by 1 200 J/s (1) Before house **C** had its cavity walls filled with foam it was losing 5 600 J/s (1) If house **C** had double glazing installed its energy loss would reduce to 3 500 J/s (1)			3	3	1	
	(b)	(i)		Conduction	1			1		
		(ii)		Conduction (1) Convection (1)	2			2		
		(iii)		Loft insulation is a poor conductor because it traps air (1) Rate of heat loss by conduction through ceiling reduces (1) Less energy transfer by convection in roof space (1)	3			3		
	(c)	(i)		Because it loses the most heat per second			1	1		
		(ii)		Rate of heat loss decreases <u>so</u> heat supply decreases (1) less fuel used means less carbon emissions (1)		1	1	2		
				Question 2 total	**6**	**1**	**5**	**12**	**1**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		Satellite remains in the same point relative to the Earth (1) so satellite dishes do not need to move (1) they remain in continuous communication with each other / complete Earth coverage (1)	3			3		
		(ii)		Satellite B placed at approximately 2 o'clock		1		1		
		(iii)		Rays from radio station 1 to satellite A to ground station at about 1 o'clock on Earth (1) Rays from ground station to satellite B to radio station 2 (1)		2		2		
	(b)	(i)		Substitution: $3 \times 10^8 = f \times 20$ (1) Manipulation: $\frac{3 \text{ x } 10^8}{20}$ (1) $= 1.5 \times 10^9$ [Hz] (1) answer / conversion	1	1 1		3	3	
		(ii)		Substitution: $3 \times 10^8 \times 0.48$ (1) $= 1.44 \times 10^8$ (1) Division by 4 to give 3.6×10^7 [m] (1) **OR** $\frac{0.48}{4} = 0.12$ (1) Substitution: $3 \times 10^8 \times 0.12$ (1) $= 3.6 \times 10^7$ [m] (1)	1	1 1		3	3	
				Question 3 total	**5**	**7**	**0**	**12**	**6**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Use of matching data pair e.g. $\frac{840}{7}$ (1) = 120 [kWh] (1)		2		2	2	
		(ii)		Energy output is directly proportional to area. **OR** As area doubles so does energy output. **OR** As area increases energy output increases (1 mark only)		2		2		
		(iii)		Energy sold to grid: 360 × 5 = 1 800 p OR £18 (1) Energy saved: 3 000 × 16 = 48 000 p OR £480 (1) FIT: 3 360 × 12 = 40 320 p OR £403 (1) Total gain = 90 100 p OR £901 (1)		4		4	4	
	(b)			Hours of sunshine / year will vary (1) Angle of panel will vary (1) Direction of roof will vary / not all roofs face directly south (1)			3	3		
				Question 4 total	**0**	**8**	**3**	**11**	**6**	**0**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
5	(a)			Substitution: 230×8 (1) = 1 840 [W]	1	1		2	2	
	(b)			Within range of 320 to 410 [kWh]			1	1		
	(c)	(i)		Substitution: 420×20 (1) = £84 (1)	1	1		2	2	
		(ii)		A cost half as much to run per year as D (1) Saving of £42 in running costs per year (1) Payback time of extra cost is less than a year / which is more than the extra cost (1)			3	3		
	(d)			Substitution & conversion $420 = 1.84 \times$ time (**ecf**) (1) Manipulation: $\frac{420}{1.84}$ (1) = 228.26 / 228.3 (1) Award 2 marks only for: $\frac{420}{1840}$ = 0.228 / 0.23 / 0.2 [2] only	1	1 1		3	3	
				Question 5 total	**3**	**4**	**4**	**11**	**7**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6		(i)		**Indicative content:**  The circuit is set up as shown. (This may be expressed in words i.e. a power supply is connected in series with a diode, ammeter and variable resistor. A voltmeter is connected in parallel with the diode.) Accept a variable dc power supply. The resistance of Y is set so current is at its lowest / highest value and a readings of current and voltage are taken. The resistance of Y is varied at intervals and another pair of readings are taken at each setting. The power supply is reversed and pairs of readings are taken as before. **5 – 6 marks** Detailed description of circuit and methodology including references to positive and negative orientation of the power supply. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.*	6			6		6

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6		(i)		**3 – 4 marks** Detailed description of circuit and methodology. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks** A basic description is given. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*						
		(ii)		 1 mark for correct line in top right quadrant OA. 1 mark for correct line in bottom left quadrant OB.	2			2		2
				Question 6 total	**8**	**0**	**0**	**8**	**0**	**8**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	4	0	6	1	0
2	6	1	5	12	1	0
3	5	7	0	12	6	0
4	0	8	3	11	6	0
5	3	4	4	11	7	0
6	8	0	0	8	0	8
TOTAL	24	24	12	60	21	8

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 4: (Double Award) BIOLOGY 2
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**4**	
3.	**4**	
4.	**10**	
5.	**8**	
6.	**5**	
7.	**6**	
8.	**6**	
9.	**9**	
Total	**60**	

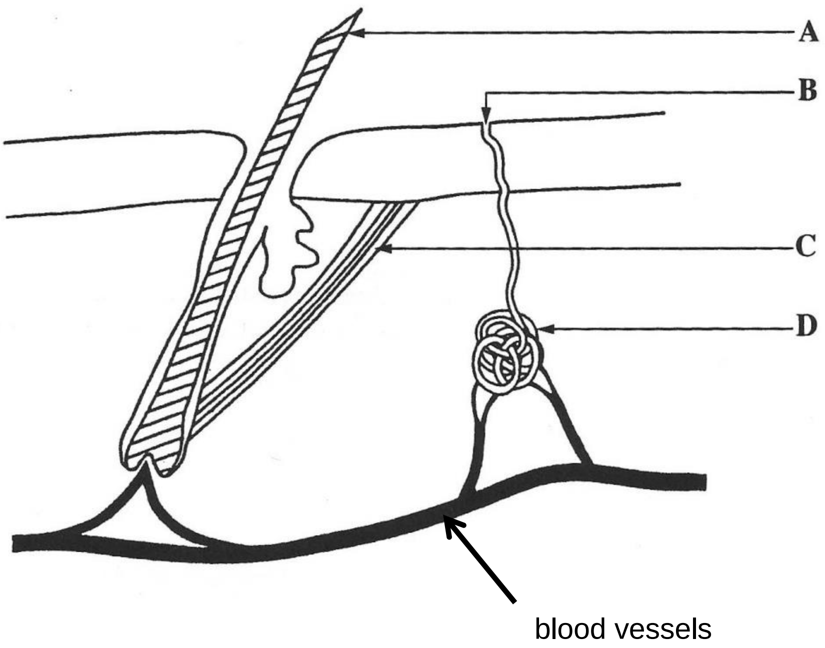
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **7** is a quality of extended response (QER) question where your writing skills will be assessed.

*Answer **all** questions*

1. The diagram shows a section through the skin.



(a) Name the structures labelled **A – D**. [4]

A …………………………………………………..

B …………………………………………………..

C …………………………………………………..

D …………………………………………………..

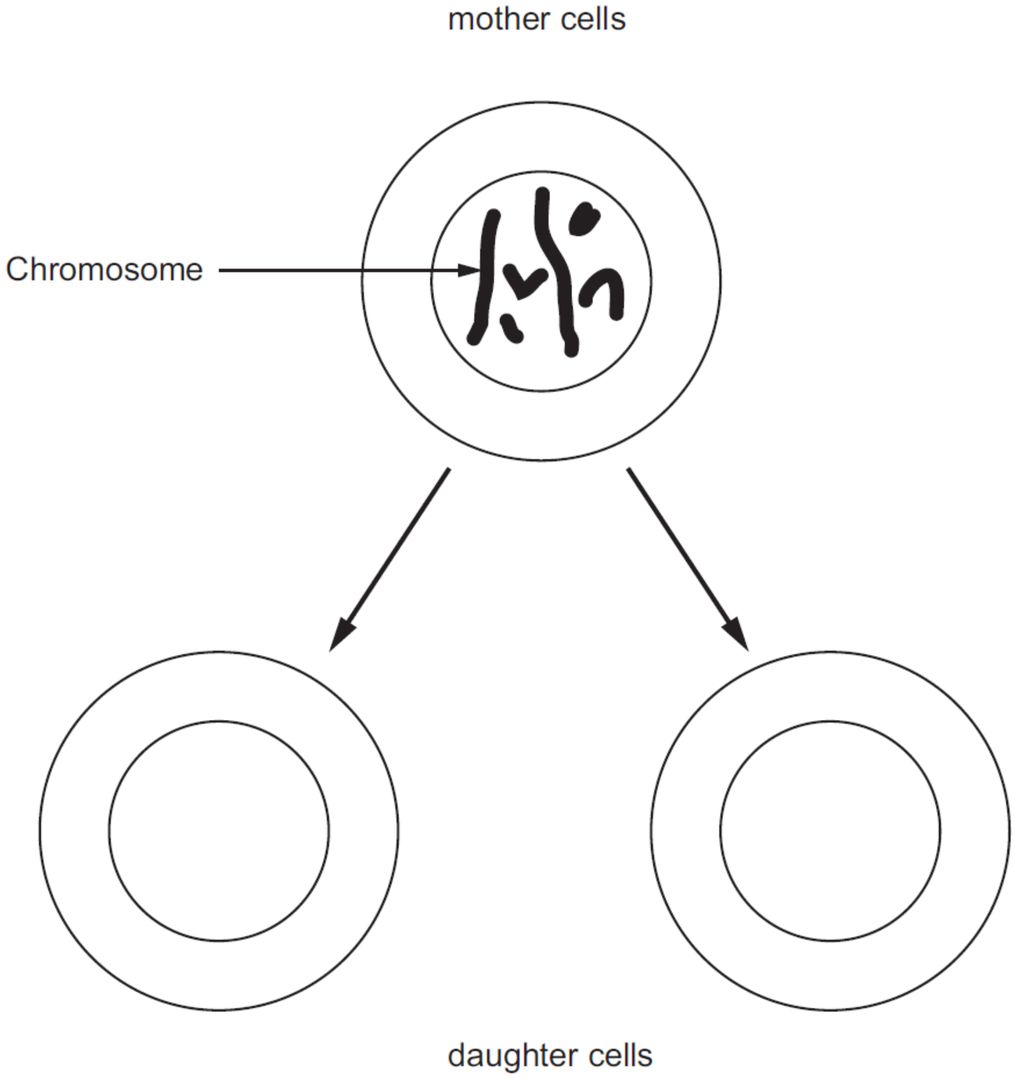
(b) Complete the following sentences by using the words from the list below. The words may be used once, more than once or not at all. [4]

dilate	more	evaporation
less	constrict	radiation

In hot weather the blood vessels in the skin ………………………… so that ……………………….. blood passes through them. Therefore ………………… heat is lost from the skin by ………………………………….. .

8

2. The diagram shows a cell dividing by mitosis.



(a) **Complete the diagram** by drawing in the chromosomes present in **both** daughter cells. [1]

(b) State **one** function of mitosis. [1]

....

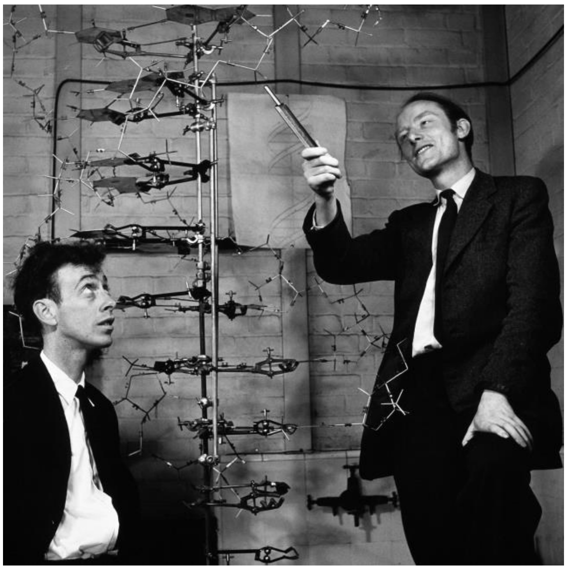
(c) State **two** ways in which the daughter cells produced by meiosis differ from the daughter cells produced by mitosis. [2]

I ....

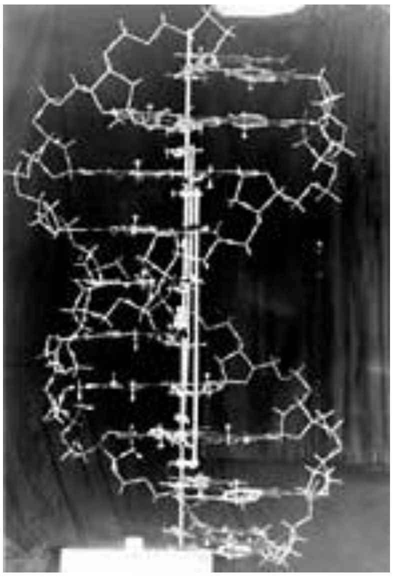
II ....

4

3. Francis Crick and James Watson first proposed the structure of DNA in 1953.



This photograph shows them working on an early model of DNA

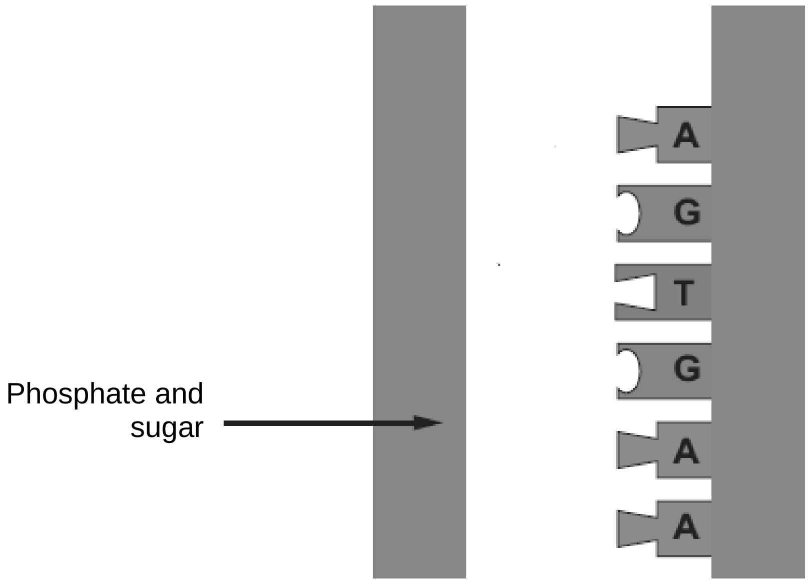


Photograph showing one of Crick and Watson's later models of DNA

(a) Crick and Watson described the shape of the DNA molecule as a [1]

…………………………………….. .

(b) Crick and Watson soon realised that their model of the DNA molecule could be untwisted to form a structure shaped like a ladder. The uprights of the ladder represented molecules of sugar and phosphate and the rungs of the ladder represented bases.



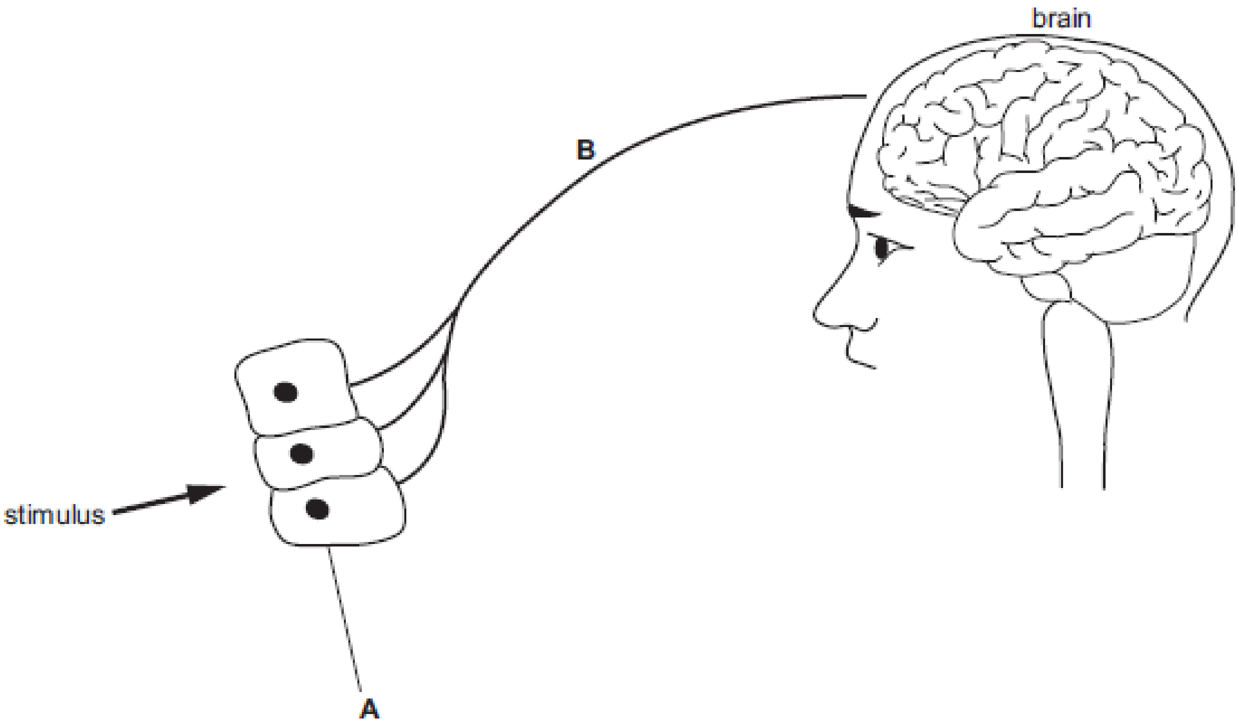
(i) **Complete the diagram** above to show the complementary base pairing. [2]

(ii) Modern technology has enabled scientists to identify the uniqueness of every person's DNA. This has led to the development of genetic profiling.
State **one** use that can be made of genetic profiling. [1]

…………………………………………………………………………………………

4

4. The diagram shows part of the nervous system.



(a) (i) Name parts **A** and **B** in the diagram above. [2]

A …………………………………………………..

B …………………………………………………..

(ii) Light and sound both act as stimuli. Give **two** *other* stimuli to which the body reacts. [1]

I ……………………………………………………….

II ………………………………………………………

(b) Helen investigated reaction times in a school laboratory. She wanted to investigate two aspects of reaction times. The two aspects were:

1. age
2. gender

Helen selected five people and asked each person to observe a red light on a computer screen. They had to click the mouse as soon as the light turned to green. The time taken for the light to change varied randomly between 1 and 7 seconds. The time taken for each subject to react to the light change was recorded by the computer program.
Helen tested each person three times. One of the people was another student in Helen's class and the other four were teachers. The results are shown in the following table.

Person			Reaction time (s)			Mean reaction time (s)
Name	Age	Gender	Test 1	Test 2	Test 3	
Liz	15	♀	0.213	0.266	0.253	0.244
Mike	27	♂	0.202	0.216	0.201	0.206
Jane	34	♀	0.254	0.249	0.251	0.251
Hywel	42	♂	0.284	0.276	0.271	0.277
Mair	56	♀	0.296	0.274	0.279	……………

♀ = female; ♂ = male

(i) Calculate the mean reaction time for Mair.
Write your answer in the table. [2]

(ii) Why did the software that Helen developed have a random time period delay of between 1 and 7 seconds? [1]

………………………………………………………………………………………

………………………………………………………………………………………

(iii) Helen made the following conclusions from the results she obtained.

1. As age increases reaction time become slower.
2. That gender has no effect on reaction time.

I Why is Helen's first conclusion not supported by the data? [1]

………………………………………………………………………………

………………………………………………………………………………

II Helen was unsure about her second conclusion and asked Dafydd, another student in her class, to review her method and results. Dafydd said that *'the second conclusion was unreliable and that Helen needed to change her method to increase her confidence in her conclusion.*
Give **three** ways in which Helen could increase her confidence in her conclusion. [3]

………………………………………………………………………………

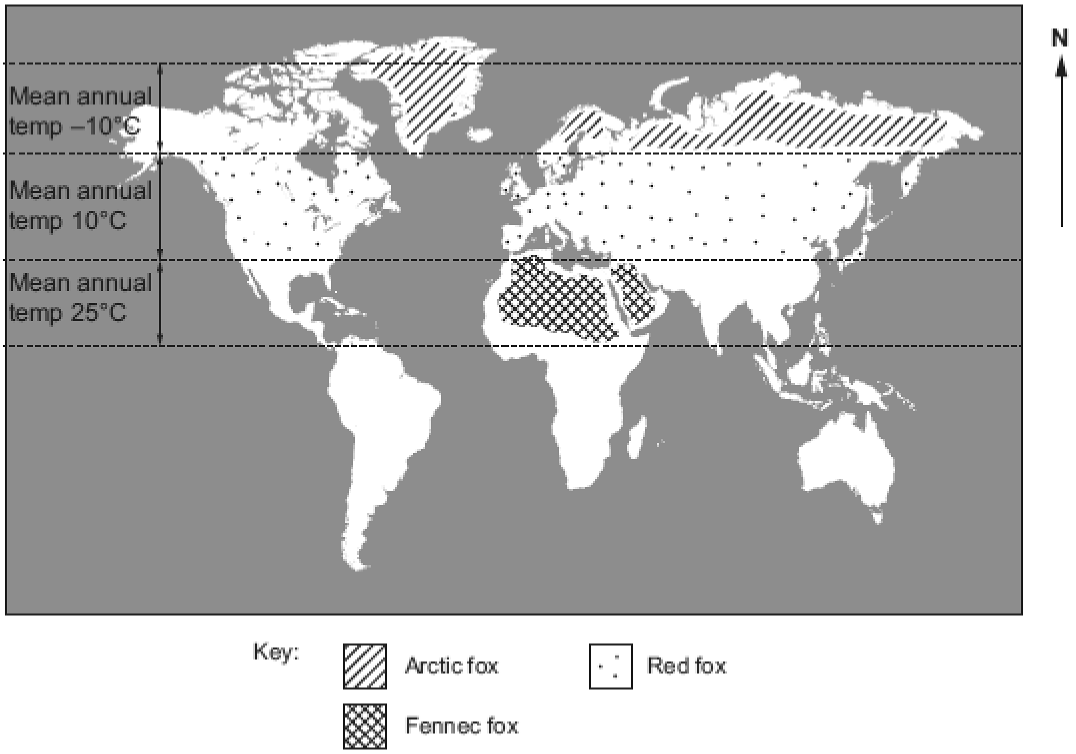
………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

10

5. The map shows the world distribution of three fox species, the fennec fox, the red fox and the arctic fox. The map also shows the mean annual temperatures of the regions where these three species are found.



Profiles	fennec fox *(Vulpes zerda)*	red fox *(Vulpes vulpes)*	arctic fox *(Vulpes lagopus)*
			
Distribution	Sahara and Arabian deserts (Equator to 35° N)	temperate regions of North America and Eurasia (35° N to 60° N)	arctic and sub-arctic tundra (60° N to 85° N)
Body mass (kg)	1.0 - 1.5	4.0 – 8.0	6.5 – 17.0
Ear length (cm)	15.0	8.0	4.0
Coat colour	sandy cream	red - brown	white (winter)

(a) (i) Bergmann's rule states that ***body size is correlated with latitude***. This means that the further north you travel the larger the body size becomes.

Study the profiles of the foxes. Does Bergmann's rule apply to them? Explain your answer by referring to each of the foxes. [3]

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…………………………………………………………………………………………

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…………………………………………………………………………………………

…………………………………………………………………………………………

(ii) Suggest how:

I the body mass of the fennec fox is an adaptation for living in a very hot environment; [1]

…………………………………………………………………………………

…………………………………………………………………………………

II the winter coat colour of the Arctic fox is an adaptation for living in a very cold climate. [1]

…………………………………………………………………………………

…………………………………………………………………………………

(iii) The three foxes have different ear lengths. Underline **one** statement from the list below which best describes the reason for this. [1]

The smaller the ears the more heat they lose.

The smaller the animal the larger the ears have to be to listen for prey.

The larger the ears the more heat they lose.

The ears only appear bigger in smaller foxes.

(b) What information in the profile tells you that these three foxes are very closely related to one another? [1]

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

(c) As well as being known by 'common' names these three foxes also have scientific names. Why is the use of scientific names important? [1]

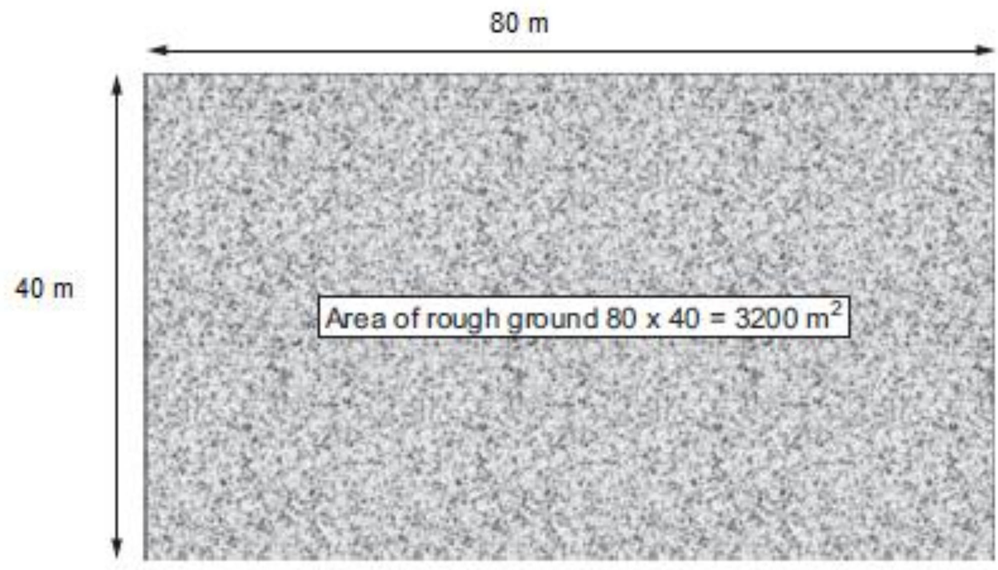
…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

8

6. Natalie was asked to estimate the number of poppies growing on an area of rough ground in the Gower using a $1 m^2$ quadrat.

The area of rough ground was 80 metres by 40 metres.



(a) Which is the correct way of using the quadrat in this sampling exercise? Tick **one** box only. [1]

	Tick (✔)
Place the quadrats where the most poppies are growing	
Place the quadrats where an average number of poppies are growing	
Place the quadrats randomly	

(b) Describe the technique Natalie should use when estimating the number of poppies on this area of rough ground. [4]

…………………………………………………………………………………………..

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5

7. Explain how the body defends itself against disease. [6 QER]

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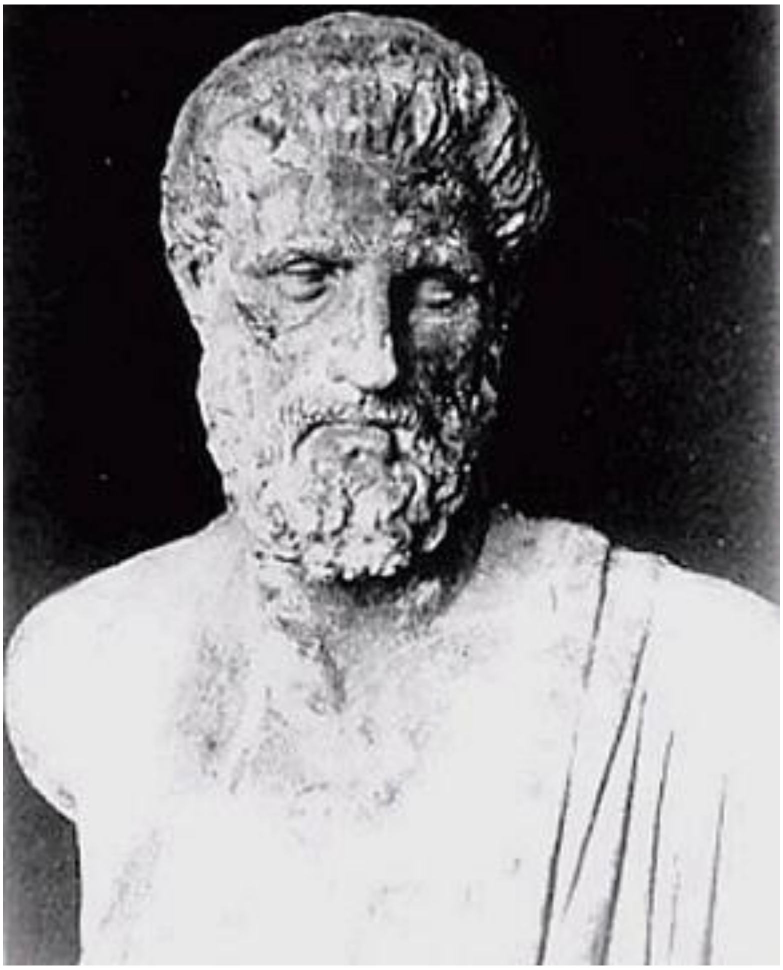
6

8. The early history of diabetes.



Aretaeus of Cappadocia

Diabetes was given its name by the Greek physician Aretaeus of Cappadocia (30 – 90CE). He recorded a disease with the three symptoms of constant thirst (polydipsia), excessive urination (polyuria) and loss of weight. He named the condition ‘diabetes’, meaning ‘a flowing through.’

In 1674, English physician Thomas Willis was the first in modern medical literature to observe the relationship between diabetes and a sweet taste to the patient’s urine. He wrote in his notes that ***‘****the pee was wonderfully sweet as if it were imbued with honey’*. This led him to add the term ‘mellitus’ to the name for this form of diabetes, from the Latin word for honey.

(a) Explain any **two** of the three symptoms of diabetes, as recorded by Aretaeus. [2]

Symptom …………………………………………………………………………..

Explanation ……………………………………………………………………..

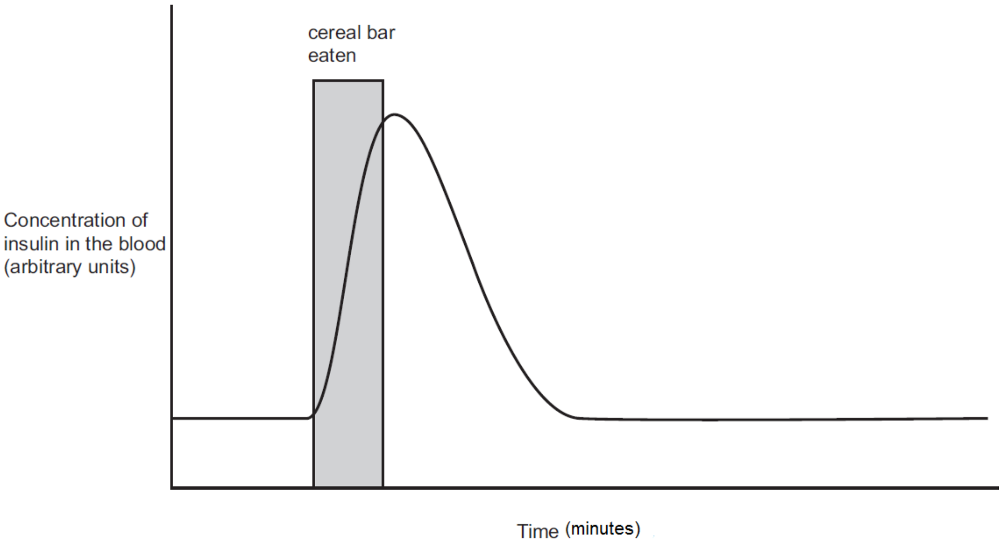
……………………………………………………………………………………..

Symptom …………………………………………………………………………..

Explanation ……………………………………………………………………..

……………………………………………………………………………………..

(b) The graph shows the level of insulin in the blood of a person without diabetes before and after eating a breakfast cereal.



(i) Explain what happens to the concentration of insulin in the blood as the breakfast cereal is being eaten. [3]

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

(ii) How would the graph above differ if the insulin levels of a person with untreated **Type 1** diabetes had been recorded? [1]

……………………………………………………………………………………

6

9. PSSM1 is a muscle disease in horses. It results in muscle stiffness and a reluctance to move. One of the characteristics of PSSM1 is a very high level of glycogen stored in muscle tissue.

(a) Suggest which class of food should be reduced in the diet of a horse suffering from PSSM1 and explain the reason for your answer. [2]

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

(b) The following table describes the number and percentage of randomly sampled horses that tested positive for the PSSM1.

Breed of horse	**Number tested**	**Number with PSSM1**	**Prevalence (%)**
Quarter horse	335	22	6.6
Paint	195	15	7.7
Appaloosa	152	9	5.9
Morgan	214	2	……….
Percheron*	149	93	62.0
Belgian*	149	58	39.0
Shire*	200	……….	0.5
Clydesdale*	48	0	0.0
Belgian draught*	37	34	92.0
Trekpaard*	23	17	74.0
Comtois*	88	70	80.0
Breton*	51	32	63.0

(i) Explain what a prevalence of 62.0% amongst Percheron horses means. [1]

…………………………………………………………………………………………….

…………………………………………………………………………………………….

(ii) **Complete the table** by calculating

I the prevalence of PSSM1 amongst the Morgan horses tested; [1]

II the number of Shire horses that had the PSSM1 gene. [1]

(iii) In the table opposite the horses marked with an asterisk (*) are heavy working or draught horses.
For environmental reasons a commercial forestry owner wants to replace some of his heavy tracked vehicles with draught horses.

Which **three** breeds of horse would you recommend to the forestry owner so that the horses have an active working life? [1]

I ……………………………………………………….

II ……………………………………………………….

III ……………………………………………………….

(c) PSSM1 is caused by a mutation and is inherited as a dominant allele, **(B)**.
A horse, heterozygous for PSSM1, is mated with a horse that does not suffer from the condition.

(i) Complete the Punnett square below to show this mating. [2]

Gametes		

(ii) State the ratio of PSSM1 horses to non-PSSM1 horses in the offspring. [1]

PSSM1 : …………………. non-PSSM1

9

END OF PAPER

UNIT 4: (Double Award) BIOLOGY 2
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

<u>Marking rules</u>

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

<u>Extended response question</u>

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			**A** Hair (1) **B** Sweat pore (1) **C** Erector muscle (1) **D** Sweat gland (1)	4			4		
	(b)			Dilate (1) More (1) More (1) Radiation (1)	4			4		
				Question 1 total	**8**	**0**	**0**	**8**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Both daughter cells contain the same 6 chromosomes as the mother cell		1		1		
	(b)			{Growth/replacement} of damaged cells/repair of damaged <u>tissues</u>	1			1		
	(c)			**Any 2 x (1) from:** Daughter cells have half the chromosomes of the mother cells/have haploid number Meiosis results in 4 daughter cells Cells produced by meiosis become gametes/sex cells Genetically different to each other	2			2		
				Question 2 total	**3**	**1**	**0**	**4**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Double helix	1			1		
	(b)	(i)		All Pairs drawn correctly (2) 3 pairs drawn correctly (1)		2		2		
		(ii)		resolving paternity cases/ criminal cases/ classification	1			1		
				Question 3 total	**2**	**2**	**0**	**4**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		**A** receptor cell(s) **B** sensory neurone	2			2		
		(ii)		**Any 2 x (1) from:** Touch Temperature Chemicals	1			1		
	(b)	(i)		(0.296 + 0.274 + 0.279)/3 (1) 0.283 (1)		2		2	2	1
		(ii)		So that the test subject could not anticipate when the green light would come on		1		1		1
		(iii)	I	Because Mike is older than Liz and has a faster mean reaction time [ORA]			1	1		1
			II	**Any 3 x (1) from:** Increase the number of both males and females Same age/ health Increase the number of tests/ repeatability Reproduceability			3	3		3
				Question 4 total	**3**	**3**	**4**	**10**	**2**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		Artic fox lives at high latitudes/furthest north and has largest body (1) Fennec fox lives at low latitudes/least furthest north and has smallest body (1) Red fox live in middle latitudes/mid-north and has medium sized body (1)		3		3		
		(ii)	I	smaller the body mass the more heat is lost		1		1		
			II	blends in with white environment/snow/ camouflage from prey/predator		1		1		
		(iii)		larger the ears the more heat they lose		1		1		
	(b)			the genus/generic name/*Vulpes*		1		1		
	(c)			because scientific names are {the same in all languages/universal/all around the world/countries}/ because common names differ in different languages/different parts of the world/countries	1			1		
				Question 5 total	**1**	**7**	**0**	**8**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Place the quadrats randomly	1			1		1
	(b)			Place the quadrat (randomly) and count the number of poppies (1) Repeat (10 times) (1) Calculate the mean number of poppies (in the 10 samples) (1) Use the mean to calculate the number of poppies in the area of waste ground (1)			4	4		4
				Question 6 total	**1**	**0**	**4**	**5**	**0**	**5**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			***Indicative content:*** • Skin forms a barrier against the entry of pathogens • If skin is cut blood clots to seal the wound • Phagocytes • ingest pathogens • Lymphocytes produce • antibodies which destroy antigens • and antitoxins which neutralize toxins produce by antigens **5 – 6 marks**: Detailed description of defence including correct reference to skin, phagocytes, lymphocytes, antibodies and antitoxins. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks**: A description of the role of skin, phagocytes and lymphocytes. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks**: A basic description of role of skin or white blood cells. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks***: No attempt made or no response worthy of credit.*	6			6		
				Question 7 total	**6**	**0**	**0**	**6**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			**Any 2 x (1) from: (explanation must link to symptom given)** *Symptom* – constant thirst (no mark) *Explanation* – ref to body having to lose a lot of water excreting glucose *Symptom* – excessive urination (no mark) *Explanation* – ref to body having excess glucose to excrete which cannot be done unless dissolved in water *Symptom* – loss of weight (no mark) *Explanation* – body can't use the glucose it gets from food as a source of energy therefore fat stores are used		2		2		
	(b)	(i)		Increases (1) Pancreas (1) recognizes increase in glucose in blood and secretes insulin (1)			3	3	1	
		(ii)		{No/ very low} insulin would be recorded			1	1		
				Question 8 total	**0**	**2**	**4**	**6**	**1**	**0**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>9</td><td>(a)</td><td></td><td></td><td>Carbohydrate (1)
excess of which is converted to glycogen (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td></td><td>of the 149 horses tested 62.0% had PSSM1gene</td><td></td><td>1</td><td></td><td>1</td><td></td><td></td></tr>
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<tr><td></td><td></td><td></td><td>II</td><td>1</td><td></td><td>1</td><td></td><td>1</td><td>1</td><td></td></tr>
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Gametes correct (1)
Cross correct (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>1 : 1</td><td></td><td>1</td><td></td><td>1</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 9 total</td><td>0</td><td>9</td><td>0</td><td>9</td><td>3</td><td>0</td></tr>
</table>

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	8	0	0	8	0	0
2	3	1	0	4	0	0
3	2	2	0	4	0	0
4	3	3	4	10	2	6
5	1	7	0	8	0	0
6	1	0	4	5	0	5
7	6	0	0	6	0	0
8	0	2	4	6	1	0
9	0	9	0	9	3	0
TOTAL	24	24	12	60	6	11

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 4: (Double Award) BIOLOGY 2
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**9**	
3.	**10**	
4.	**6**	
5.	**10**	
6.	**10**	
7.	**9**	
Total	**60**	

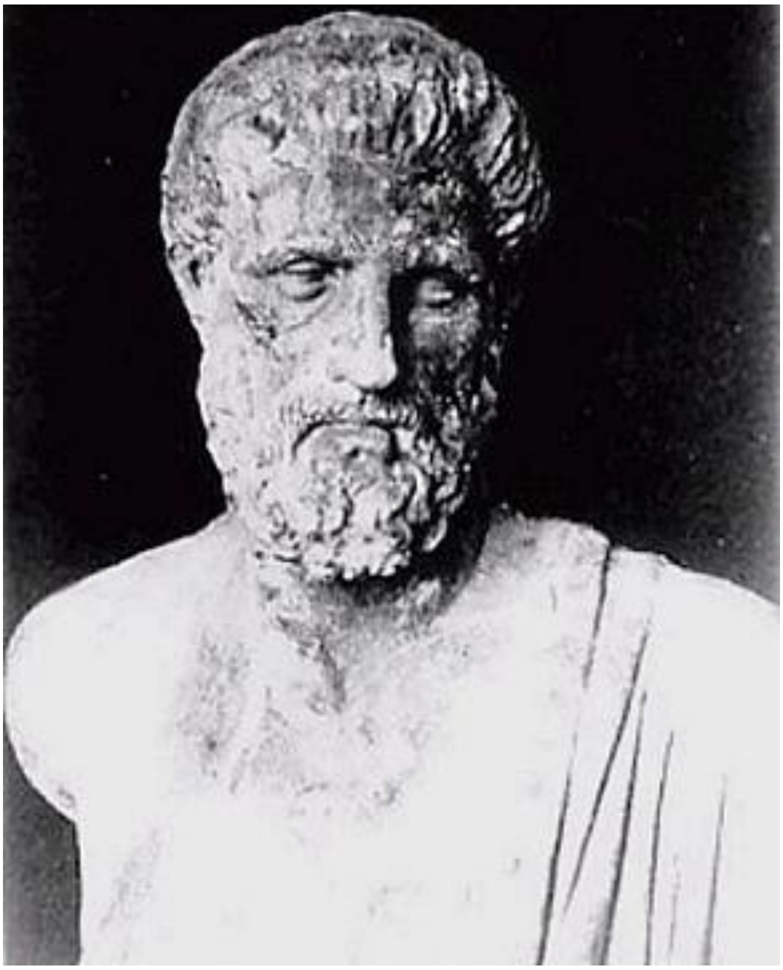
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **4** is a quality of extended response (QER) question where your writing skills will be assessed.

*Answer **all** questions*

1**.** The early history of diabetes.



Aretaeus of Cappadocia

Diabetes was given its name by the Greek physician Aretaeus of Cappadocia (30 – 90CE). He recorded a disease with the 3 symptoms of constant thirst (polydipsia), excessive urination (polyuria) and loss of weight. He named the condition ‘diabetes’, meaning ‘a flowing through.’

In 1674, English physician Thomas Willis was the first in modern medical literature to observe the relationship between diabetes and a sweet taste to the patient’s urine. He wrote in his notes that *‘the pee was wonderfully sweet as if it were imbued with honey’*. This led him to add the term ‘mellitus’ to the name for this form of diabetes, from the Latin word for honey.

(a) Explain any **two** of the three symptoms of diabetes, as recorded by Aretaeus. [2]

Symptom ……………………………………………………………………………..

Explanation …………………………………………………………………………..

……………………………………………………………………………………………..

Symptom ……………………………………………………………………………..

Explanation …………………………………………………………………………..

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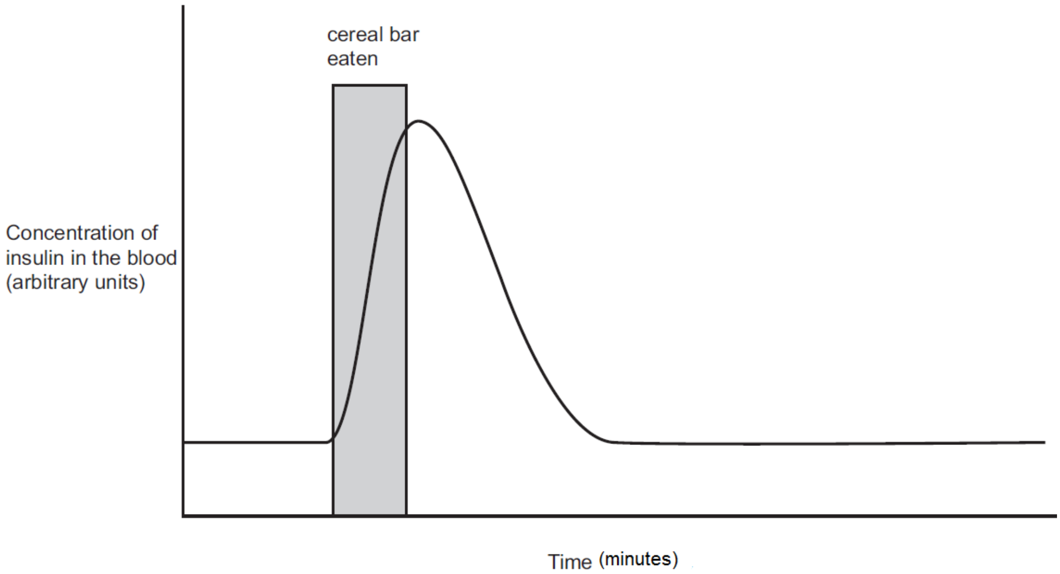
(b) The graph shows the level of insulin in the blood of a person without diabetes before and after eating a breakfast cereal.



(i) Explain what happens to the concentration of insulin in the blood as the breakfast cereal is being eaten. [3]

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(ii) How would the graph above differ if the insulin levels of a person with untreated **Type 1** diabetes had been recorded? [1]

……………………………………………………………………………………

6

2. PSSM1 is a muscle disease in horses. It results in muscle stiffness and a reluctance to move. One of the characteristics of PSSM1 is a very high level of glycogen stored in muscle tissue.

(a) Suggest which class of food should be reduced in the diet of a horse suffering from PSSM1 and explain the reason for your answer. [2]

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(b) The following table describes the number and percentage of randomly sampled horses that tested positive for the PSSM1.

Breed of horse	**Number tested**	**Number with PSSM1**	**Prevalence (%)**
Quarter horse	335	22	6.6
Paint	195	15	7.7
Appaloosa	152	9	5.9
Morgan	214	2	……….
Percheron*	149	93	62.0
Belgian*	149	58	39.0
Shire*	200	……….	0.5
Clydesdale*	48	0	0.0
Belgian draught*	37	34	92.0
Trekpaard*	23	17	74.0
Comtois*	88	70	80.0
Breton*	51	32	63.0

(i) Explain what a prevalence of 62.0% amongst Percheron horses means. [1]

…………………………………………………………………………………………

…………………………………………………………………………………………

(ii) **Complete the table** by calculating:

I the prevalence of PSSM1 amongst the Morgan horses tested;. [1]

II the number of Shire horses that had the PSSM1 gene. [1]

(iii) In the table opposite the horses marked with an asterisk (*) are heavy working or draught horses.
For environmental reasons a commercial forestry owner wants to replace some of his heavy tracked vehicles with draught horses.

Which **three** breeds of horse would you recommend to the forestry owner so that the horses have an active working life? [1]

I ……………………………………………………….

II ……………………………………………………….

III ……………………………………………………….

(c) PSSM1 is caused by a mutation and is inherited as a dominant allele, **(B)**.
A horse, heterozygous for PSSM1, is mated with a horse that does not suffer from the condition.

(i) Complete the Punnett square below to show this mating. [2]

Gametes		

(ii) State the ratio of PSSM1 horses to non-PSSM1 horses in the offspring. [1]

PSSM1 : …………………. non-PSSM1

9

3. The adder (*Vipera berus*) is a protected species in the UK under the Wildlife and Countryside Act and is classified as a Priority Species in the UK Biodiversity Action Plan.

© *Alan Gravell*

Scientists are concerned that the numbers of adders in an area of west Wales is decreasing. The scientists decided to estimate the population size, in the area, using capture/recapture techniques.

In 2015, 47 adders were captured in one day and some scales on the body were marked with a harmless biodegradable paint. This first sample of adders was then released. Two days later a second sample of 51 adders were captured, in the same area, and of these 36 were found to be marked with the paint.

The population of adders in the area can be estimated using the formula

$$\text{population size} = \frac{\text{number in first sample x number in second sample}}{\text{number in second sample marked with paint}}$$

(a) Using the above formula calculate the population size **to the nearest whole number**. Show your working. [2]

Population of adders = ………………………………

(b) State **three** assumptions that the scientists have to make when using capture recapture data. [3]

I ....

II ....

III ....

(c) 2015 was the fourth time that the population of adders in the area had been estimated using capture/recapture techniques. The table below shows the data for three previous sampling years.

	Year of capture/recapture exercise			
	2009	**2011**	**2013**	**2015**
population of adders	86	82	73	....

Complete the table with the data you calculated for 2015.
State how the contribution the adder makes to the biodiversity of the sample area has changed since 2009. [1]

....

(d) Explain why it is important that the harmless paint used to mark the adders is biodegradable and in your answer suggest a minimum time for the paint to last before it biodegrades. [2]

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....

The following chart shows the adder's year.

Month	**Activity**
January February	Adders in hibernation deep underground
March	Adders emerge from hibernation with the males appearing first
April May	Mating takes place
June	
July	
August September	Females give birth to between 3 – 18 live young. Young are vulnerable to predation
October	
November	Adders return to hibernation
December	Adders in hibernation

(e) Between which months would it be best to carry out a capture/recapture investigation in order to gain a true picture of the population of adders in the sample area? Justify your answer. [2]

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10

4. Tuberculosis, cholera and typhoid are bacterial diseases for which vaccines are available. Give a brief outline of how vaccines can be produced and explain how a vaccine can protect the body against a disease caused by a bacterium. [6 QER]

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6

5. (a) What are stem cells? [2]

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………………………………………………………………………………………………….

(b) Stem cell transplants are classified differently depending on the individual providing the stem cells.

- Stem cells which come from the patient are called autologous stem cells.
- Stem cells which come from a donor are called allogenic stem cells.

(i) Explain the advantage to the patient of treating them with autologous stem cells rather than allogenic stem cells. [2]

…………………………………………………………………………………………

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(ii) Name the source of allogenic (donor) stem cells whose use, for some people, raises a serious ethical issue and give reasons for your answer. [2]

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(c) Injuries can be treated with stem cells. One method of treatment involves the following processes and stages.

1. **HARVESTING**

$200\ cm^3$ of fat is taken from a patient's waist area. This fat contains fat cells and a small number of stem cells

↓

2. **SEPARATION**

↓

3. **ACTIVATION**

Stem cells are enriched with the patient's blood plasma which contains many nutrients and oxygen.

↓

4. **TREATMENT**

Large numbers of activated stem cells are then added to a saline drip bag and returned to the patient's body via an IV drip line

(i) What happens in the **separation** stage of the process? [1]

…………………………………………………………………………………………………

(ii) Suggest what happens to the stem cells in the activation stage after they have been enriched with patient's blood plasma. [2]

…………………………………………………………………………………………………

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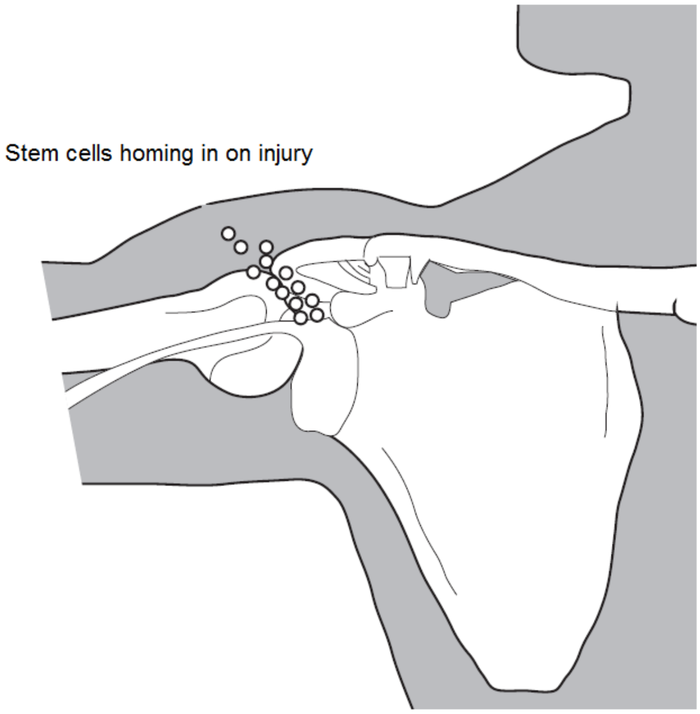
(iii) A patient was treated for a shoulder injury with autologous stem cells. The stem cells were introduced into the patient via a drip connected to the back of the hand. All injured tissues in the body secrete a chemical called chemokine.



Using the information provided explain how the stem cells are able to '*home in'* on the area of the injury in the patient's shoulder. [1]

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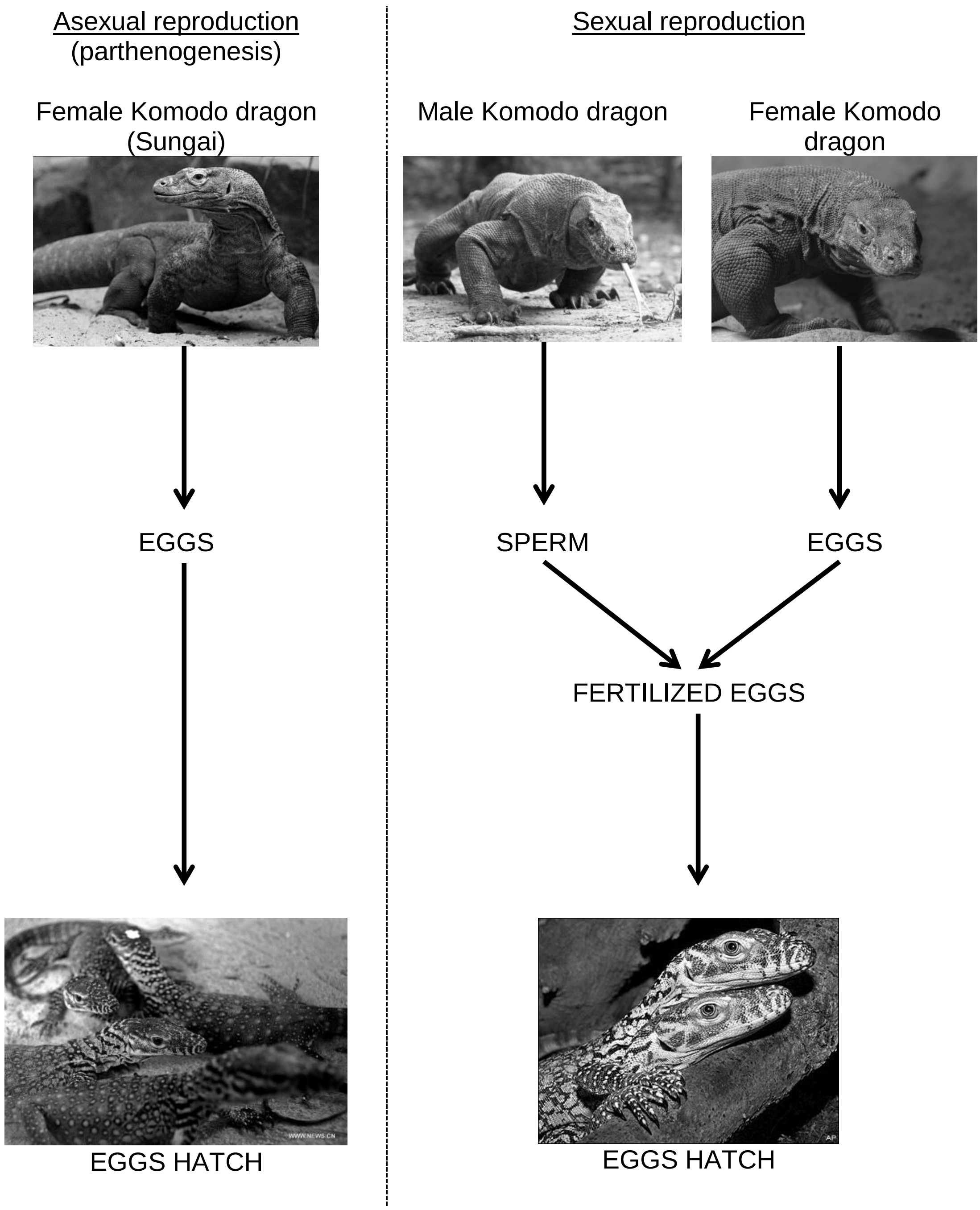
.

10

6. Parthenogenesis happens when an unfertilized egg produces offspring. This means that the organism has reproduced asexually. Parthenogenesis occurs in many animal species which normally reproduce sexually. It occurs either for a lack of males, for population sex control, or in some cases because of an abundance of resources. Parthenogenesis occurs in about 0.1% of vertebrate species.

In 2006 two different cases of parthenogenesis occurred in two female Komodo dragons
(Varanus komodoensis) in London Zoo. Komodo dragons are large lizards. One of the females was called Sungai.

The diagram below shows some of the stages in asexual reproduction (parthenogenesis) and sexual reproduction in Komodo dragons.



(a) Using the **information in the diagrams only**, complete the table below by giving **three** differences between asexual and sexual reproduction. [3]

Asexual reproduction	Sexual reproduction

(b) When Komodo dragons reproduce sexually, the male introduces sperm into the female's body. Some female reptiles, including some lizards, are able to store sperm in their bodies for years after mating. Sungai had not been with a male Komodo dragon for over 12 months and therefore some scientists thought that she had stored sperm from a previous mating. Other scientists disagreed with this because they thought that the offspring were too similar to one another and they were all male. They thought Sungai's offspring were a clone.

(i) Describe the test the scientists could carry out on Sungai's offspring in order to find out whether they were a clone. Include the possible results of the test in your answer. [3]

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(ii) Komodo dragons live on many small and large islands in Indonesia. What advantage would the species gain by being able to reproduce by parthenogenesis? [1]

…………………………………………………………………………………………

…………………………………………………………………………………………

(iii) Suggest a possible advantage to a species of the female being able to store sperm in her body for many years. [1]

…………………………………………………………………………………

(c) In many species the main advantage of parthenogenesis is that large numbers of offspring can be produced very quickly. However this could be a ‘risky strategy’. Suggest why this could be a ‘risky strategy’ compared to the production of offspring by sexual reproduction. [2]

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7. (a) What is meant by antibiotic resistance? In your answer give an example of a pathogen which is resistant to antibiotics. [2]

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………………………………………………………………………………………………….

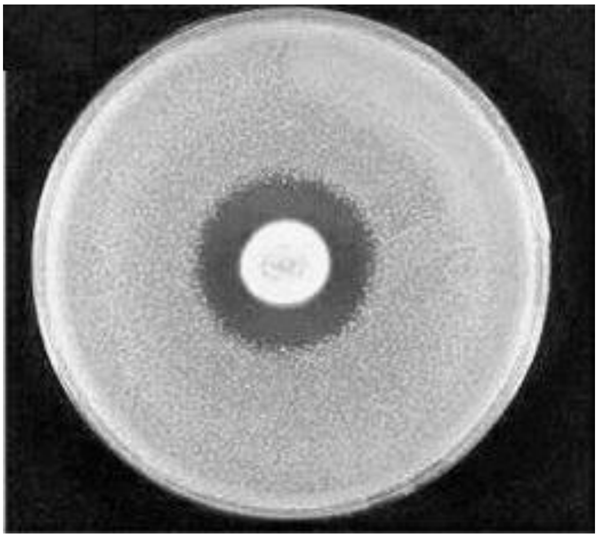
(b) In 1928 Sir Alexander Fleming was working on ways to destroy bacteria. He grew colonies of bacteria on agar jelly in Petri dishes. One of his dishes became infected with a mould.

Study the photographs below.

Plate A

1928 Alexander Fleming's photograph of bacterial colonies growing on agar jelly. The agar has become contaminated at the bottom of the dish with a mould.

Plate B



Recent photograph of 1000s of bacterial colonies growing on agar jelly. A drop of crocodile blood has been placed in the centre of the colonies.

(i) Describe and explain the similarities you can see between Plates **A** and **B**. [2]

…………………………………………………………………………………

…………………………………………………………………………………

(ii) Name the chemical which was developed as a result of Sir Alexander Fleming's work on bacteria. [1]

……………………………………………………..

(c) The increased incidence of antibiotic resistance has led many pharmaceutical companies to carry out research into the development of new antimicrobial drugs. One of the sources of new antibiotics which scientists are very interested in is crocodile blood.

Scientists exposed human blood and crocodile blood to 23 different strains of bacteria, including antibiotic resistant strains. The results are shown in the table below.

	Crocodile blood	**Human blood**
Number of strains of bacteria destroyed	23	8

Unfortunately, it is not possible to inject crocodile blood into human patients suffering from life-threatening bacterial infections because it would be identified as a foreign tissue and be destroyed. It may also have harmful effects on the body.
What would the pharmaceutical companies have to do before crocodile blood could be used to make new drug treatments for bacterial infections? [4]

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9

END OF PAPER

UNIT 4: (Double Award) BIOLOGY 2
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
1	(a)			**Any 2 x (1) from:** *Symptom* – constant thirst (no mark) *Explanation* – ref to body having to lose a lot of water excreting glucose *Symptom* – excessive urination (no mark) *Explanation* – ref to body having excess glucose to excrete which cannot be done unless dissolved in water *Symptom* – loss of weight (no mark) *Explanation* – body can't use the glucose it gets from food as a source of energy therefore fat stores are used		2		2		
	(b)	(i)		Increases (1) Pancreas (1) recognizes increase in glucose in blood and secretes insulin (1)			3	3	1	
		(ii)		{No/ very low} insulin would be recorded			1	1		
				Question 1 total	**0**	**2**	**4**	**6**	**1**	**0**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td></td><td>Carbohydrate (1)
excess of which is converted to glycogen (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td><td>Question 2 total</td><td>0</td><td>9</td><td>0</td><td>9</td><td>3</td><td>0</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			$\frac{47 \times 51}{36}$ (1) 67 (1) must be a whole number	1	1		2	2	
	(b)			**Any 3 x (1) from:** no death no immigration or emigration sampling methods are identical marking has not affected the survival rate of the adders	3			3		3
	(c)			decreased (no mark is awarded for completing the table)			1	1		
	(d)			minimum 2 or 3 days (1) so that adders can be counted but are not permanently marked which could affect their chance of successful reproduction or increase predation (1)		2		2		2
	(e)			April – July (1) all adders out of hibernation or population not increased by young animals (1)			2	2		2
				Question 3 total	**4**	**3**	**3**	**10**	**2**	**7**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>4</td><td></td><td></td><td></td><td>Indicative content:
• Disease causing bacteria can be weakened or killed in the laboratory
• The weakened bacteria are made into a vaccine
• When introduced into the body the immune system treats the weakened bacterium as a disease causing antigen
• lymphocytes
• secrete antibodies specific to the antigen
• antibodies destroy antigens
• memory cells remain in body
• and produce antibodies very quickly
• if the same antigen is encountered a second time

5 – 6 marks: Detailed description of how bacteria are used to produce vaccines and the effect vaccination has on the body.
There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.

3 – 4 marks: A description of the effect vaccination has on the body.
There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.

1- 2 marks: A basic description, including vaccines contain antigens to which the body makes antibodies.
There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.

0 marks: No attempt made or no response worthy of credit.</td><td>6</td><td></td><td></td><td>6</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 4 total</td><td>6</td><td>0</td><td>0</td><td>6</td><td>0</td><td>0</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			Undifferentiated/unspecialized cells (1) which can become any type of cell/any specialized cell (1)	2			2		
	(b)	(i)		Unlikely to be rejected/more likely to be accepted (1) Genetically identical (1)	2			2		
		(ii)		Embryos (1) Embryos are destroyed (1)	2			2		
	(c)	(i)		Stem cells are separated from fat cells		1		1		1
		(ii)		Divide/ reproduce (1) By mitosis (1)	1	1		2		
		(iii)		stem cells are attracted to the chemokine		1		1		
				Question 5 total	**7**	**3**	**0**	**10**	**0**	**1**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="4">Marks Available</th><th rowspan="2">Maths</th><th rowspan="2">Prac</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td></td><td>1 mark for each correct row. Both columns in the row must be completed correctly
<table><tr><th>Asexual</th><th>Sexual</th></tr><tr><td>1 parent/female only</td><td>2 parents/male & female</td></tr><tr><td>no sperm (involved)</td><td>sperm (involved)</td></tr><tr><td>no fertilization</td><td>fertilization</td></tr></table></td><td>3</td><td></td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td></td><td>extract DNA (1)
genetic profile the DNA (1)
if clone then all profiles will be the same/
if not clone then all profiles will be different (1)</td><td></td><td></td><td>3</td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>if female isolated then can produce offspring/ no males needed</td><td></td><td>1</td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>if conditions are unfavourable for young/ lack of food/drought/ unsuitable temp then fertilization can be delayed until conditions improve</td><td></td><td>1</td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td></td><td>if disease occurs then members of a clone either all survive or all die – high risk (1)
<u>variation</u> in offspring produced by sexual reproduction mean some will survive disease (1)</td><td></td><td></td><td>2</td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 6 total</td><td>3</td><td>2</td><td>5</td><td>10</td><td>0</td><td>0</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
7	(a)			A bacterium is no longer destroyed by an antibiotic which was once used to kill it (1) MRSA or any other correct e.g. *Clostridium difficile (c-diff)*(1)	2			2		
	(b)	(i)		Fewer colonies around both the mould and crocodile blood are being destroyed (1) by a chemical diffusing out (1)	1	1		2		2
		(ii)		Penicillin	1			1		
	c)			**Any 4 (x1) from:** extract active chemical purify active chemical extensive field trials rigorous testing look for side effects ethical issues including animal testing		4		4		
				Question 7 total	**4**	**5**	**0**	**9**	**0**	**2**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	0	2	4	6	1	0
2	0	9	0	9	3	0
3	4	3	3	10	2	7
4	6	0	0	6	0	0
5	7	3	0	10	0	1
6	3	2	5	10	0	0
7	4	5	0	9	0	2
TOTAL	24	24	12	60	6	10

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 5: (Double Award) CHEMISTRY 2
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**7**	
3.	**7**	
4.	**8**	
5.	**5**	
6.	**5**	
7.	**6**	
8.	**8**	
9.	**7**	
Total	**60**	

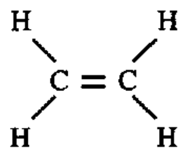
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

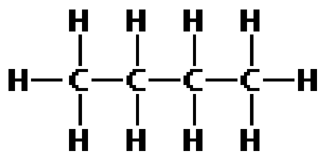
INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **7** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions.*

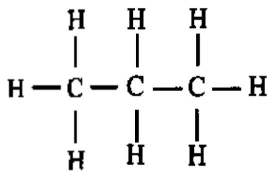
1. (a) The diagrams below show the structural formulae of some hydrocarbons.



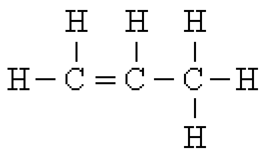
A



B



C



D

(i) Give the **letters** of the two hydrocarbons which are alkenes. Give the reason for your choice. [2]

.... and ....

Reason ……………………………………………………………………...

………………………………………………………………………………

(ii) Give the **letter** of the hydrocarbon which is represented by the molecular formula C_3H_6. [1]

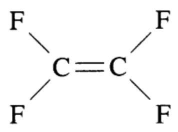
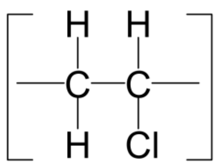
………………………………...

(iii) Give the name of hydrocarbon **B**. [1]

…………………………………

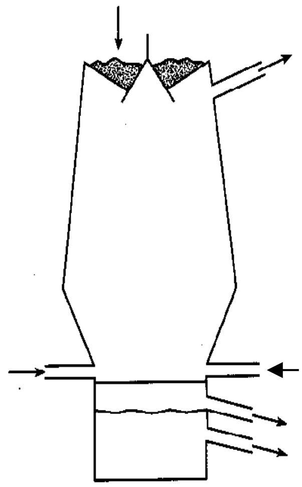
(b) An alkane contains two carbon atoms and six hydrogen atoms. Draw its structural formula. [1]

(c) The table below shows some information about monomers and the polymers that can be made from them.
Complete the table. [2]

Name of monomer	Structural formula of monomer	Name of polymer	Repeating unit for the polymer
tetrafluoroethene		polytetrafluoroethene PTFE	....
vinylchloride (chloroethene)	....	polyvinylchloride PVC	

7

2. Iron is extracted from iron ore in a blast furnace.



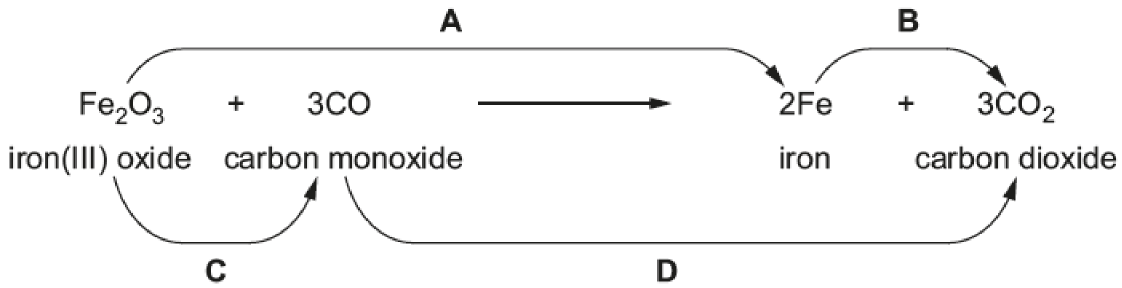
(a) Draw a line to link the raw material to its use in the blast furnace. [2]

Raw material	Use
iron ore	source of iron
limestone	acts as a fuel
coke	removes impurities

(b) Coke contains the element carbon. Carbon reacts with oxygen in the air forming carbon dioxide.
Write a **symbol** equation for this reaction. [1]

………………………. + ………………………. ⟶ ……………………….

(c) The equation below shows the formation of iron in the blast furnace.



Give the **letter** of the arrow which shows **reduction** taking place. Give a reason for your choice. [2]

…………………………………………………………………………………………………..

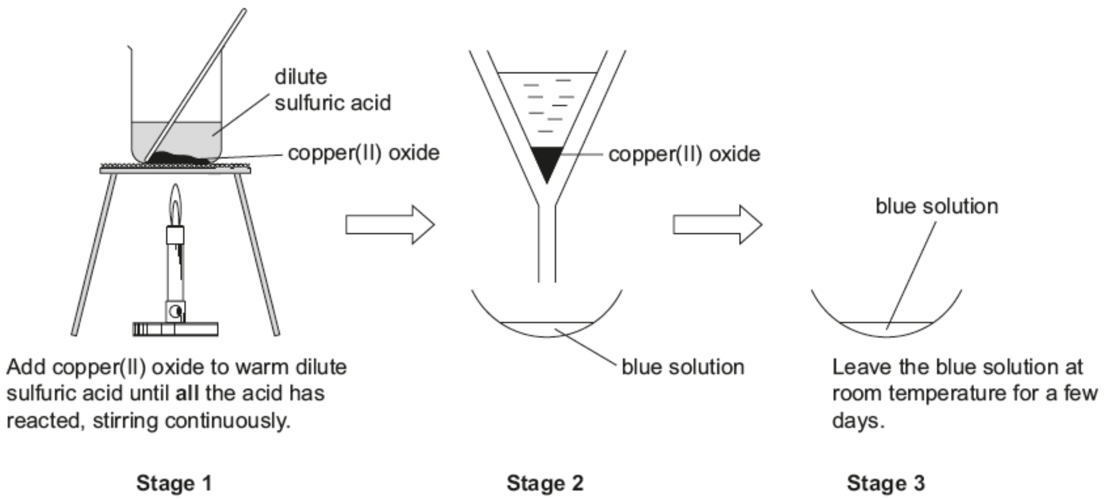
…………………………………………………………………………………………………..

(d) The maximum mass of iron that can be obtained from 1 tonne of iron oxide is 0.7 tonnes. In the actual reaction, only 0.65 tonnes of iron is made. Calculate the percentage yield of iron in the reaction. [2]

Percentage yield = ……………… %

7

3. The diagrams below show the three stages a pupil follows to make copper(II) sulfate crystals.



(a) State what the pupil will **see** when **all** the acid has reacted in stage 1. [1]

....

(b) Name the process in stage 2. Give the reason why it is necessary. [2]

....

....

(c) Complete the symbol equation for this reaction. [2]

$$CuO + H_2SO_4 \longrightarrow \text{.......................} + \text{.......................}$$

(d) If hydrochloric acid were used instead of sulfuric acid, give the name and chemical formula for the salt formed. [2]

Name ……………..……………………………………………………………….

Chemical formula ………………………………………………………..…….

7

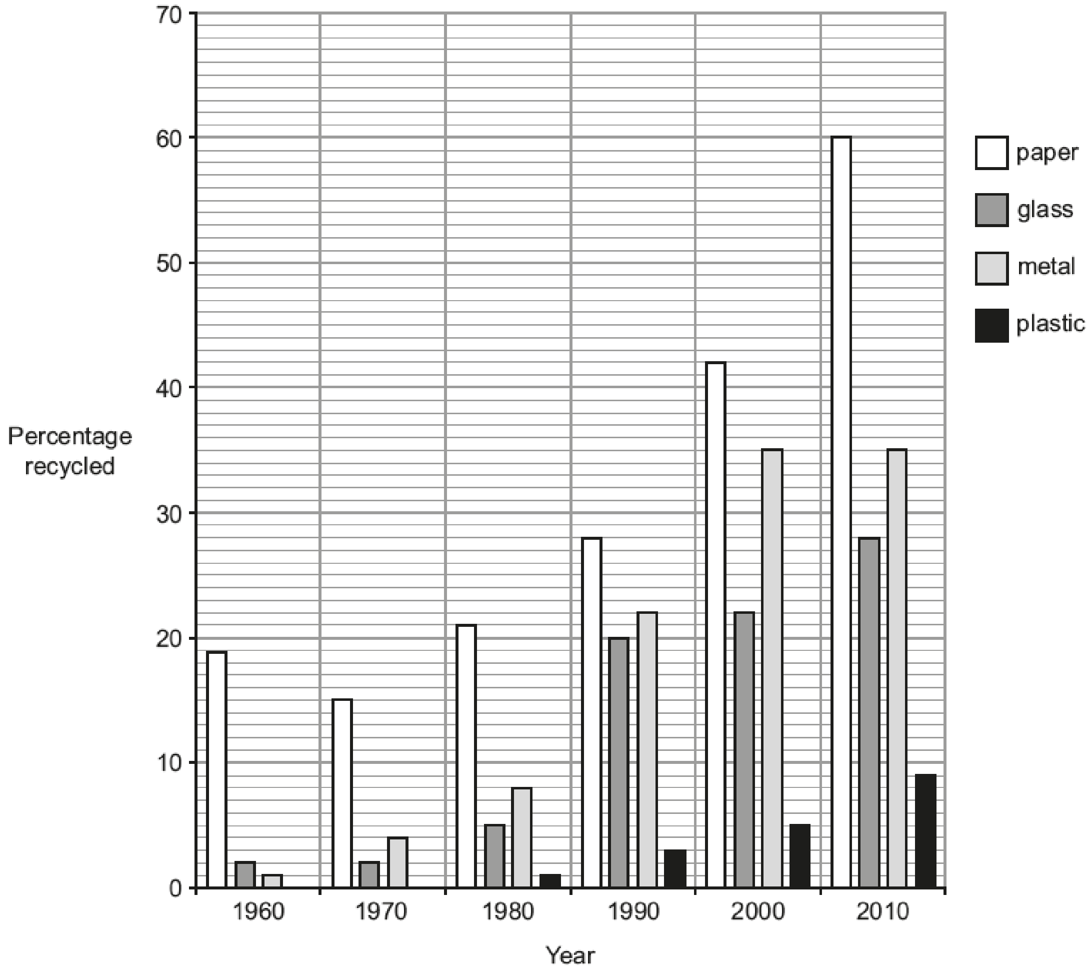
4. Plastic bottles can be found as litter almost anywhere on Earth.

(a) State **one** advantage of recycling plastic bottles. [1]

....

....

(b) **Graph 1** shows how the percentage of common materials recycled changed between 1960 and 2010.



Graph 1

(i) Use the graph to find the **increase** in percentage of each material recycled between 1980 and 2010. List the materials in order from the one with the greatest increase to the one with the smallest increase.

Greatest increase ……………………… [2]

………………………

………………………

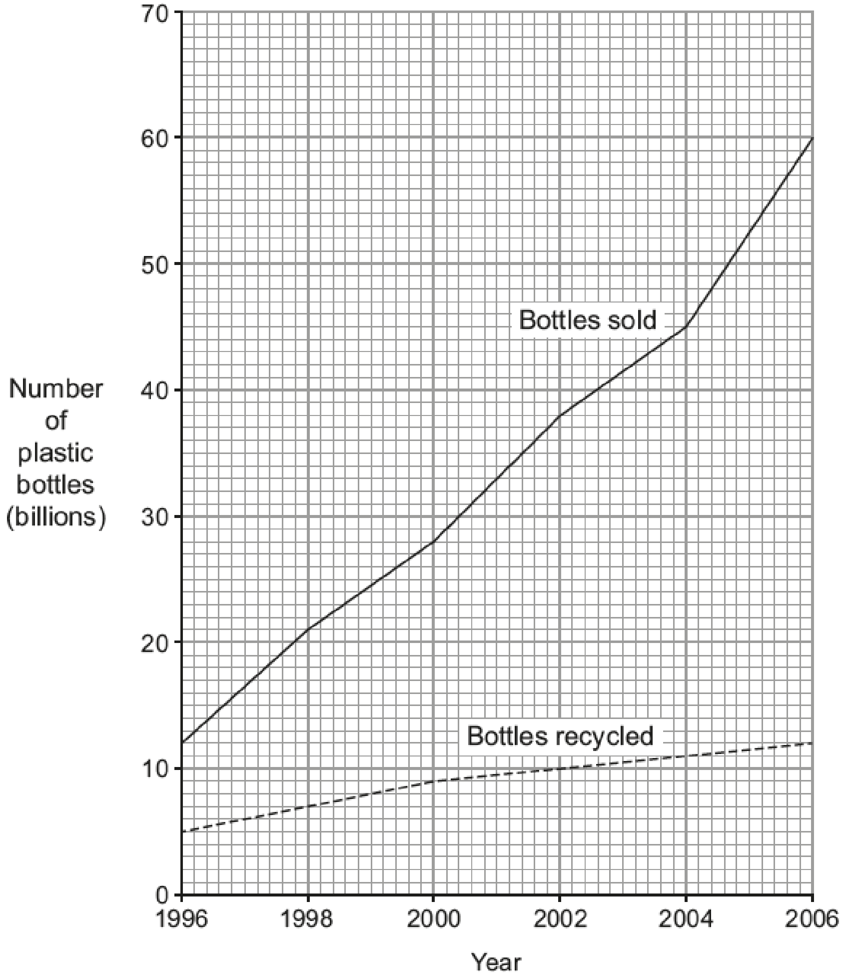
Smallest increase ………………………

(ii) Describe how the percentage of plastic recycled **changed** between 1960 and 2010. [2]

....

....

(c) **Graph 2** shows the number of plastic bottles produced and recycled in the USA between 1996 and 2006.



Graph 2

(i) Between 1996 and 2006 the number of plastic bottles recycled increased. Using the graph, explain why this increase has had little effect on the amount of plastic bottle litter. [1]

....

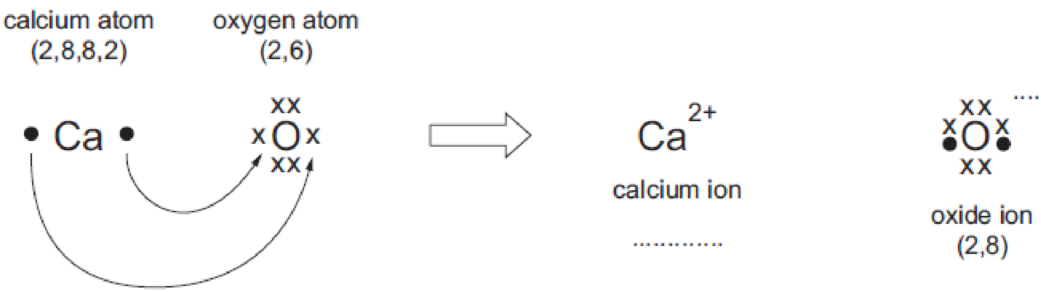
....

(ii) Calculate the number of plastic bottles **not** recycled in 2006. [2]

Number not recycled = ...

8

5. (a) The diagram shows the electronic changes that occur when calcium reacts with oxygen to form calcium oxide. The • and x symbols represent outer shell electrons.



(i) Complete the diagram by adding the charge on the oxide ion **and** the electronic structure of the calcium ion. [1]

(ii) Write the chemical formula of calcium oxide. [1]

....

(b) Calcium oxide has a giant ionic structure. It has a high melting point, is soluble in water and conducts electricity when molten.

Select the substance from the following table that is most likely to have a giant covalent structure. Explain your choice. [2]

Substance	Melting point (°C)	Solubility in water	Conductivity when molten
W	–70	soluble	poor
X	650	insoluble	good
Y	1050	soluble	good
Z	1600	insoluble	poor

…………………………………………………………………………………………………..

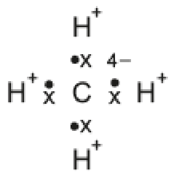
…………………………………………………………………………………………………..

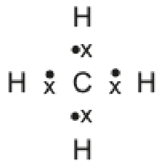
…………………………………………………………………………………………………..

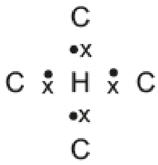
(c) Methane contains carbon and hydrogen atoms.

Element	Electronic structure
carbon	2,4
hydrogen	1

Put a tick (✓) in the box which represents the bonding in a methane molecule.
[1]







5

6. When hydrogen, H_2, burns in air, water is formed.

$$\begin{matrix} \mathrm{H{-}H} & & & & \mathrm{H{-}O{-}H} \\ & + & \mathrm{O{=}O} & \longrightarrow & \\ \mathrm{H{-}H} & & & & \mathrm{H{-}O{-}H} \end{matrix}$$

The bond energies relevant to the reaction are shown in the table.

Bond	**Bond energy (kJ)**
H—H	436
O=O	498
O—H	464

(a) (i) Calculate the energy needed to break **all** the bonds in the **reactants**. [2]

Energy needed = ………………….kJ

(ii) Calculate the energy released when **all** the bonds in the **product** are formed. [2]

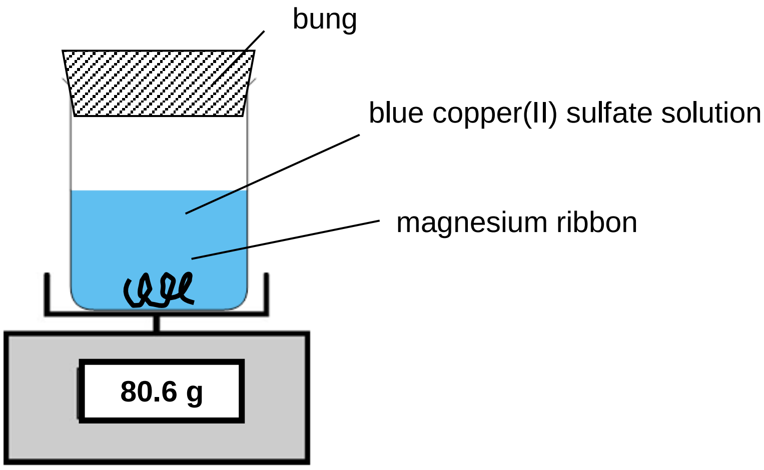
Energy released = ………………….kJ

(b) Use your answers from part (a) to calculate the overall energy change. [1]

Energy change = ………………….kJ

5

7. A student investigated what happened when a piece of magnesium ribbon was added to copper(II) sulfate solution. The diagram below shows the apparatus she set up. She left the apparatus for 1 hour.



At the start

Describe **all** the observations the student would make when she returned after 1 hour. Explain these observations. [6 QER]

....

....

....

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....

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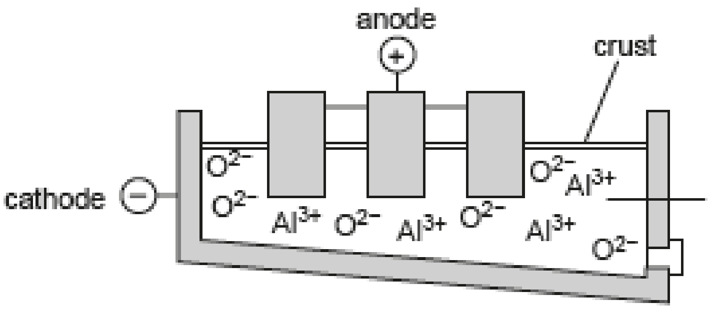
....

6

8. (a) Aluminium is obtained by the electrolysis of molten aluminium oxide.



(i) The electrode equation for the formation of aluminium is as shown below.

$$Al^{3+} \;+\; 3e^{-} \longrightarrow Al$$

State at which electrode aluminium is formed. Give a reason for your answer. [2]

…………………………………………………………………………………………

…………………………………………………………………………………………

(ii) Write a balanced symbol equation for the overall reaction taking place. [3]

………………….. $\longrightarrow$ ………………….. + ………………………..

(iii) Explain how the extraction of aluminium may contribute to global warming. [2]

…………………………………………………………………………………………

…………………………………………………………………………………………

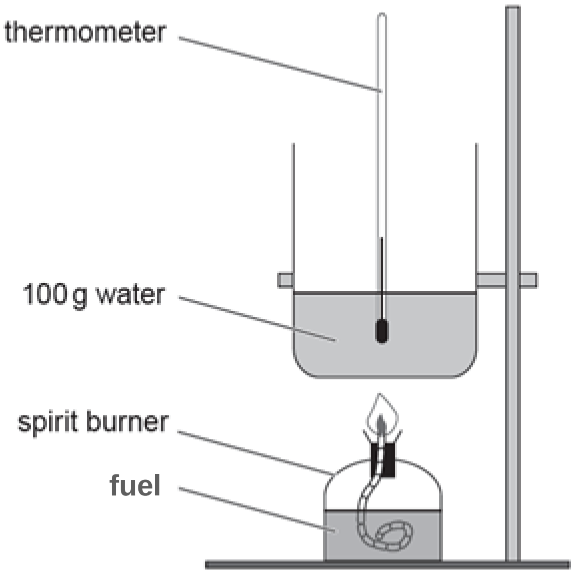
(b) Aluminium is a good electrical conductor and is therefore used to make overhead power cables.

Give a **different** property of aluminium and **one** use which relies on this property. [1]

…………………………………………………………………………………………......

8

9. Methanol, ethanol, propanol and butanol can be used as fuels. An experiment was carried out to find out which alcohol gives out the most energy when burned.
The diagram below shows the apparatus used.



1 g of each fuel was used to heat 100 g of water. The results are shown below.

Fuel	Initial temperature of water (°C)	Final temperature of water (°C)	Temperature change (°C)	Energy given out (J/g)
methanol	18	31	13	5460
ethanol	20	45	25	10 500
propanol	19	48	29	12 180
butanol	20	50	30	

(a) The energy given out by each fuel can be calculated using the formula:

energy given out = mass of water × 4.2 × temperature change

Use this formula to calculate the energy given out per gram of butanol burned. [2]

Energy given out = …………………..J/g

(b) Apart from using 1 g of each fuel and 100 g of water, give **two** *other* ways the experiment could be made a fair test. [2]

1. ……………………………………………………………………………………

……………………………………………………………………………………………

2. ……………………………………………………………………………………

……………………………………………………………………………………………

(c) The theoretical values for the energy given out by each alcohol are given in the table below.

Fuel	**Theoretical energy given out values (J/g)**
methanol	22 700
ethanol	29 700
propanol	33 600
butanol	36 100

(i) Give **one** similarity and **one** difference between the experimental and theoretical values. [2]

Similarity ……..……………………………………………………………

……………………………………………………………………………………

Difference …………………………………………………………………

……………………………………………………………………………………

(ii) Give the **main** reason for the difference between the experimental and theoretical values. [1]

……………………………………………………………………………………………

……………………………………………………………………………………………

7

END OF PAPER

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^-
Ammonium	NH_4^+	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^-
Calcium	Ca^{2+}	Fluoride	F^-
Copper(II)	Cu^{2+}	Hydroxide	OH^-
Hydrogen	H^+	Iodide	I^-
Iron(II)	Fe^{2+}	Nitrate	NO_3^-
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^+	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^+		
Silver	Ag^+		
Sodium	Na^+		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2					Group						3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:

Mass number → A

X ← Element Symbol

Atomic number → Z

Name

UNIT 5: (Double Award) CHEMISTRY 2
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

<u>Marking rules</u>

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

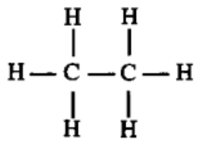
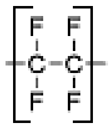
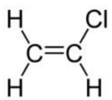
<u>Extended response question</u>

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

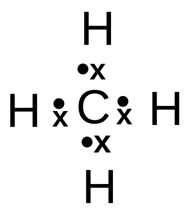
cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
1	*(a)*	(i)		**A** and **D** – both needed, either order (1) Both contain a double bond / both unsaturated (1)	2			2		
		(ii)		**D**	1			1		
		(iii)		Butane	1			1		
	(b)				1			1		
	(c)			 ignore 'n' (1)  (1)		2		2		
				Question 1 total	**5**	**2**	**0**	**7**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*			All three correct (2) Any one correct (1) iron ore source of iron limestone acts as a fuel coke removes impurities	2			2		
	(b)			$C + O_2 \rightarrow CO_2$		1		1		
	(c)			**A** (1) Oxygen removed / iron(III) oxide loses oxygen (1) Do not accept oxide lost	1	1		2		
	(d)			93 (2) Accept any number of decimal places but rounding up must be correct If answer is incorrect award (1) for 0.65/0.7 × 100		2		2	2	
				Question 2 total	**3**	**4**	**0**	**7**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*			Copper(II) oxide / black solid remains	1			1		1
	(b)			Filtration / filtering (1) Removes excess / unreacted copper(II) oxide (1)	2			2		2
	(c)			$CuSO_4$ (1) H_2O (1) Ignore any attempt at balancing	1	1		2	1	
	(d)			Copper(II) chloride (1) $CuCl_2$ (1)		2		2	1	
				Question 3 total	**4**	**3**	**0**	**7**	**2**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*			Any one of following Less litter Less waste to landfill Saves resources / crude oil New products formed more cheaply	1			1		
	(b)	(i)		Paper Metal Glass Plastic All correct (2) Any two correct (1)			2	2	2	
		(ii)		None recycled prior to 1980 (1) Gradual increase since 1980 (1)			2	2	2	
	(c)	(i)		Any one of following A lot more plastic bottles sold than recycled Number of plastic bottles sold has increased at a faster rate			1	1		
		(ii)		48 billion (2) If answer incorrect award (1) for 60 – 12		2		2	2	
				Question 4 total	**1**	**2**	**5**	**8**	**6**	**0**

Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
5	*(a)*	(i)		Oxide ion has a charge of 2– Calcium ion has the electronic structure 2,8,8 **Both** needed	1			1		
		(ii)		CaO Accept $Ca^{2+}O^{2-}$		1		1		
	(b)			Substance **Z** (1) Because it has a **high** melting point **and** does not conduct electricity when molten (1) Do not award second mark if 1600 °C given without reference to this being a high temperature			2	2		
	(c)				1			1		
				Question 5 total	**2**	**1**	**2**	**5**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*	(i)		1370 (2) If answer is incorrect award (1) for indication that two H—H bonds and one O=O bond are broken		2		2	2	
		(ii)		1856 (2) If answer is incorrect award (1) for indication that four O—H bonds are broken		2		2	2	
	(b)			–486 (1) Accept 486		1		1	1	
				Question 6 total	**0**	**5**	**0**	**5**	**5**	**0**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
7				**Indicative content** Observations Magnesium disappears; solution turns paler/goes colourless; brown solid forms; mass stays constant Explanation Magnesium displaces copper ions from solution; magnesium more reactive than copper; mass conserved as no atoms leave or enter the beaker Equation **5–6 marks** At least three observations with good explanation in terms of reactivity; understanding of conservation of mass; symbol equation *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3–4 marks** At least two observations with attempt at explanation in terms of reactivity; word equation and/or use of some chemical formulae *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1–2 marks** Any correct observation; any product named *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*	4	2		6		6
				Question 7 total	**4**	**2**	**0**	**6**	**0**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	*(a)*	(i)		cathode / negative electrode (1) Al^{3+} ions attracted to opposite charge / negative charge (1) Do not accept Al for Al^{3+} Opposites attract gains no credit	2			2		
		(ii)		$2Al_2O_3 \rightarrow 4Al + 3O_2$ (3) If equation not correct award (1) for each of following Al_2O_3 on reactant side Al and O_2 on product side		3		3	2	
		(iii)		Either of following Carbon electrodes used up (1) linked to carbon dioxide emission (1) Burning coal/gas to form electricity (1) linked to carbon dioxide emission (1) No credit for carbon dioxide emission alone	2			2		
	(b)			Any of following properties **and** uses for (1) Low density … overhead power cables Good heat conductor …. saucepans Non-toxic … drinks can Corrosion resistant …. window frames No credit for use relating to aluminium as a good electrical conductor	1			1		
				Question 8 total	**5**	**3**	**0**	**8**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	*(a)*			12600 (2) If answer is incorrect award (1) for 100 × 4.2 × 30		2		2	2	2
	(b)			Any two of following for (1) each Same distance between beaker/can and flame Same beaker/can used Beaker/can bottom is cleaned after each alcohol is burned Same spirit burner/ size flame/ size wick			2	2		2
	(c)	(i)		Similarity: same rank order (1) Difference: theoretical values > experimental values (1)			2	2		2
		(ii)		Heat loss to surroundings			1	1		1
				Question 9 total	**0**	**2**	**5**	**7**	**2**	**7**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	5	2	0	7	0	0
2	3	4	0	7	2	0
3	4	3	0	7	2	3
4	1	2	5	8	6	0
5	2	1	2	5	0	0
6	0	5	0	5	5	0
7	4	2	0	6	0	6
8	5	3	0	8	2	0
9	0	2	5	7	2	7
TOTAL	24	24	12	60	19	16

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 5: (Double Award) CHEMISTRY 2
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**7**	
3.	**6**	
4.	**6**	
5.	**6**	
6.	**8**	
7.	**8**	
8.	**5**	
9.	**6**	
Total	**60**	

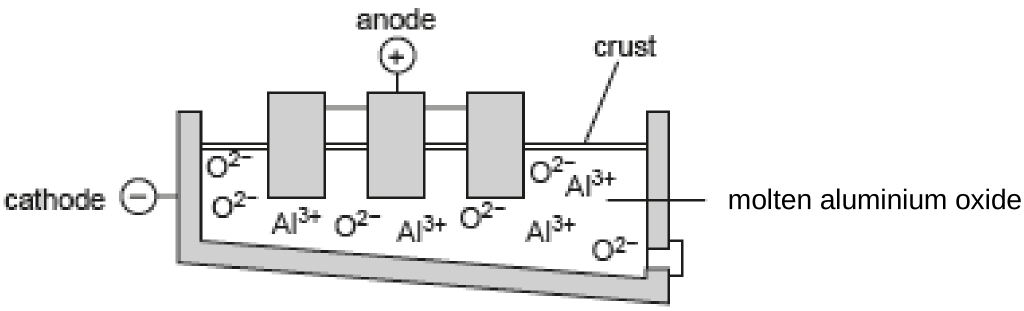
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **9** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions.*

1. (a) Aluminium is obtained by the electrolysis of molten aluminium oxide.



(i) The electrode equation for the formation of aluminium is as shown below.

$$Al^{3+} + 3e^{-} \longrightarrow Al$$

State at which electrode aluminium is formed. Give a reason for your answer. [2]

…………………………………………………………………………………….

…………………………………………………………………………………….

(ii) Write a balanced symbol equation for the overall reaction taking place. [3]

………………….. $\longrightarrow$ ………………….. + ………………………..

(iii) Explain how the extraction of aluminium may contribute to global warming. [2]

…………………………………………………………………………………………

…………………………………………………………………………………………

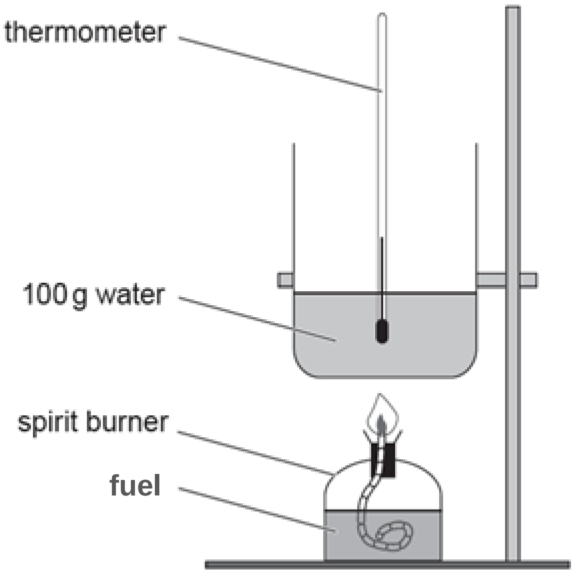
(b) Aluminium is a good electrical conductor and is therefore used to make overhead power cables.

Give a **different** property of aluminium and **one** use which relies on this property. [1]

……………………………………………………………………………………………......

8

2. Methanol, ethanol, propanol and butanol can be used as fuels. An experiment was carried out to find out which alcohol gives out the most energy when burned.
The diagram below shows the apparatus used.



1 g of each fuel was used to heat 100 g of water. The results are shown below.

Fuel	**Initial temperature of water (°C)**	**Final temperature of water (°C)**	**Temperature change (°C)**	**Energy given out (J/g)**
methanol	18	31	13	5460
ethanol	20	45	25	10 500
propanol	19	48	29	12 180
butanol	20	50	30	

(a) The energy given out by each fuel can be calculated using the formula:

energy given out = mass of water × 4.2 × temperature change

Use this formula to calculate the energy given out per gram of butanol burned. [2]

Energy given out = …………………..J/g

(b) Apart from using 1 g of each fuel and 100 g of water, give **two** *other* ways the experiment could be made a fair test. [2]

1. ……………………………………………………………………………………

……………………………………………………………………………………………

2. ……………………………………………………………………………………

……………………………………………………………………………………………

(c) The theoretical values for the energy given out by each alcohol are given in the table below.

Fuel	**Theoretical energy given out values (J/g)**
methanol	22 700
ethanol	29 700
propanol	33 600
butanol	36 100

(i) Give **one** similarity and **one** difference between the experimental and theoretical values. [2]

Similarity ……..……………………………………………………………………

……………………………………………………………………………………

Difference …………………………………………………………………………

……………………………………………………………………………………

(ii) Give the **main** reason for the difference between the experimental and theoretical values. [1]

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……………………………………………………………………………………………

7

3. Organic substances are arranged in families of compounds with similar properties.

The table below shows the first three members of two families of hydrocarbon compounds – alkanes and alkenes.

Alkanes	**Alkenes**
methane, CH_4	ethene, C_2H_4
ethane, C_2H_6	propene, C_3H_6
propane, C_3H_8	butene, C_4H_8

(a) Decane contains 10 carbon atoms. Give the molecular formula of decane. [1]

…………………………

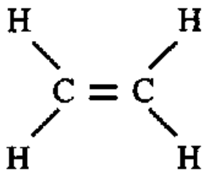
(b) Isomers are compounds which have the same molecular formula but different structural formulae.

Butene has two isomers. Draw the two isomers of butene. [2]

Isomer 1	Isomer 2

(c) Ethene can undergo addition polymerisation to make polythene.

Complete the equation for this reaction and explain what is meant by the term addition polymerisation. [3]

n  $\longrightarrow$

ethene

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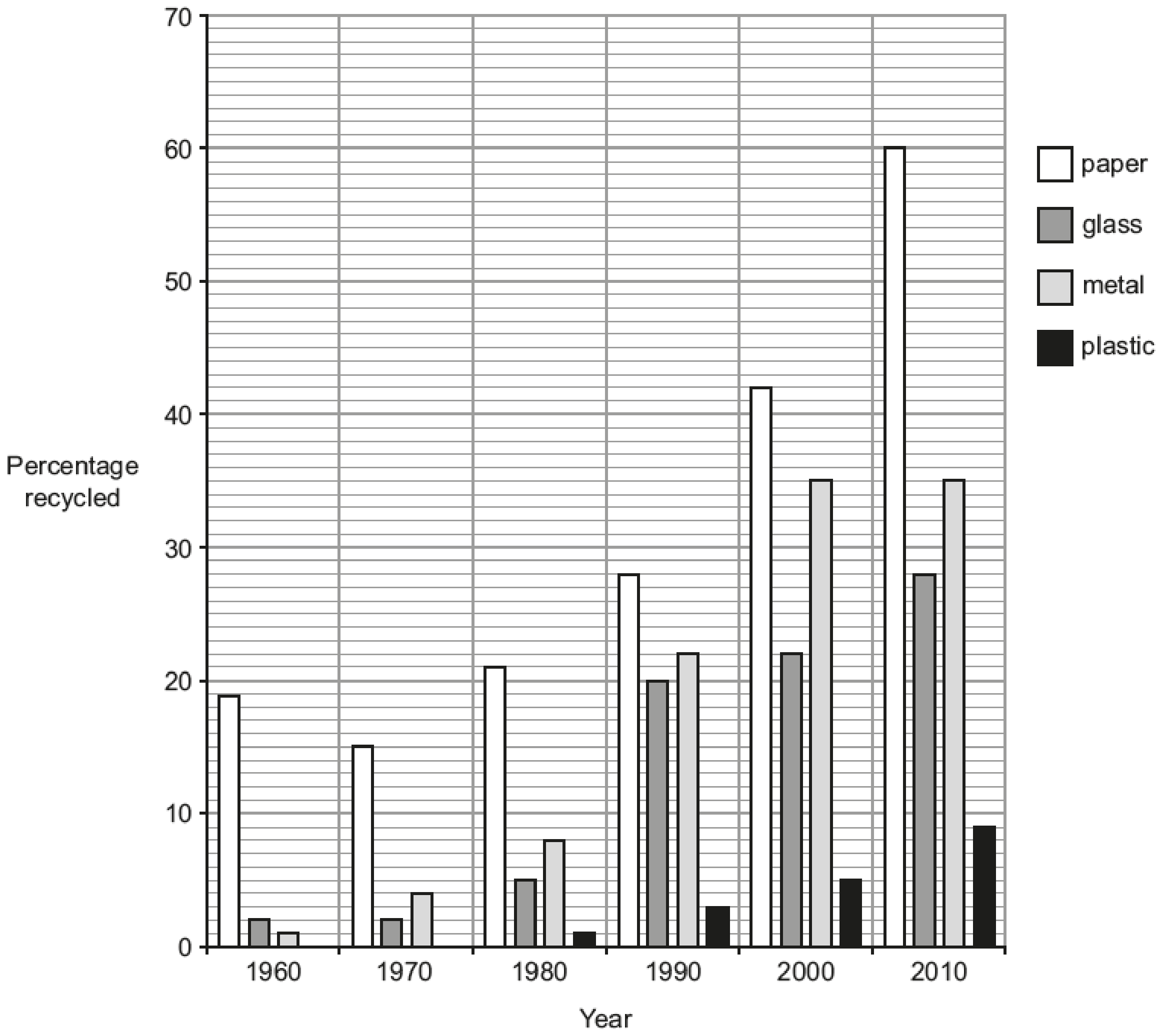
…………………………………………………………………………………………………......

…………………………………………………………………………………………………......

6

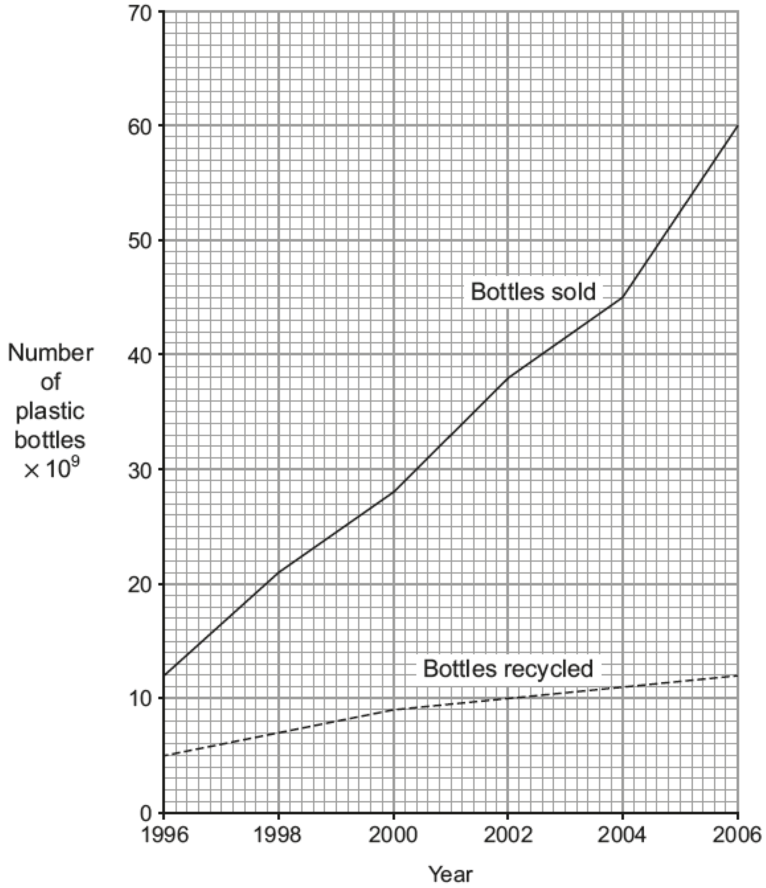
4. Plastic bottles can be found as litter almost anywhere on Earth. Plastics are cheap to produce and most drinks are now sold in plastic bottles. There is continuing discussion and debate over whether the recycling of plastic bottles is economically viable.

Graph 1 shows how the percentage of common materials recycled changed between 1960 and 2010.



Graph 1

Graph 2 shows the number of plastic bottles produced and recycled between 1996 and 2006.



Graph 2

(a) Determine which of paper and plastic has the greater percentage increase in recycling between 2000 and 2010. Show your working. [2]

…………………………………………………………………………………………………......

(b) Calculate the total number of un-recycled plastic bottles between 2004 and 2006, estimating a value for the number in 2005. [2]

Number of un-recycled plastic bottles = ……………………

(c) Discuss why recycling plastic bottles does not save money. [2]

…………………………………………………………………………………………………......

…………………………………………………………………………………………………......

6

5. (a) Describe how you would prepare a sample of dry copper(II) sulfate crystals from sulfuric acid. Explain each stage of your procedure. [4]

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(b) Write a balanced **symbol** equation for your chosen reaction. [2]

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6

6. Tetrachloromethane and calcium chloride contain different types of bonding.

Element	Electronic structure
carbon	(2.4)
calcium	(2.8.8.2)
chlorine	(2.8.7)

(a) (i) Explain the bonding in calcium chloride using dot and cross diagrams. [2]

(ii) State and explain **two** expected properties of calcium chloride which supports the presence of ionic bonding. [4]

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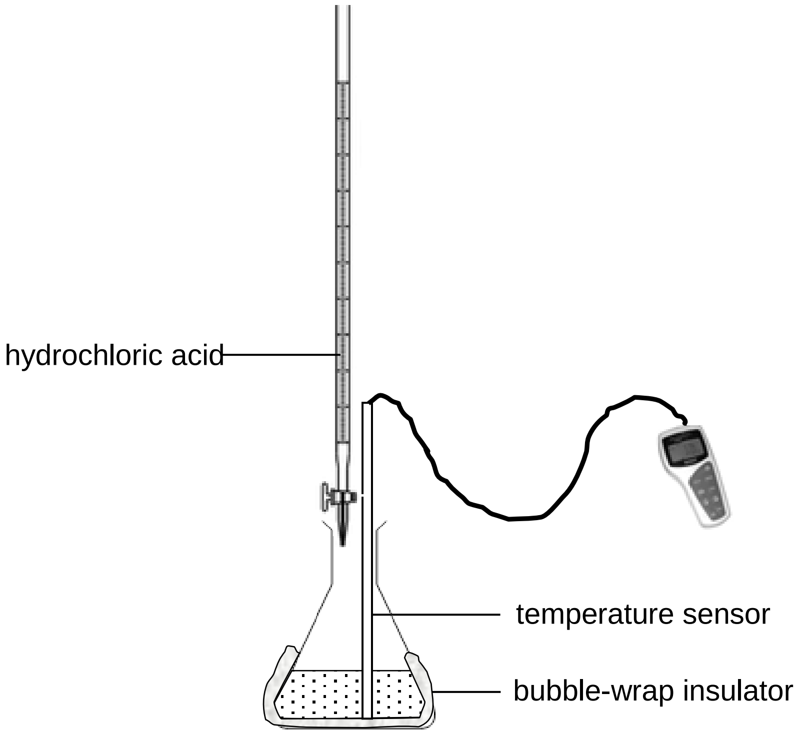
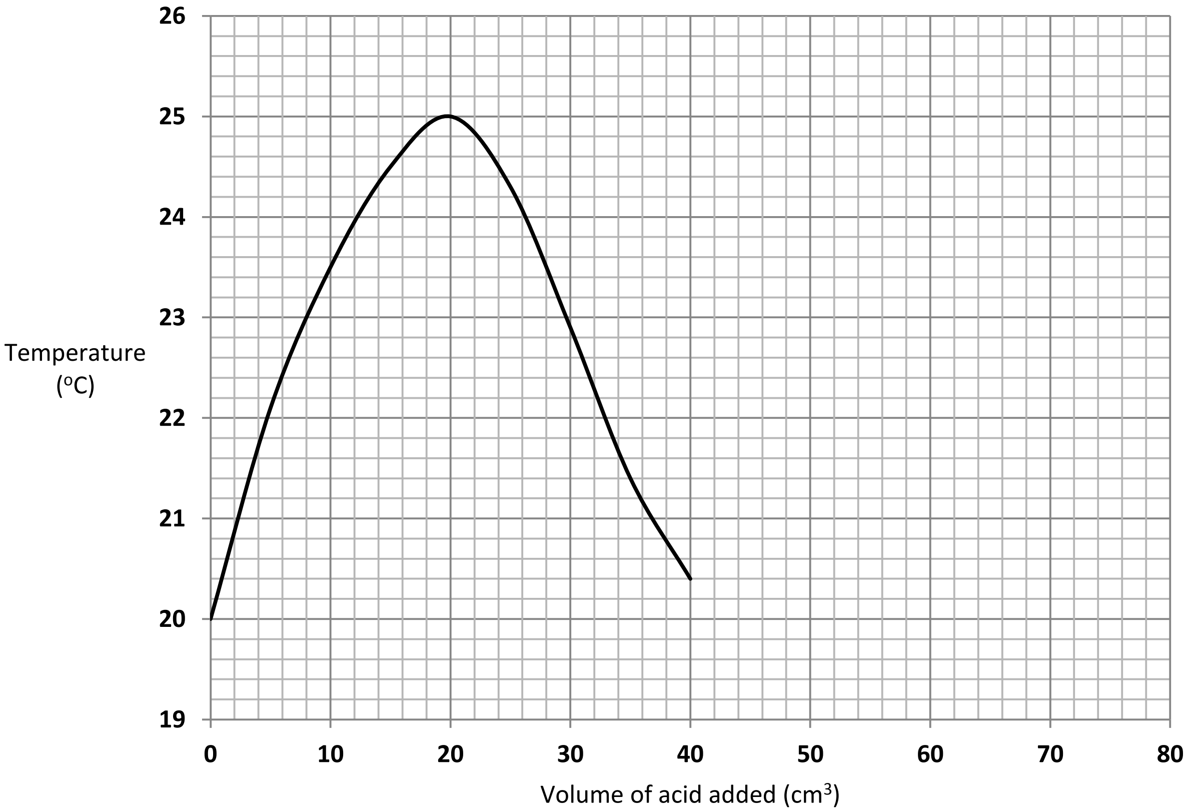
(b) Show the bonding in tetrachloromethane using a dot and cross diagram. [2]

8

7. 25 cm^3 of sodium hydroxide solution was added to a bubble-wrap insulated conical flask. 40 cm^3 of dilute hydrochloric acid were added 5 cm^3 at a time and the temperature was recorded using a temperature sensor.



The following graph shows the temperature change observed as the acid was added.



(a) If the experiment were repeated with all 20 cm^3 of acid added at once, how would you expect the maximum temperature recorded to be different? Explain your answer. [2]

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…………………………………………………………………………………………………......

(b) Sketch the graph you would expect if the experiment were repeated using hydrochloric acid of **half** the original concentration. Explain the differences between your sketch and the original graph. [4]

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(c) The equation for this reaction is

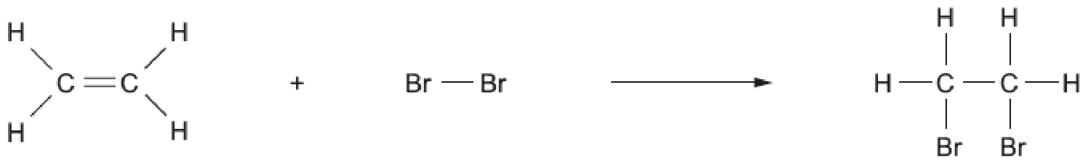
$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Write the **ionic** equation that summarises the reaction between any acid and alkali. Include state symbols. [2]

…………………………………….. $\longrightarrow$ ……………………………….

8

8. The equation below shows the reaction between ethene and bromine.



The bond energies relevant to the reaction are shown in the table.

Bond	Bond energy (kJ)
Br—Br	193
C—H	413
C—Br	276

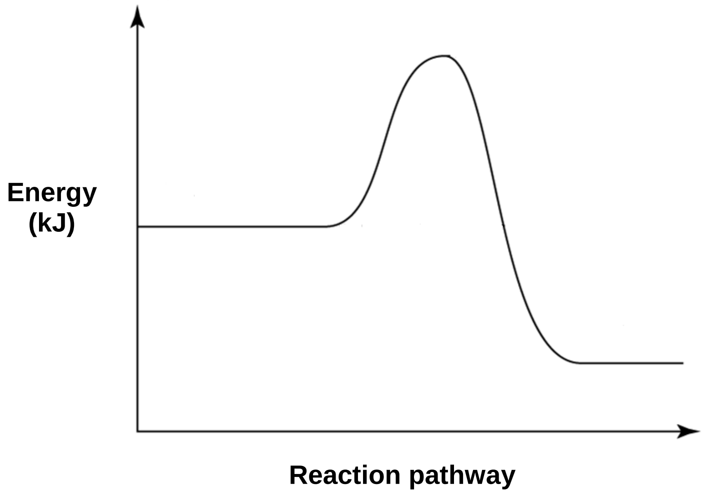
(a) The **total** energy needed to break the bonds in the reactants is 2459 kJ. Calculate the energy needed to break a C=C bond. [2]

Energy needed = ………………… kJ

(b) The **total** energy released when bonds in the products are formed is 2551 kJ. Calculate the energy released in forming a C—C bond. [2]

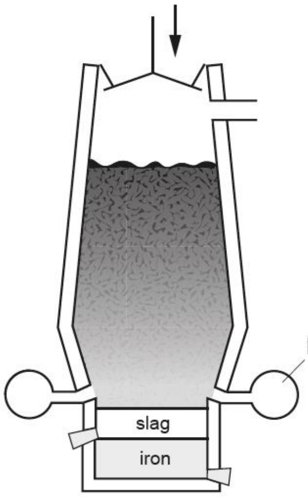
Energy released = …………………kJ

(c) On the reaction profile below use arrows (↕) to show the activation energy and the overall energy change. Label the activation energy, **A**, and the overall energy change, **B**. [1]



5

9. The diagram below shows the blast furnace used to extract iron from its ore in plants such as that in Port Talbot.



Explain, using chemical equations, the industrial extraction of iron. [6 QER]

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6

END OF PAPER

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^-
Ammonium	NH_4^+	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^-
Calcium	Ca^{2+}	Fluoride	F^-
Copper(II)	Cu^{2+}	Hydroxide	OH^-
Hydrogen	H^+	Iodide	I^-
Iron(II)	Fe^{2+}	Nitrate	NO_3^-
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^+	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^+		
Silver	Ag^+		
Sodium	Na^+		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2					Group						3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:

Mass number → A

X ← Element Symbol

Atomic number → Z

Name

UNIT 5: (Double Award) CHEMISTRY 2
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

<u>Marking rules</u>

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

<u>Extended response question</u>
A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

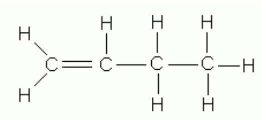
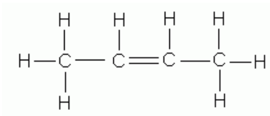
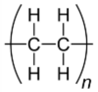
Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

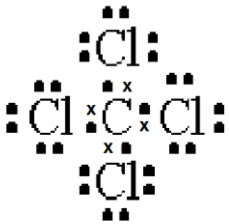
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	*(a)*	(i)		cathode / negative electrode (1) Al^{3+} ions attracted to opposite charge / negative charge (1) Do not accept Al for Al^{3+} Opposites attract gains no credit	2			2		
		(ii)		$2Al_2O_3 \rightarrow 4Al + 3O_2$ (3) If equation not correct award (1) for each of following Al_2O_3 on reactant side Al and O_2 on product side		3		3	2	
		(iii)		Either of following Carbon electrodes used up (1) linked to carbon dioxide emission (1) Burning coal/gas to form electricity (1) linked to carbon dioxide emission (1) No credit for carbon dioxide emission alone	2			2		
	(b)			Any of following properties **and** uses for (1) Low density … overhead power cables Good heat conductor …. saucepans Non-toxic … drinks can Corrosion resistant …. window frames No credit for use relating to aluminium as a good electrical conductor	1			1		
				Question 1 total	**5**	**3**	**0**	**8**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*			12600 (2) If answer is incorrect award (1) for 100 × 4.2 × 30		2		2	2	2
	(b)			Any two of following for (1) each Same distance between beaker/can and flame Same beaker/can used Beaker/can bottom is cleaned after each alcohol is burned Same spirit burner/ size flame/ size wick			2	2		2
	(c)	(i)		Similarity: same rank order (1) Difference: theoretical values > experimental values (1)			2	2		2
		(ii)		Heat loss to surroundings			1	1		1
				Question 2 total	**0**	**2**	**5**	**7**	**2**	**7**

Question				**Marking details**	**Marks Available**					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
3	*(a)*			$C_{10}H_{22}$		1		1		
	(b)			 (1)  (1)		2		2		
	(c)			 (1) C=C bond opens (1) ethene molecules join together to form one polymer (1)	3			3		
				Question 3 total	**3**	**3**	**0**	**6**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*			80% increase in recycling of plastic compared with 43% increase in recycling of paper (2) If answer is incorrect award (1) for calculation of actual increase for both i.e. 42 to 60 for paper and 5 to 9 for plastic			2	2	2	
	(b)			1.23×10^{11} (2) Accept 123×10^{9} If answer is incorrect award (1) for calculation of number of un-recycled plastic bottles in any 2 of the 3 years 2006 - 48×10^{9} 2005 - 41×10^{9} 2004 - 34×10^{9}		2		2	2	
	(c)			Any **two** of following for (1) Labour / transport costs for collecting Labour / machine costs for sorting / washing Plant costs for melting Sum of costs is greater than cost of producing new plastic bottles (1)	2			2		
				Question 4 total	**2**	**2**	**2**	**6**	**4**	**0**

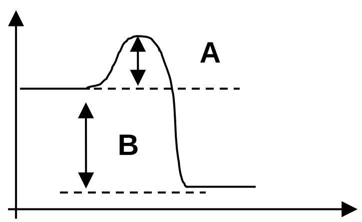
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*			Copper(II) oxide / copper(II) carbonate named as reactant (1) Add excess to neutralise / remove **all** the acid (1) Filter to remove excess solid / reagent (1) Heat to evaporate some of solution and leave to cool and crystallise **or** Concentrate solution and leave to cool and crystallise **or** Leave solution to evaporate over time and crystallise (1)	3	1		4		4
	(b)			For copper(II) oxide $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$ (2) If equation not correct award (1) for correct reactants **or** products **or** For copper(II) carbonate $CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$ (2) If equation not correct award (1) for correct reactants **or** products		2		2	1	
				Question 5 total	**3**	**3**	**0**	**6**	**1**	**4**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*	(i)		Electron transfer – calcium atom loses two outer shell electrons with one going to the outer shell of each of two chlorine atoms (1) Ion formation – one Ca^{2+} ion and two Cl^{-} ions formed showing octet around each chloride ion (1)		2		2		
		(ii)		Any two of following – property (1) and explanation (1) Soluble in water (1) ions break apart (1) High melting point/boiling point (1) large amount of energy required to overcome the strong attraction between ions (1) Conducts electricity when molten / dissolved (1) charged ions are free to move (1)	4			4		
	(b)			Shared pair of electrons between carbon and each of four chlorine atoms (1) Octet of electrons around carbon and all four chlorines (1) 		2		2		
				Question 6 total	**4**	**4**	**0**	**8**	**0**	**0**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
7	*(a)*			Higher than 25°C (1) Accept numerical value between 26-30°C Less time for heat to be lost to be lost to surroundings (1)		1	1	2		2
	(b)			Graph peak at 40 cm^3 (1) Acid of half concentration therefore twice the volume needed (1) Maximum temperature slightly below 25°C (20-24°C) (1) Same amount of heat generated by reaction but greater volume of liquid (1)			2 2	4	2	4
	(c)			$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ (2) If state symbols missing or incorrect award (1) for correct reactants **and** products	2			2		
				Question 7 total	**2**	**1**	**5**	**8**	**2**	**6**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>8</td><td>(a)</td><td></td><td></td><td>614 (2)

If answer is incorrect award (1) for indication of energy needed to break other bonds e.g. 4(413) + 193</td><td></td><td>2</td><td></td><td>2</td><td>2</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>347 (2)

If answer is incorrect award (1) for indication of energy released in forming other bonds e.g. 4(413) + 2(276)</td><td></td><td>2</td><td></td><td>2</td><td>2</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td></td><td>


Both needed for (1)</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 8 total</td><td>1</td><td>4</td><td>0</td><td>5</td><td>4</td><td>0</td></tr>
</table>

Question		Marking details	AO1	AO2	AO3	Total	Maths	Prac
			Marks Available					
9		**Indicative content** • Coke burns in hot air heating furnace and producing carbon dioxide • Coke also reacts with carbon dioxide producing carbon monoxide (reducing agent) • Carbon monoxide reduces iron(III) oxide in the iron ore to molten iron which falls to bottom of furnace • Limestone containing calcium carbonate thermally decomposes to form calcium oxide which is a base • Calcium oxide reacts with acidic impurities in the iron ore to form liquid slag which floats on top of molten iron Use of suitable formulae and equations **5–6 marks**: Description of all five steps; use of redox reaction/reduction; liquid products; minimum two chemical equations, including that of the reduction of iron(**III**) oxide *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3–4 marks**: Reference to purpose of iron ore, coke and limestone; description of reduction reaction and at least one other; at least one chemical equation *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1–2 marks**: Reference to purpose of at least two raw materials; description of at least one reaction; reasonable attempt at one chemical equation *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks**: *No attempt made or no response worthy of credit.*	4	2		6		
		Question 9 total	**4**	**2**	**0**	**6**	**0**	**0**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	5	3	0	8	2	0
2	0	2	5	7	2	7
3	3	3	0	6	0	0
4	2	2	2	6	4	0
5	3	3	0	6	1	4
6	4	4	0	8	0	0
7	2	1	5	8	2	6
8	1	4	0	5	4	0
9	4	2	0	6	0	0
TOTAL	24	24	12	60	15	17

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 6: (Double Award) PHYSICS 2
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**12**	
3.	**10**	
4.	**6**	
5.	**8**	
6.	**4**	
7.	**15**	
Total	**60**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **4** is a quality of extended response (QER) question where your writing skills will be assessed.

Equations

$\text{speed} = \dfrac{\text{distance}}{\text{time}}$	
$\text{acceleration [or deceleration]} = \dfrac{\text{change in velocity}}{\text{time}}$	$a = \dfrac{\Delta v}{t}$
acceleration = gradient of a velocity-time graph	
resultant force = mass × acceleration	$F = ma$
weight = mass × gravitational field strength	$W = mg$
work = force × distance	$W = Fd$
force = spring constant × extension	$F = kx$

SI multipliers

Prefix	**Multiplier**
m	1×10^{-3}
k	1×10^{3}
M	1×10^{6}

*Answer **all** questions*

1. (a) Select the correct words from the list below to complete the life cycle of a large mass star. [3]

white dwarf **red giant** **neutron star** **supergiant** **supernova**

Large mass main sequence star	→		→		→	

(b) Explain in terms of forces why main sequence stars are stable. [2]

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5

2. A class of students used dice to model radioactive decay. Each of 8 groups gathered data.

(a) Put the following steps from their method in order in the boxes below. [3]

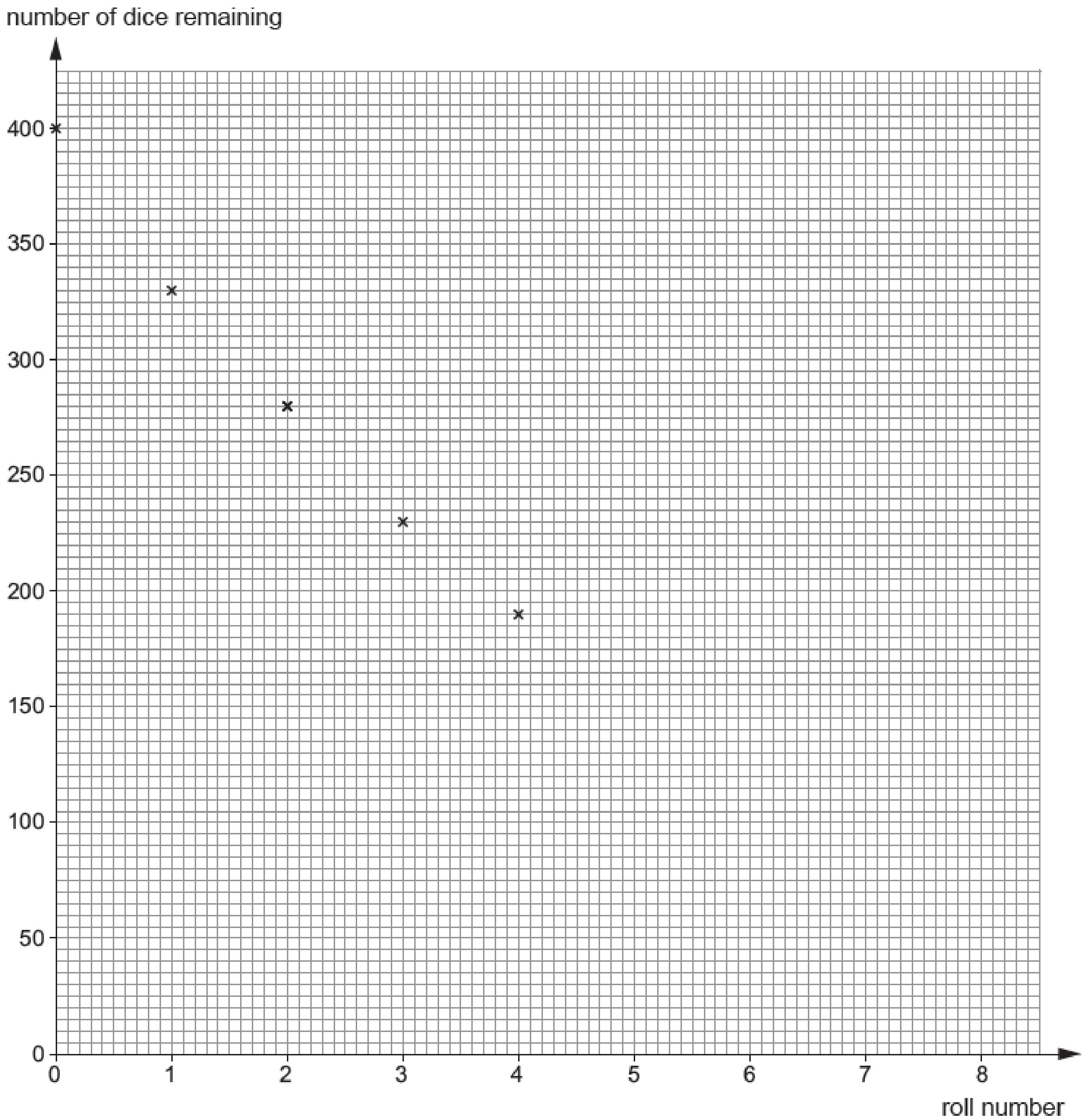
A. Each group's results were added together to give the class results.
B. Each group of students counted 50 dice.
C. The remaining dice were counted.
D. The dice were rolled.
E. Any that landed with a 6 facing upwards were removed.
F. The remaining dice were rolled again.

B			C		

The table shows the class results.

Number of rolls	Number of dice remaining
0	400
1	330
2	280
3	230
4	190
5	160
6	130
7	110
8	90

(b) The graph shows part of the data from the whole class. Plot the remaining data and draw a suitable line. [3]



(c) The half-life of a radioactive isotope is the time taken for half of the nuclei to decay. Dice can be used to model radioactive decay and half-life because dice have a certain probability of 'decay'. Different isotopes have different probabilities of decay and therefore different half-lives. The dice used in this experiment had a 1 in 6 probability of decaying on each throw.

(i) Use the graph to determine the half-life of the dice in the experiment, showing clearly the method used. [2]

half-life = ……………… rolls

(ii) The experiment was repeated with 20 sided dice. Explain how this would affect the value of the half-life. [2]

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(iii) Explain why the data from each group were added together. [2]

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12

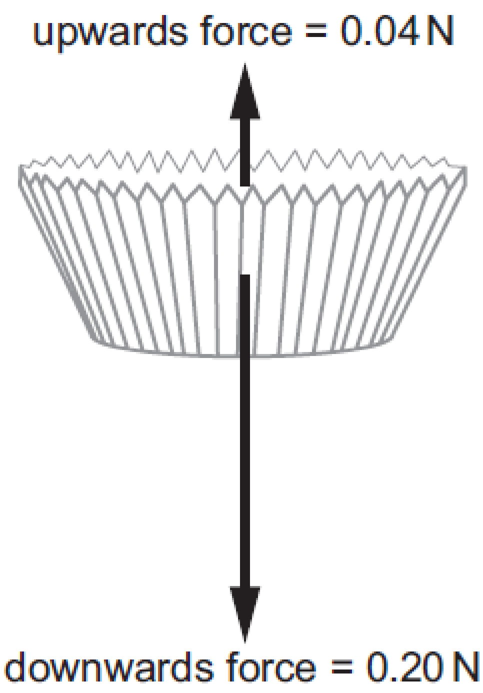
3. Read the information below and answer the questions that follow.

The physicist and mathematician Sir Isaac Newton was born in 1643. He is famous for the laws of motion which describe the effect of forces on mass. The mass of an object is a fundamental property of that body and is a measure of its inertia whereas the weight of a body is dependent on where it is in the Universe. Gravitational field strength on the Earth has a value of 10 N/kg whereas on the Moon the gravitational field strength is 1.6 N/kg.

(a) Read the following statements and tick (✓) the boxes alongside the correct statements. [2]

The weight of a body is measured in kg	☐
The mass of a body is much lower on the Moon	☐
The inertia of a body does not change on a different planet	☐
The gravitational force on a 2 kg body on the Moon is 3.2 N	☐

(b) A student investigates the motion of objects falling through the air using cake cases. She drops a stack of cake cases of mass 0.02 kg from a height of 1.5 m. The diagram shows the forces acting on the cake cases soon after they are dropped.



(i) Name the upwards force that is acting on the cake cases. [1]

....

(ii) Calculate the resultant force that is acting on the cake cases. [2]

force = ……….. N

(iii) Use the equation:

$$\text{acceleration} = \frac{\text{resultant force}}{\text{mass}}$$

to calculate the acceleration of the cake cases. [2]

acceleration = ……….. m/s^2

(c) Describe and explain how the acceleration of the cake cases changes over the next few seconds of the journey. [2]

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…………………………………………………………………………………………………..

(d) State the value of the upwards force when the cake cases travel at terminal velocity. [1]

force = …………. N

10

4. Our solar system consists of the Sun along with a variety of different objects and planets. Name these and describe some of their features and their relative positions.

[6 QER]

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6

5. Read the information below then answer the questions that follow:

Dimitri Mendeleev predicted the existence of an element with atomic number 43 in 1871. Element 43, now known as technetium, was actually discovered in 1937. The name technetium comes from the Greek word 'technetos' meaning artificial, since technetium is a man-made isotope. One form of an isotope of technetium is $^{99}_{43}\mathrm{Tc}$ which is used in nuclear medicine as a tracer. It has a half-life of 6 hours. A patient is injected with the isotope and when a technetium-99 nucleus decays it emits gamma radiation which is easily detected outside the body. This technique is used to tell us about the function of parts of the body such as the heart, liver and lungs.

(a) Read the following statements and tick (✓) the box alongside the 2 correct statements. [2]

There are 99 neutrons in a nucleus of technetium-99 ☐

There are 43 protons in nucleus of technetium-99 ☐

There are 43 neutrons in nucleus of technetium-99 ☐

Technetium-99 is not found in the earth's crust ☐

Technetium was discovered by Mendeleev ☐

(b) State why a nucleus of technetium is unstable. [1]

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

(c) Technetium-99 decays by gamma emission. Complete the table below. [2]

Radiation	**Nature**
Alpha	....
Beta	Fast moving electron
Gamma	………………………

(d) Technetium-99 has a half-life of 6 hours and it is the most widely used radio-isotope in the world for medical procedures. Explain why technetium-99 is used as a tracer. [3]

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8

6. (a) When a box is lifted and placed on a shelf 0.5 m off the ground 20 J of work is done on it. Use the equation:

$$\text{force} = \frac{\text{work done}}{\text{distance}}$$

to calculate the force used to lift the box. [2]

force = ……………….. N

(b) When work is done on the box energy is transferred to it. What type of energy does the box store when it is on the shelf? [1]

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

(c) What happens to this energy if the box is knocked off the shelf? [1]

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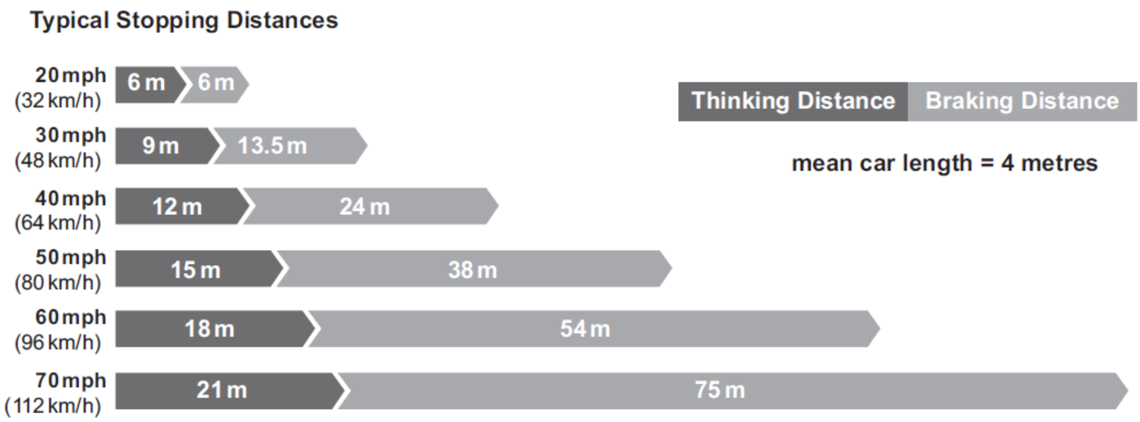
4

7. Read the information below then answer the questions that follow.

Speed is a critical factor in all road traffic accidents (RTA). Driving is unpredictable and if something unexpected happens on the road ahead – such as a child stepping out from between parked cars – it is a driver's speed that will determine whether they can stop in time, and if they can't stop - the size of the impact force.

Hence reducing and managing traffic speeds is crucial to road safety. It has been estimated that for every 1 mph reduction in mean speeds, RTA rates fall by an average of 5%. Breaking the speed limit or travelling too fast for the road conditions is recorded as a contributory factor in more than one in four (28%) serious RTAs in the UK. Research has found that British drivers who regularly exceed the speed limit are nearly twice as likely to have been involved in a RTA.

Stopping distances include the distance travelled while the driver notices a hazard and applies the brakes (thinking distance), and while the vehicle comes to a full stop from its initial speed (braking distance). Typical minimum stopping distances for cars are shown below.



Source: Department for Transport, 2007

Technology such as anti-lock brakes and stability control are designed to enable greater control over the vehicle, not shorten stopping distances. There may be a very small reduction in braking distance with modern technology, but not enough to significantly affect overall stopping distance. Technology such as air bags is designed to reduce the harm to passengers in the event of a RTA. Whatever technology a vehicle has, the basic fact remains that the bigger the speed, the longer the stopping distance, and the less chance of stopping in time in an emergency.

Adapted from: http://www.brake.org.uk/news/15-facts-a-resources/facts/1255-speed

(a) Read the following statements and tick (✓) the boxes next to the correct statements. [2]

A speed limit of 30 mph indicates that it is **always** safe to travel at 30 mph in that area ☐

Cars always have a braking distance of 24 m at 40 mph ☐

Travelling twice as fast always doubles the thinking distance ☐

The typical minimum overall stopping distance at 50 mph is 53 m ☐

(b) Explain in practice why actual stopping distances may differ from the minimum distances shown on the diagram. [3]

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(c) Describe the relationship between speed and braking distance shown in the diagram. [2]

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…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

(d) Using the patterns shown in the data, calculate the overall stopping distance at 80 mph. [3]

stopping distance = …………………. m

(e) (i) The text suggests that air bags reduce the harm to passengers in the event of an accident. Explain how they do this. [2]

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

(ii) Name another safety feature of cars other than air bags. [1]

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(f) The text states that: "It has been estimated that for every 1 mph reduction in mean speed, crash rates fall by an average of 5%." Suggest measures that are taken to encourage people to drive more slowly. [2]

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15

UNIT 6: (Double Award) PHYSICS 2
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Red super giant – supernova – neutron star (3) 1 mark for each correctly placed	3			3		
	(b)			Star is stable because forces are balanced (1) gravitational force balanced by gas and radiation pressure (1)	2			2		
				Question 1 total	**5**	**0**	**0**	**5**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
2	(a)			D E F A 3 or 4 correct (3) 2 correct (2) 1 correct (1)	3			3		3
	(b)			All 4 points correctly plotted within ± ½ small square division (2) 3 points correctly plotted within ± ½ small square division (1) 0-2 points correctly plotted within ± ½ small square division (0) Smooth curve of best fit within ± ½ small square division of all points (1) Don't accept thick, double, whispy lines		3		3	3	3
	(c)	(i)		Method clear (1) Half-life correct from graph to 1 d.p. (1)		2		2	2	2
		(ii)		Longer half-life (1) As lower probability of decay (1)		2		2		2
		(iii)		To increase sample size (1) to reduce effect of anomalies / to smooth out fluctuations in data (1)			2	2		2
				Question 2 total	**3**	**7**	**2**	**12**	**5**	**12**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Bottom 2 boxes ticked (2) -1 for each additional box ticked		2		2	1	
	(b)	(i)		Air resistance	1			1		
		(ii)		0.20 – 0.04 (1) = 0.16 [N] (1)		2		2	2	
		(iii)		Substitution: $\frac{0.16}{0.02}$ **ecf** (1) = 8 [m/s^2] (1)	1	1		2	2	
	(c)			Acceleration decreases (1) because air resistance increases / resultant force decreases (1)		2		2		
	(d)			0.20 [N]	1			1		
				Question 3 total	**3**	**7**	**0**	**10**	**5**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			**Indicative content:** There are 8 planets in the solar system. The rocky inner planets in order from the Sun are: Mercury, Venus, Earth and Mars. The outer planets are much bigger and they are made of gas. They are, in order of distance from the Sun: Jupiter, Saturn, Uranus and Neptune. The planet furthest from the Sun is Pluto. Between Mars and Jupiter is the asteroid belt which contains rocky objects which have never formed into a planet. Some of the inner planets have a small number of moons [Earth 1, Mars 2] but the outer planets have many moons. Generally the further away from the Sun the lower the temperature of the moons and planets, and the orbit time around the Sun increases as the distance from the Sun increases. The solar system also has dwarf planets and small comets which are made of ice. **5 – 6 marks**: All parts of the solar system named. Order of planets evident. Detail of composition of planets. Detailed description of features. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks**: Most parts of the solar system named such as planets, moons, asteroids, comets, dwarf planets, with some detail given. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks**: A basic description of the solar system is given, perhaps limited to naming some planets. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure*. *The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*	6			6		
				Question 4 total	**6**	**0**	**0**	**6**	**0**	**0**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
5	(a)			2nd and 4th boxes ticked (2) -1 for each additional tick		2		2		
	(b)			There is an imbalance between the number of protons and neutrons	1			1		
	(c)			Alpha - helium nucleus (1) accept 2p and 2n Gamma – em wave (1)	2			2		
	(d)			Technetium-99 emits gamma which is very penetrating / less ionising (1) It has a short half-life so it decays quickly (1) It is easily detected / causes less harm (1)			3	3		
				Question 5 total	**3**	**2**	**3**	**8**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Substitution: $\frac{20}{0.5}$ (1) Force = 40 [N] (1)	1	1		2	2	
	(b)			[Gravitational] potential energy	1			1		
	(c)			Transferred to kinetic energy		1		1		
				Question 6 total	**2**	**2**	**0**	**4**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			3rd and 4th boxes only ticked (2) -1 for additional boxes ticked			2	2	2	
	(b)			Thinking distance is increased by factors like tiredness and alcohol (1) Braking distance is increased by wet roads / poor brakes / heavy loads (1) Hence the distances given only correspond to best possible conditions (1)			3	3		
	(c)			As speed doubles braking distance increases (1) By a factor of 4 (1)		2		2		
	(d)			24 [m] (1) 96 [m] (1) Substitution: 24 + 96 = 120 [m] (1) **ecf**	 1	1 1		3	3	
	(e)	(i)		Air bags increase the time taken to stop / increase the distance the passenger travels whilst stopping (1) reducing the force acting on passenger (1)		2		2		
		(ii)		**Any (1) from:** • Crumple zone • Side impact protection bars • Seat belt	1			1		
	(f)			**Any 2 ×(1) from:** • Use of speed bumps / speed cameras • Speed limits • Public awareness campaigns			2	2		
				Question 7 total	**2**	**6**	**7**	**15**	**5**	**0**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	5	0	0	5	0	0
2	3	7	2	12	5	12
3	3	7	0	10	5	0
4	6	0	0	6	0	0
5	3	2	3	8	0	0
6	2	2	0	4	2	0
7	2	6	7	15	5	0
TOTAL	24	24	12	60	17	12

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 6: (Double Award) PHYSICS 2
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**15**	
2.	**11**	
3.	**9**	
4.	**17**	
5.	**8**	
Total	**60**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **3(a)** is a quality of extended response (QER) question where your writing skills will be assessed.

Equations

$\text{speed} = \dfrac{\text{distance}}{\text{time}}$	
$\text{acceleration [or deceleration]} = \dfrac{\text{change in velocity}}{\text{time}}$	$a = \dfrac{\Delta v}{t}$
acceleration = gradient of a velocity-time graph	
distance travelled = area under a velocity-time graph	
resultant force = mass × acceleration	$F = ma$
weight = mass × gravitational field strength	$W = mg$
work = force × distance	$W = Fd$
$\text{kinetic energy} = \dfrac{\text{mass x velocity}^2}{2}$	$\text{KE} = \frac{1}{2}mv^2$
change in potential energy = mass × gravitational field strength × change in height	$\text{PE} = mgh$
force = spring constant × extension	$F = kx$
work done in stretching = area under a force-extension graph	$W = \frac{1}{2}Fx$

SI multipliers

Prefix	Multiplier
p	1×10^{-12}
n	1×10^{-9}
μ	1×10^{-6}
m	1×10^{-3}

Prefix	Multiplier
k	1×10^{3}
M	1×10^{6}
G	1×10^{9}
T	1×10^{12}

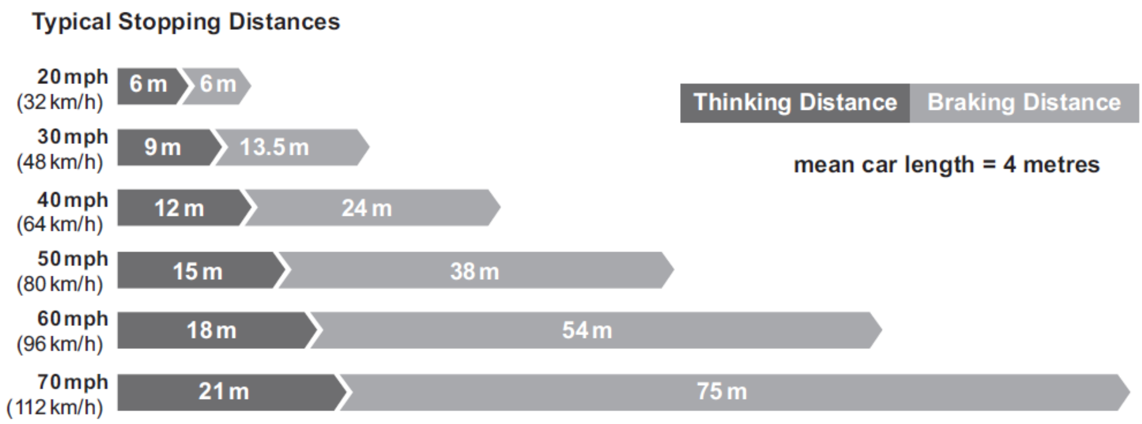
*Answer **all** questions*

1. Read the information below then answer the questions that follow.

Speed is a critical factor in all road traffic accidents (RTA). Driving is unpredictable and if something unexpected happens on the road ahead – such as a child stepping out from between parked cars – it is a driver's speed that will determine whether they can stop in time, and if they can't stop - the size of the impact force.

Hence reducing and managing traffic speeds is crucial to road safety. It has been estimated that for every 1 mph reduction in mean speeds, RTA rates fall by an average of 5%. Breaking the speed limit or travelling too fast for the road conditions is recorded as a contributory factor in more than one in four (28%) serious RTAs in the UK. Research has found that British drivers who regularly exceed the speed limit are nearly twice as likely to have been involved in a RTA.

Stopping distances include the distance travelled while the driver notices a hazard and applies the brakes (thinking distance), and while the vehicle comes to a full stop from its initial speed (braking distance). Typical minimum stopping distances for cars are shown below.



Source: Department for Transport, 2007

Technology such as anti-lock brakes and stability control are designed to enable greater control over the vehicle, not shorten stopping distances. There may be a very small reduction in braking distance with modern technology, but not enough to significantly affect overall stopping distance. Technology such as air bags is designed to reduce the harm to passengers in the event of a RTA. Whatever technology a vehicle has, the basic fact remains that the bigger the speed, the longer the stopping distance, and the less chance of stopping in time in an emergency.

Adapted from: http://www.brake.org.uk/news/15-facts-a-resources/facts/1255-speed

(a) Read the following statements and tick (✓) the boxes next to the correct statements. [2]

A speed limit of 30 mph indicates that it is **always** safe to travel at 30 mph in that area ☐

Cars always have a braking distance of 24 m at 40 mph ☐

Travelling twice as fast always doubles the thinking distance ☐

The typical minimum overall stopping distance at 50 mph is 53 m ☐

(b) Explain in practice why actual stopping distances may differ from the minimum distances shown on the diagram. [3]

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(c) Describe the relationship between speed and braking distance shown in the diagram. [2]

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

(d) Using the patterns shown in the data, calculate the overall stopping distance at 80 mph. [3]

stopping distance = …………………. m

(e) (i) The text suggests that air bags reduce the harm to passengers in the event of an accident. Explain how they do this. [2]

…………………………………………………………………………………………

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(ii) Name another safety feature of cars other than air bags. [1]

…………………………………………………………………………………………

(f) The text states that: "It has been estimated that for every 1 mph reduction in mean speed, crash rates fall by an average of 5%." Suggest measures that are taken to encourage people to drive more slowly. [2]

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15

2. A class of students used 50, 6-sided dice to model radioactive decay. Each of 8 groups gathered data which were added together to give the class results shown in the table below.

(a) Describe the method each group used to collect data. [3]

…………………………………………………………………………………………………..

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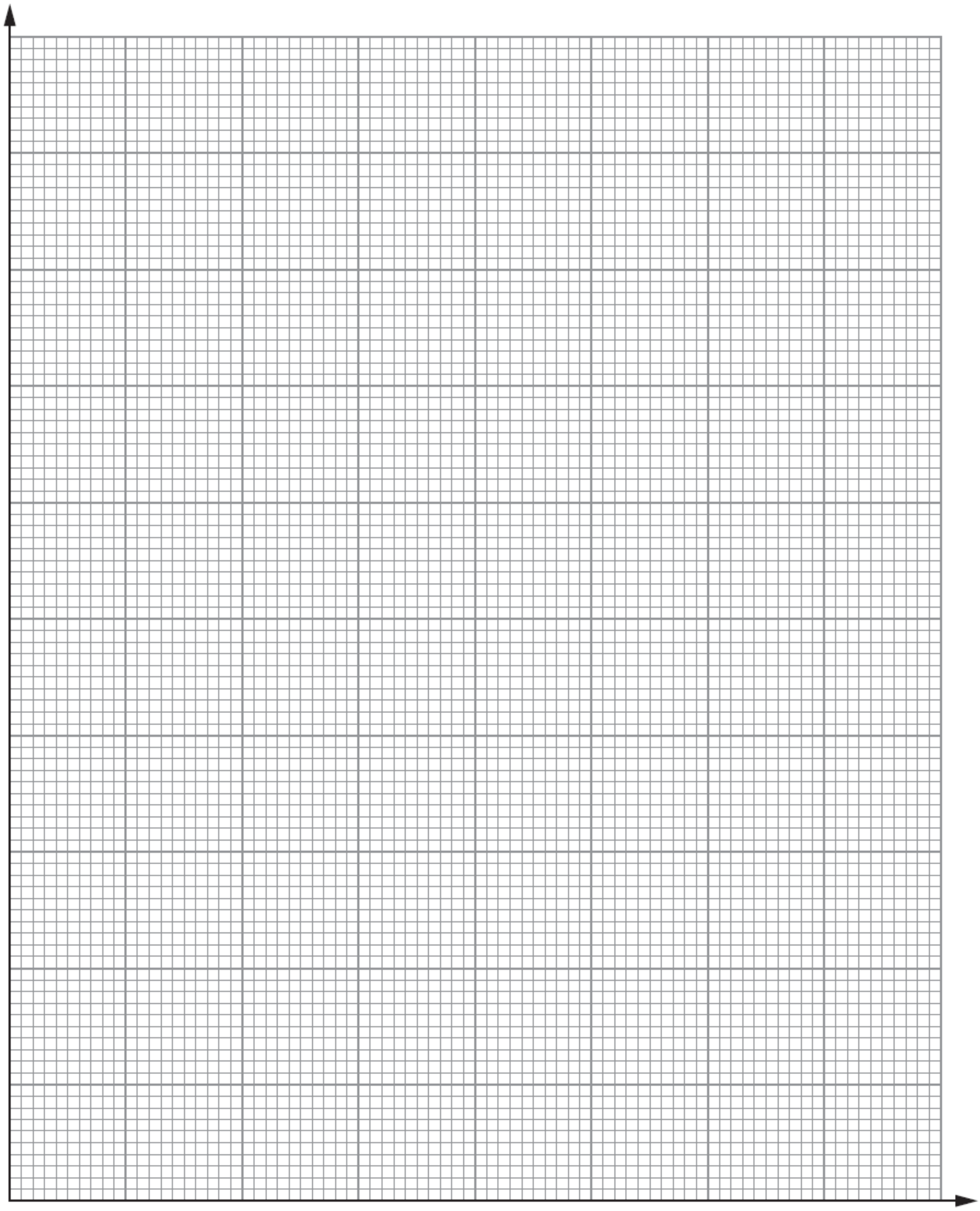
The table shows the class results.

Number of rolls	**Number of dice remaining**
0	400
1	335
2	281
3	230
4	245
5	163
6	135
7	108
8	92

(b) Plot a graph of the data on the grid below. [3]

Number of dice remaining



Number of rolls

(c) (i) The experiment is modelling the process of radioactive decay. Which important quantity relating to radioactive decay can be estimated from the graph? [1]

....

(ii) Use your graph to estimate this quantity. [2]

…………………………………………………………………………………………………

…………………………………………………………………………………………………

(d) Explain how the results would be different if 12 sided dice were used instead. [2]

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

11

3. Zeta Puppis is a main sequence blue star in the constellation of Puppis, also known by the traditional name Naos. It is the 62nd brightest star visible from the Earth and is approximately 1 090 light years away. It has a surface temperature of 42 400 ^{o}C and mass 22.5 times that of the Sun. This means that it will use up its fuel much more quickly than the Sun and move away from the main sequence.

(a) Describe and explain the remaining observable stages in the life cycle of the star Zeta Puppis. [6 QER]

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(b) Describe the formation of our solar system. [3]

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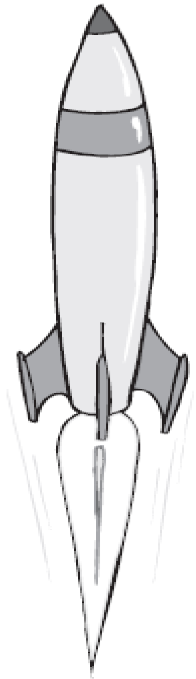
9

4. A bottle rocket contains water and air which has been pressurised. When launched the air pushes water out of the bottle.



A rocket of total mass 0.5 kg is launched vertically.
(Gravitational field strength = 10 N/kg.)

(a) (i) State Newton's third law. [2]

…………………………………………………………………………………………

…………………………………………………………………………………………

(ii) Explain how Newton's third law applies to the rocket. [2]

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

(b) At 1 m above the ground all the water has left the rocket. At this point the rocket has 5 J of potential energy and a velocity of 22 m/s. Use equations from page 2 to calculate the maximum height that could be reached by the rocket. Show your workings clearly. [5]

height = ………….. m

(c) Explain why the rocket will not actually reach the height calculated in (b). [2]

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

(d) The initial acceleration of the rocket is $4\,m/s^2$.

(i) Use Newton's second law to calculate the initial resultant force acting on the rocket. [3]

initial resultant force = ………………… N

(ii) Calculate the size of the initial thrust force. [2]

initial thrust force = ……………. N

(iii) A student suggests that the resultant force increases as the rocket gains height. Give a reason why. [1]

………………………………………………………………………………………….

………………………………………………………………………………………….

17

5. Read the information below then answer the questions that follow:

Dimitri Mendeleev predicted the existence of an element with atomic number 43 in 1871. Element 43, now known as technetium, was actually discovered in 1937. Technetium is the element in the periodic table with the lowest atomic number which has no stable isotopes. Technetium-99 is one isotope of technetium which has a half-life of 2.11×10^5 years. It decays by 'soft' beta decay – the electrons emitted are low energy electrons. Technetium-99m is a form of technetium which is used as a radioactive tracer; it decays to technetium-99 by gamma emission with a half-life of 6 hours. A patient is injected with the isotope and when a technetium-99m nucleus decays it emits gamma radiation which is easily detected outside the body. This technique is used to tell us about the function of parts of the body such as the heart, liver and lungs.

(a) (i) State the number of protons in a nucleus of technetium. [1]

…………………………………………………………………………………………

(ii) Two types of radioactive decay are mentioned in the text. Name the other type of radioactive decay and state what it is. [2]

…………………………………………………………………………………………

(iii) The initial activity of a sample of technetium-99m is 5×10^4 Bq. Calculate the activity remaining after 2.5 days. [3]

activity = ……………….. Bq

(b) The isotope of technetium with the longest half-life is technetium-98. It has a half-life of 4.2 million years. In 1952 technetium-98 was detected in red giant stars [which are billions of years old]. Explain how the discovery of technetium-98 in these stars added support to the theory that heavier elements are produced within stars. [2]

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…………………………………………………………………………………………..

…………………………………………………………………………………………..

8

UNIT 6: (Double Award) PHYSICS 2
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

<u>Marking rules</u>

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

<u>Extended response question</u>

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			3rd and 4th boxes only ticked (2) -1 for additional boxes ticked			2	2	2	
	(b)			Thinking distance is increased by factors like tiredness and alcohol (1) Braking distance is increased by wet roads / poor brakes / heavy loads (1) Hence the distances given only correspond to best possible conditions (1)			3	3		
	(c)			As speed doubles braking distance increases (1) By a factor of 4 (1)		2		2		
	(d)			24 [m] (1) 96 [m] (1) Substitution: 24 +96 = 120 [m] (1) **ecf**	 1	1 1		 3	 3	
	(e)	(i)		Air bags increase the time taken to stop / increase the distance the passenger travels whilst stopping (1) reducing the force acting on passenger (1)		2		2		
		(ii)		**Any (1) from:** • Crumple zone • Side impact protection bars • Seat belt	1			1		
	(f)			**Any 2 ×(1) from:** • Use of speed bumps / speed cameras • Speed limits • Public awareness campaigns			2	2		
				Question 1 total	**2**	**6**	**7**	**15**	**5**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Dice are rolled and all those with a certain number facing upwards are removed (1) Number of dice remaining are recorded (1) Remaining dice re-rolled a number of times (1)	3			3		3
	(b)			Suitable scales (i.e. intervals of 50 on the y-axis and intervals of 1 on the x-axis) (1) All 9 points correctly plotted within ± ½ small square division (1) Smooth curve of best fit within ± ½ small square division of all points ignoring anomaly (1) Don't accept thick, double, whispy lines		3		3	3	3
	(c)	(i)		Half-life	1			1		1
		(ii)		Correct method clear from graph (1) Answer consistent with graph to 1 d.p.(1)		2		2		2
	(d)			Longer half-life / less dice decay each time (1) Since probability of decay is lower (1)			2	2		2
				Question 2 total	**4**	**5**	**2**	**11**	**3**	**11**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
3	(a)			**Indicative content:** Initially the star is fusing hydrogen, it is stable as the forces of gravitation and radiation pressure are equal and opposite. Once hydrogen is largely exhausted helium fuses, the radiation pressure is bigger than the inward gravity forces and the star's outer layers expand and cool, the star becomes a supergiant. Fusion of increasingly heavier elements occurs in layers around the core. Once fusion stops, the star's core rapidly collapses and then explodes in a supernova, scattering material from the outer layers of the star into space. The core then contracts and cools, becoming either a neutron star or a black hole. **5 – 6 marks**: Clear description of each stage in the life cycle with reference to role of fusion and the forces acting. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3 – 4 marks**: Each stage in the life cycle is named with some references to fusion / forces at each stage. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1-2 marks**: Name of each stage in the life is given. Some stages named / detail given. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks***: No attempt made or no response worthy of credit.*	6			6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(b)			Cloud of dust and gas (1) and heavy elements ejected by supernovae (1) collapse under gravitational attraction (1)	3			3		
				Question 3 total	**9**	**0**	**0**	**9**	**0**	**0**

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
4	(a)	(i)		If a body A exerts a force on body B (1) then body B exerts an equal and opposite force on body A (1) Accept: Every action has an equal and opposite reaction (1) which act on different bodies (1)	2			2		
		(ii)		Rocket / air exerts a downwards force on the water (1) so water exerts an upward force on the rocket (1)		2		2		
	(b)			Substitution: KE = ½ × 0.5 × 22^2 (1) KE = 121 [J] (1) PE = total energy = 126 [J] (1) Substitution: 0.5 × 10 × h = 126 (1) h = 25.2 [m] (1)	1 1	 1 1 1		5	5	
	(c)			Not all KE transferred to GPE (1) Some lost as work is done against air resistance (1)		2		2		
	(d)	(i)		Use of $F = ma$ (1) F = 0.5 × 4 (1) F = 2.0 [N] (1)	1 1	 1		3	3	
		(ii)		2.0 + 5.0 (**ecf**) (1) Thrust = 7.0 [N] (1)		2		2	2	
		(iii)		Rocket mass decreases reducing weight as water is ejected			1	1		
				Question 4 total	**6**	**10**	**1**	**17**	**10**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		43	1			1		
		(ii)		Alpha decay (1) Helium nucleus (1) accept 2p + 2n	2			2		
		(iii)		2.5 days = 60 hours = 10 half-lives (1) Activity remaining = $\frac{5 \times 10^4}{2^{10}}$ (1) = 49 [Bq] (1)		3		3	3	
	(b)			Any technetium-98 initially present in the star would have all decayed (1) so it must have been made later (1)			2	2		
				Question 5 total	**3**	**3**	**2**	**8**	**3**	**0**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	6	7	15	5	0
2	4	5	2	11	3	11
3	9	0	0	9	0	0
4	6	10	1	17	10	0
5	3	3	2	8	3	0
TOTAL	24	24	12	60	21	11

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INSTRUCTIONS TO TEACHERS / EXAMS OFFICERS

Confidential

To be opened on receipt for immediate use by

TEACHERS / EXAMS OFFICERS

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

A. General Instructions

1. Each candidate will have to submit the number of tasks indicated in the table below.

Qualification	Number of tasks to be submitted
Biology	1
Chemistry	1
Physics	1
Science (Double Award)	2
Applied Science (Double Award)	2
Applied Science (Single Award)	1

The assessment will need to be completed in the first half of the spring term (i.e. January-February). Each task will be completed in two sessions each of 60 minutes duration.

Each task will have a section A and a section B. Section A and section B will be two separate question papers.

Section A will be completed in session 1 and will involve obtaining results. This will be collected from the candidates at the end of session 1. Section B will be completed in session 2 and will involve the analysis and evaluation of the results. Candidates should be given access to their section A question paper in session 2. **Section B should not be given to candidates until the second session. Both sections should be collected in at the end of session 2.**

2. The assessment should be supervised at all times by a member of staff responsible for teaching GCSE Science. Centres may use additional laboratories, provided that a subject teacher is available to supervise all groups at all times.

3. Teachers may open the **“Setting up Instructions”** document at the start of January. **This is for the purpose of ensuring that the apparatus functions well enough for the candidates to complete the task fully. Teachers are encouraged to try out the task, whilst preserving the confidentiality of the assessment.**

4. The question papers for all tasks will be made available to the examinations officer in each centre at the start of January.

5. **Section A**: It is permissible for candidates to work in small groups, of no more than three candidates. Teachers should ensure that each group has adequate working space and that the groups are set a reasonable distance apart. Each group requires uninterrupted access to the allocated apparatus – one set of apparatus per group. This is carried out under a limited level of control, i.e. learners may work with others to obtain results but they must provide their own responses to the questions set. Teacher assistance should not normally be required, but may be given if equipment failure occurs.

6. Once section A is completed, the question paper should be securely stored by the teacher until section B takes place.

7. **Section B**: This is carried out under a high level of control, i.e. learners must work individually. This section is to be completed with no teacher feedback or assistance allowed and under formal supervision. Candidates should have access to their section A question paper, as they need the results obtained in the first session to answer the questions in section B.

8. Candidates should write their answers in the spaces provided on the question paper. Should there be a need for additional space then a standard extension/answer booklet should be provided.

9. If candidates fail to obtain results for section A, it is acceptable for them to be given unformatted teacher results.

10. As soon as both section A and section B have taken place, the question papers for each candidate should be attached to each other and then securely stored by the exams officer before they are sent to the examiner by ……………… at the latest. Teachers should not be given access to the completed question papers after the actual assessments have taken place.

11. The assessment will be externally marked by a WJEC examiner. The name and address of the examiner will be issued to centres by the end of April.

12. Monitoring visits will take place on a random sample of centres to ensure the practical assessment is being administered correctly.

B. Specific Instructions

Details of the apparatus and materials required for the tasks follow.

If any difficulty is experienced in providing the apparatus, WJEC should be informed as soon as possible.

Contacts:

Subject Officer Helen Francis 029 2026 5081 helen.francis@wjec.co.uk

Support Officer Lowri Evans 029 2026 5140 lowri.evans@wjec.co.uk

INVESTIGATING THE SUGAR CONTENT OF BISCUITS

Apparatus Required

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 5 × different crushed biscuit types (2 × 2.0 g of each)
  A suggested range of biscuits could include ginger, nice, digestive, rich tea and crackers.
- 1 × stopwatch (± 0.01 s)
- 1 × 250 cm^3 beaker
- 2 × 10 cm^3 measuring cylinders/ syringes
- 5 × boiling tubes
- 10 × pieces of filter paper
- 50 cm^3 Benedict's reagent
- spatula
- CLEAPSS student safety sheet 4 – Food testing (1)
- labelling pen

The following is required for each class:

- Access to recently boiled water (kettle/ waterbath)
- Balance (± 0.1 g)

Please be aware of any candidates who may have nut allergies.

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE

Apparatus Required

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 1 × standard size polystyrene cup to fit in 250 cm^3 beaker
- 1 × 100 cm^3 measuring cylinder
- 1 × 250 cm^3 beaker
- 100 cm^3 0.5M copper sulfate
- 10 g zinc powder
- 1 × microspatula
- 1 × thermometer (-10 °C to 110 °C and resolution ± 1 °C)
- safety goggles
- CLEAPSS student safety sheet 49 - zinc and its compounds

INVESTIGATING THE EXTENSION OF A SPRING

Apparatus Required

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 1 × expendable spring (spring constant 25 $N\,m^{-1}$) prestretched prior to use
- 1 × clamp stand and boss
- 1 × 30 cm ruler (resolution ± 1 mm)
- 1 × 100 g mass hanger and 5 × slotted masses

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE SUGAR CONTENT OF BISCUITS

SETTING UP INSTRUCTIONS

Confidential

To be opened on …………………… (date) by TEACHERS

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

SECTION A

Introduction

Your task is to investigate the sugar content of different biscuits.

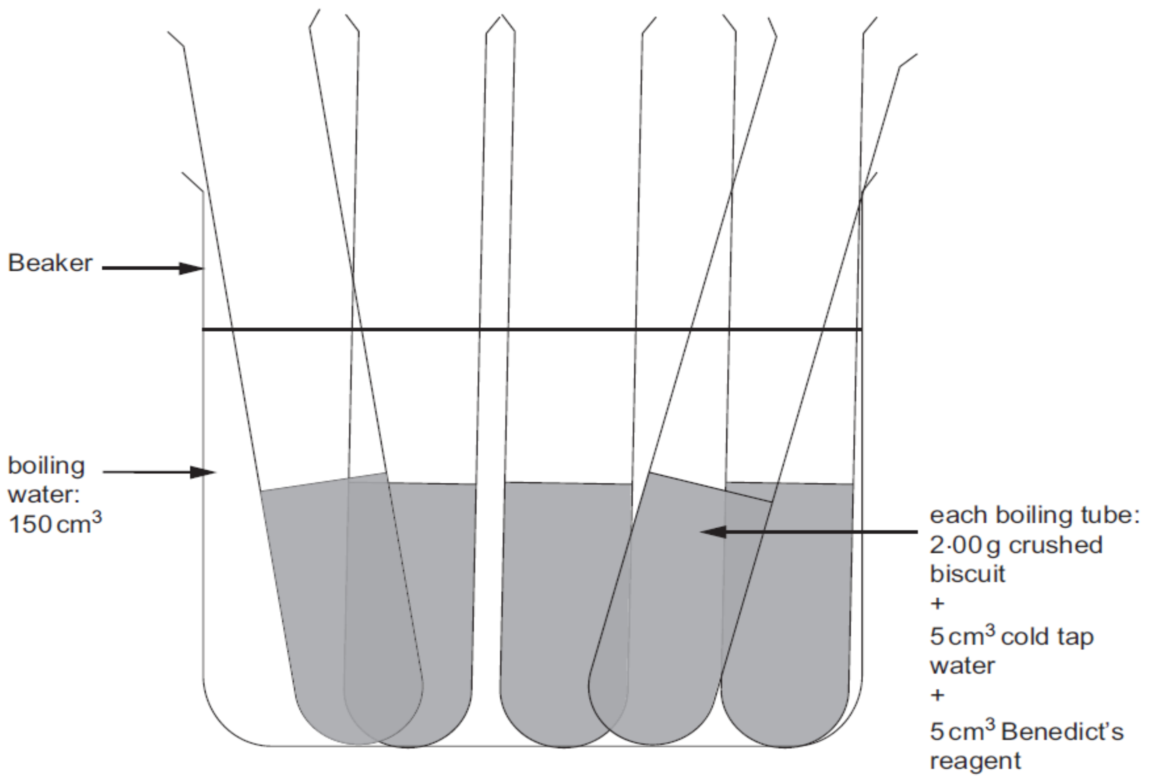
Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 5 × different crushed biscuit types (2 × 2.0 g of each)
  A suggested range of biscuits could include ginger, nice, digestive, rich tea and crackers.
- 1 × stopwatch (± 0.01 s)
- 1 × 250 cm^3 beaker
- 2 × 10 cm^3 measuring cylinders/ syringes
- 5 × boiling tubes
- 10 x pieces of filter paper
- 50 cm^3 Benedict's reagent
- spatula
- CLEAPSS student safety sheet 4 – Food testing (1)
- labelling pen

  The following is required for each class:

  - Access to recently boiled water (kettle/ waterbath)
  - Balance (± 0.1 g)



Method

1. Label the five boiling tubes for each type of biscuit.

2. Transfer 2.0 g of each biscuit type into the correct boiling tube.

3. Using a measuring cylinder/syringe, transfer 5 cm^3 of cold tap water into each boiling tube.

4. Using another measuring cylinder/syringe, transfer 5 cm^3 of Benedict's reagent into each boiling tube.

5. Shake each tube gently to ensure that the contents are thoroughly mixed.

6. Pour 150 cm^3 of boiling water into the 250 cm^3 beaker.

7. Place the five test tubes into the boiling water and immediately start the stopwatch.

8. Record, to the nearest second, the time it takes for the Benedict's reagent to change from blue to orange/brick red in colour.

9. Repeat steps 1 to 8 to gain two sets of results in total for each biscuit.

The remainder of the examination paper is not required for the purpose of checking the setting up of the task.

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE SUGAR CONTENT OF BISCUITS

SECTION A

(1 hour)

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Section A	**6**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

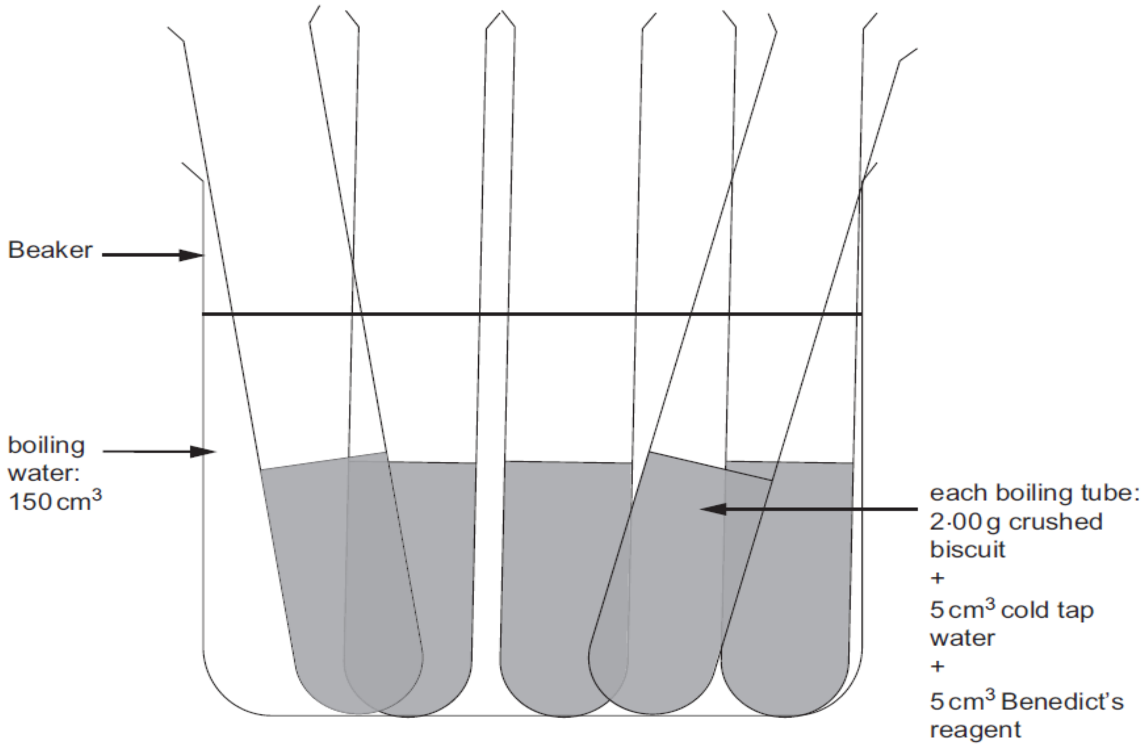
INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 6.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will complete section **A** in one session and section **B** in the next session.

SECTION A

Your task is to investigate the sugar content of different biscuits.

The following apparatus available for each group:

- A range of five different crushed biscuit types (2 × 2.0 g of each)
- 1 × stopwatch (± 0.01 s)
- 1 × 250 cm^3 beaker
- 2 × 10 cm^3 measuring cylinders
- 5 × boiling tubes
- Filter paper
- Benedict's reagent
- Kettle
- Spatula
- Balance (± 0.1 g)
- CLEAPSS student safety sheet 4 – Food testing (1)



Read the method and answer question 1(a) before carrying out the experiment and recording your results.

Method:

1. Label the five boiling tubes for each type of biscuit.
2. Transfer 2.0 g of each biscuit type into the correct boiling tube.
3. Using a measuring cylinder/syringe, transfer 5 cm^3 of cold tap water into each boiling tube.
4. Using another measuring cylinder/syringe, transfer 5 cm^3 of Benedict's reagent into each boiling tube.
5. Shake each tube gently to ensure that the contents are thoroughly mixed.
6. Pour 150 cm^3 of boiling water into the 250 cm^3 beaker.
7. Place the boiling test tubes into the boiling water and immediately start the stopwatch.
8. Record, to the nearest second, the time it takes for the Benedict's reagent to change from blue to orange/brick red in colour.
9. Repeat steps 1 to 8 to gain two sets of results in total for each biscuit.

Answer **all** *questions*

1. (a) Carry out a risk assessment **for this experiment**.

Describe how each hazard may result in a risk of injury. Describe the control measures needed to minimise each risk. [2]

HAZARD	RISK	CONTROL MEASURE
Benedict's reagent: is an irritant		
Boiling water: can cause burns.		

You may record raw results in the space below.

(b) Present your results in a table; include all of your results and the mean time taken for the Benedict's solution to change from blue to orange/ brick red for each biscuit type. [4]

6

END OF PAPER

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE SUGAR CONTENT OF BISCUITS

SECTION B

(1 hour)

For Examiner's use only		
	Maximum Mark	Mark Awarded
Section B	24	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator and your section **A** exam paper.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 24.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will have completed section **A** in a previous session.

SECTION B

Answer **all** *questions*

2. (a) (i) State the independent variable in this experiment. [1]

……………………………………………………………………………………..................

(ii) State the dependent variable in this experiment. [1]

……………………………………………………………………………………..................

(iii) State **two** variables that needed to be controlled **for this experiment**. Explain why you controlled each of these. [4]

Control variable 1: …………………………………………………………………………

Explanation: ……………………………………………………………………………..

Control variable 1: …………………………………………………………………………

Explanation: ……………………………………………………………………………..

(b) Describe how you could set up a control tube for this experiment. [3]

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(c) Use your results from section A to draw a graph of your results on the grid below. [4]

(d) What can you conclude about the sugar content of the biscuits tested? Explain your answer. [3]

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(e) State the **main** source of uncertainty during this experiment. Describe how this uncertainty could be reduced. [2]

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(f) Why does it make sense to record the time to the nearest second rather than tenths or hundredths of a second? [1]

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(g) Angharad tests the sugar content of three types of biscuit (A, B and C). She times how long it takes for the Benedict's reagent to change colour. She repeats each biscuit three times.

Biscuit	Trial 1	Trial 2	Trial 3	Mean
A	361.8	355.3	347.2	354.8
B	315.4	329.3	333.5	326.1
C	303.9	312.0	398.6	338.2

(i) Circle the anomalous result in the table. State why this result is anomalous. [2]

……………………………………………………………………………………………………

……………………………………………………………………………………………………

(ii) Angharad concluded that Biscuit **B** contained the most sugar. Another student disagreed with her. Suggest why the other student disagreed with her. [1]

……………………………………………………………………………………………………

……………………………………………………………………………………………………

(iii) State what **further** data would be needed to produce a more valid conclusion. [2]

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………

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………

24

END OF PAPER

UNIT 7: (Double Award) PRACTICAL ASSESSMENT
INVESTIGATING THE SUGAR CONTENT OF BISCUITS

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

SECTION A

Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
1	(a)			Benedict's risk: sensible risk e.g. chemical splashing into eyes, risk of spitting if heat tubes directly **and** Benedict's control measure: wear goggles, heat tubes indirectly/using a water bath (1) Boiling water risk: sensible risk e.g. can cause burns to skin/eyes when carrying the beaker/water bath **and** Boiling water control measure: wear goggles, avoid spillages, care when handling (1)	2			2		2
	(b)			Ordered layout into columns (1) Suitable column headings (1) Appropriate units (1) Correct calculation of mean scores from two repeat sets of results (1)	 1 1	1 1		4	1	4
				Section A total	**4**	**2**	**0**	**6**	**1**	**6**

SECTION B

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		The type of biscuit (1)	1			1		1
		(ii)		The time taken for the (Benedict's reagent) colour change (1)	1			1		1
		(iii)		**Any 2 (x1) from:** • Control variable - mass of biscuit • Explanation - used a balance to weigh to 2 • Control variable - volume of cold/tap water • Explanation - used a measuring cylinder/ syringe to measure to 5 cm^3 • Control variable - volume of Benedict's reagent • Explanation - used a measuring cylinder/ syringe to measure to 5 cm^3	2	2		4		4
	(b)			Use 2 g of a food that does not contain sugar (1) Same volume of Benedict's reagent (1) Other reference to same conditions e.g. same volume of water, use of boiling water in the beaker (1)		3		3		3
	(c)			Axes labelled correctly with units (1) Scales & use of at least ½ of graph paper (1) All plots correctly plotted with ± ½ small square tolerance (2) 1 error (1) >1 error (0)	1 1	2		4	4	4

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
	(d)			Correct statement regarding which biscuit contained the most or the least sugar- check against candidates own results (1) All biscuits mean results considered (1) The faster/quicker/less time taken for the Benedict's reagent to change colour, the higher/greater/more sugar content of the biscuit (1)			3	3		3
	(e)			Random error stated as difficulty in judging when the Benedict's reagent had (fully) changed colour (1) Sensible suggestion of how to reduce the error e.g. sensor to detect colour change/ using the same person to make the judgement/ having agreement between two group members in making the judgement/ colour standard to compare (1)	2			2		2
	(f)			There is a delay of more than one tenth of a second between seeing the Benedict's colour change and stopping the stopwatch/difficulty in pinpointing the exact time of the colour change		1		1		1
	(g)	(i)		398.6 s is correctly circled (1) Anomalous results are not clustered to/do not fit the pattern/are not within the range of the other results (1)			2	2		2
		(ii)		Angharad included the anomalous result in her mean for C, otherwise that result would have been the lowest			1	1		1
		(iii)		Repeat trial 3 for C/ repeat all biscuits more times to assess repeatability (1) Compare with other groups for reproducibility (1)		2		2		2
				Section B total	**8**	**10**	**6**	**24**	**4**	**24**

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE

SETTING UP INSTRUCTIONS

Confidential

To be opened on …………………… (date) by TEACHERS

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

SECTION A

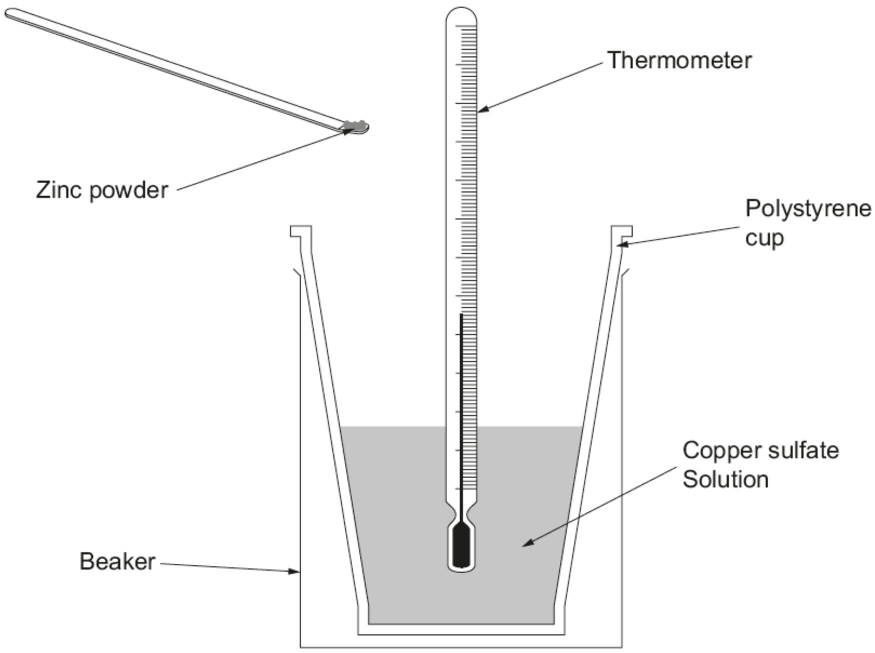
Introduction

Your task is to investigate the reaction between zinc and copper sulfate solution.

Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- Polystyrene cup
- 100 cm^3 measuring cylinder
- 250 cm^3 beaker
- Safety goggles
- 50 cm^3 0.5M copper sulfate
- Zinc powder
- Microspatula



Method:

1. Measure 50 cm^3 of copper sulfate into the polystyrene cup.
2. Stand the cup in a beaker to keep it stable.
3. Measure the initial temperature of the copper sulfate solution.
4. Add 1 microspatula of zinc powder to the copper sulfate solution and stir.
5. Measure and record the highest temperature reached by the mixture.
6. Calculate the temperature rise compared to the original temperature.
7. Repeat steps 4 - 6 until a total of 8 microspatulas of zinc powder have been added to the copper sulfate solution.
8. Repeat steps 1 to 7 to gain two sets of results in total.
9.

The remainder of the examination paper is not required for the purpose of checking the setting up of the task.

In order that the work of each candidate may be correctly assessed, information is required about the materials used in the task. Please ensure that the "**Information required from centres**" sheet on page 354 is completed and given to the exams officer to be sent to the examiner with the completed examination papers.

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE

INFORMATION REQUIRED FROM CENTRES

Centre Number ....

(Please detach and send with the completed examination papers to the **examiner.**)

SPECIFIC DATA REQUIRED:

Concentration of copper sulfate solution

....

Volume of copper sulfate used

....

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE SOLUTION

SECTION A

(1 hour)

For Examiner's use only		
	Maximum Mark	Mark Awarded
Section A	6	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 6.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will complete section **A** in one session and section **B** in the next session.

SECTION A

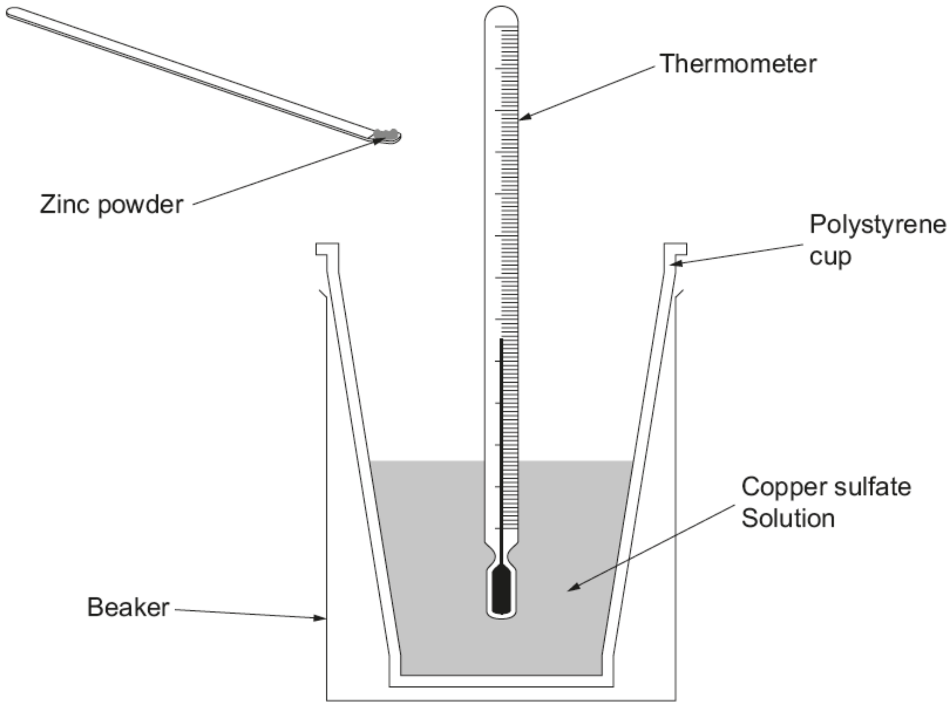
Introduction

Your task is to investigate the reaction between zinc and copper sulfate solution.

Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- Polystyrene cup
- 100 cm^3 measuring cylinder
- 250 cm^3 beaker
- Safety goggles
- 50 cm^3 0.5M copper sulfate
- Zinc powder
- Microspatula



Read the method and answer question 1(a) before carrying out the experiment and recording your results.

Method:

1. Measure 50 cm^3 of copper sulfate into the polystyrene cup.
2. Stand the cup in a beaker to keep it stable.
3. Measure the initial temperature of the copper sulfate solution.
4. Add 1 microspatula of zinc powder to the copper sulfate solution and stir.
5. Measure and record the highest temperature reached by the mixture.
6. Calculate the temperature rise compared to the original temperature.
7. Repeat steps 4 - 6 until a total of 8 microspatulas of zinc powder have been added to the copper sulfate solution.
8. Repeat steps 1 to 7 to gain two sets of results in total.

Answer **all** *questions*

1. (a) Copper sulfate and zinc powder are irritants. Complete the risk assessment for copper sulfate using the template set out below. [1]

HAZARD	RISK	CONTROL MEASURE
Copper sulfate is an irritant/ harmful		

You may record raw results in the space below.

(b) Present your results in a table, including all of your results and the mean temperature rise for each spatula added. [5]

6

END OF PAPER

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE

SECTION B

(1 hour)

For Examiner's use only		
	Maximum Mark	Mark Awarded
Section B	24	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator and your section **A** exam paper.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 24.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will have completed section **A** in a previous session.

SECTION B

Answer **all** *questions*

2. (a) (i) Identify the independent and dependent variables in the experiment completed in section A. [2]

independent variable: ………………………………………

dependent variable: ………………………………………

(ii) State **two** controlled variables from the method used in section A and give the value for each. [2]

Controlled variable 1 ………………………………………………………..

value ………………………………………………………..

Controlled variable 2 ………………………………………………………..

value ………………………………………………………..

(b) Use your results from section A to draw a graph on the grid below. [5]

(c) Use your graph to describe the relationship between the quantity of zinc added and the temperature change. [2]

………………………………………………………………………………………………………

………………………………………………………………………………………………………

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………………………………………………………………………………………………………

(d) Why is a polystyrene cup used to carry out the experiment? [1]

………………………………………………………………………………………………………

(e) (i) How could you change the apparatus/method used to ensure that the maximum temperature change was achieved? [2]

………………………………………………………………………………………………

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(ii) Identify **two** inaccuracies in the method and suggest an improvement for each. [4]

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………………………………………………………………………………………………

(f) What is the name given to a reaction in which heat energy is given out? [1]

………………………………………………………………………………………………………

(g) What happens in terms of energy changes during the reaction that causes the temperature to rise? [2]

…………………………………………………………………………………………………

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…………………………………………………………………………………………………

(h) Using the formula given below, calculate the maximum energy released during your experiment. [3]

$$E = mc\Delta T$$

where:

E = Energy released (J)

m = mass of solution used (1 cm^3 = 1 g)

c = specific heat capacity = 4.18 J/g ^oC

ΔT = temperature change ($T_{maximum}$ - $T_{initial}$)

energy released = ...J

24

END OF PAPER

UNIT 7: (Double Award) PRACTICAL ASSESSMENT
INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE SOLUTION

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

SECTION A

Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
1	(a)			Copper sulfate risk: copper sulfate could get onto skin when being added to cup **and** Copper sulfate control measure: wash hands immediately if any copper sulfate gets on to them/ wear laboratory gloves **OR** Copper sulfate risk: copper sulfate could get transferred from hands to eyes **and** Copper sulfate control measure: wear eye protection (1)	1			1		1
	(b)			All data recorded and logically organised (1) Headings – number of spatulas/ temperature/ temperature increase (1) Units – ^{o}C (1) Temperature rise calculated correctly (1) Temperature rise means calculated correctly (1)	1 1 1	1 1		5	2	5
				Section A total	**4**	**2**	**0**	**6**	**2**	**6**

SECTION B

Question				Marking details	AO1	AO2	AO3	Total	Maths	Prac
					Marks Available					
2	(a)	(i)		Independent variable - Number of spatulas (1) Dependent variable - Temperature rise (1)	2			2		2
		(ii)		**Any 2 x (1) from:** • Zinc + 1 microspatula • Copper sulfate volume + 50 cm^3 • Copper sulfate concentration + 0.5 M	2			2		2
	(b)			Axes labelled correctly with units (1) Scales & use of at least ½ of graph paper (1) All plots correctly plotted with ± ½ small square tolerance (2) 1 error (1) >1 error (0) Smooth curve of best fit within ± ½ small square division of all points (1) Don't accept thick, double, whispy line	1 1	2 1		5	5	5
	(c)			As more zinc is added there is an increase in temperature (1) To a given value (corresponding to graph) (1)		2		2		2
	(d)			To reduce heat losses to the surroundings		1		1		1
	(e)	(i)		Put a lid on the polystyrene cup/increase the insulation (1) Stirring (1)			2	2		2
		(ii)		**Any 2 suitable inaccuracies** (1) + **improvement** (1) masses of zinc on spatula vary (1) weigh out equal amounts of the zinc (1) **OR** thermometer only accurate to nearest °C(1) thermometer/ digital thermometer with higher resolution/ smaller divisions (1) **OR** measuring cylinder only accurate to nearest cm^3(1) measuring cylinder with higher resolution/ smaller divisions (1)			4	4		4
	(f)			Exothermic	1			1		1

Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
	(g)			Energy is needed to break bonds and energy is released when bonds are made (1) In this reaction **more** energy is released when bonds are made than is needed to break bonds (1)		2		2		2
	(h)			Correct calculation of ΔT (1) Correct substitution of figures (1) Correct calculation of E (1)	1	1 1		3	3	3
				Section B total	**8**	**10**	**6**	**24**	**8**	**24**

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE EXTENSION OF A SPRING

SETTING UP INSTRUCTIONS

Confidential

To be opened on …………………… (date) by TEACHERS

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

SECTION A

Introduction

Your task is to investigate the extension of a spring.

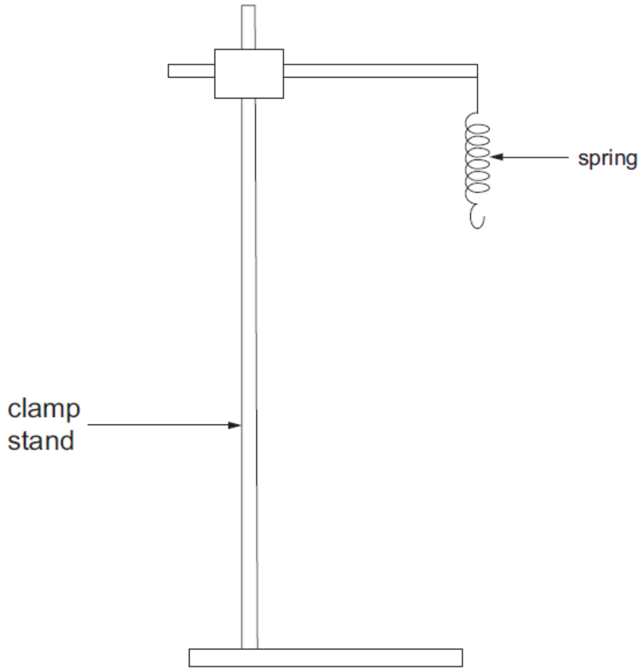
When a load is added to a spring it extends. The extension of a spring is the difference between the unstretched and the stretched length. The apparatus shown below can be used to investigate how the extension of a spring varies with the force stretching it. The force on the spring can be calculated from:

force (N) = mass (kg) × 10

Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 1 × expendable spring (spring constant 25 N m^{-1}) prestretched prior to use
- 1 × clamp stand and boss
- 1 × 30 cm ruler (resolution ± 1 mm)
- 1 × 100 g mass hanger and 5 x slotted masses



Method

1. Set up the apparatus as shown in the diagram.

2. Use the ruler to measure the length of the spring.

3. Add a 100 g mass hanger to the spring.

4. Measure the new length of the spring.

5. Calculate the extension.

6. Repeat steps 3 - 5 until all masses have been added.

7. Repeat steps 1 - 6 to gain three sets of results in total.

The remainder of the examination paper is not required for the purpose of checking the setting up of the task.

In order that the work of each candidate may be correctly assessed, information is required about the materials used in the task. Please ensure that the "**Information required from centres**" sheet on page 373 is completed and given to the exams officer to be sent to the examiner with the completed examination papers.

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE EXTENSION OF A SPRING

INFORMATION REQUIRED FROM CENTRES

Centre Number ……………………………....

(Please detach and send with the completed examination papers to the **examiner.**)

Typical spring constant value:

....

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE EXTENSION OF A SPRING

SECTION A

(1 hour)

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Section A	**6**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 6.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will complete section **A** in one session and section **B** in the next session.

SECTION A

Introduction

Your task is to investigate the extension of a spring.

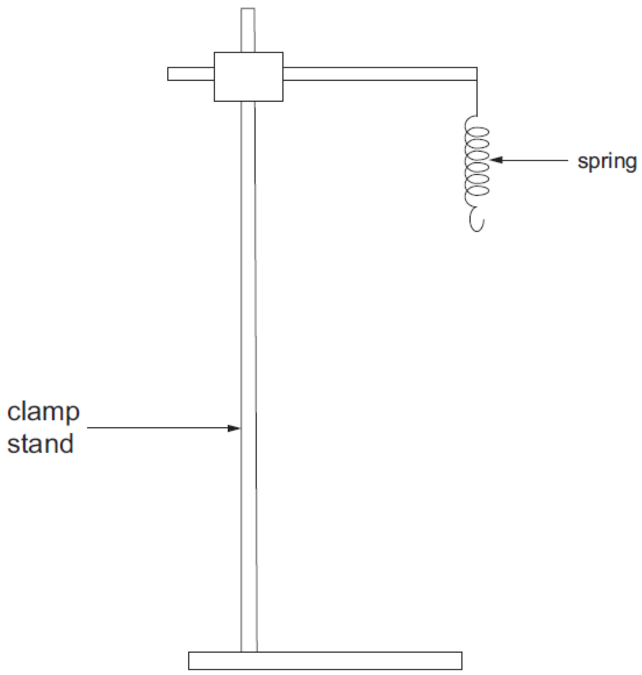
When a load is added to a spring it extends. The extension of a spring is the difference between the unstretched and the stretched length. The apparatus shown below can be used to investigate how the extension of a spring varies with the force stretching it. The force on the spring can be calculated from:

force (N) = mass (kg) × 10

Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 1 × expendable spring (spring constant 25 N m^{-1}) prestretched prior to use
- 1 × clamp stand and boss
- 1 × 30 cm ruler (resolution ± 1 mm)
- 1 × 100 g mass hanger and 5 × slotted masses



Read the method and answer question 1(a) before carrying out the experiment and recording your results.

Method

1. Set up the apparatus as shown in the diagram.
2. Use the ruler to measure the length of the spring.
3. Add a 100 g mass hanger to the spring.
4. Measure the new length of the spring.
5. Calculate the extension.
6. Repeat steps 3 - 5 until all masses have been added.
7. Repeat steps 1 - 6 to gain three sets of results in total.

Answer **all** *questions*

1. (a) Make a hypothesis for this experiment. [1]

………………………………………………………………………………………………………

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You may record raw results in the space below.

(b) Present your results in a table, including all of your results and the mean extension for each value of the independent variable. [5]

6

END OF PAPER

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

SCIENCE (Double Award)

UNIT 7: (Double Award) PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE EXTENSION OF A SPRING

SECTION B

(1 hour)

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Section B	**24**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator and your section **A** exam paper.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 24.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will have completed section **A** in a previous session.

SECTION B

Answer **all** *questions*

2. (a) (i) Identify the independent and dependent variables in this experiment. [2]

independent variable: ……………………………………….

dependent variable: ……………………………………….

(ii) Name **one** variable that must be controlled in this experiment. Give a reason for your answer. [2]

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(b) A mass of 100 g provides a force of 1 N to the spring. Use this information and your results from section A to plot a graph of force (vertical axis) against extension (horizontal axis). [5]

(c) It is suggested that the extension is directly proportional to the force. Do your results support this theory? [2]

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(d) The spring constant, k, is given by:

$$k = \frac{\text{force}}{\text{extension}}$$

Use data from your graph to calculate a value for the spring constant. Include a unit with your answer.

[3]

spring constant = ………………

unit = ………………..

(e) The experiment is repeated with a spring which is twice as stiff. This means its spring constant is twice as big. Use the equation:

force = $k \times$ extension

to calculate the force required to give an extension of 0.5 m. [3]

force = ……………. N

(f) Evaluate the quality of the data you have collected. You should consider accuracy and repeatability in your answer. [3]

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(g) Identify **one** source of inaccuracy in this experiment and state an improvement. [2]

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(h) The experiment was repeated with an elastic band. The results are shown in the table below. Describe how the elastic band behaves differently to an ideal spring for which extension is directly proportional to force. [2]

Force (N)	**Extension (mm)**
1.0	102
2.0	303
3.0	470
4.0	579
5.0	653
6.0	732
7.0	800
8.0	860

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END OF PAPER

UNIT 7: PRACTICAL ASSESSMENT
INVESTIGATING THE EXTENSION OF A SPRING

MARK SCHEME

GENERAL INSTRUCTIONS

<u>Recording of marks</u>

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

<u>Marking rules</u>

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

<u>Marking abbreviations</u>

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

SECTION A

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			As mass increases extension increases	1			1		1
	(b)			All data recorded and logically organised (1) Headings - mass/ length/ extension(1) Units – g / mm / mm (1) Accept kg / m Extension calculated correctly (1) Extension means calculated correctly (1)	1 1 1	1 1		5	2	5
				Section A total	**4**	**2**	**0**	**6**	**2**	**6**

SECTION B

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Independent variable – mass (1) Dependent variable – extension (1)	2			2		2
		(ii)		Same spring (1) Different springs have different stiffness (1)	1	1		2		2
	(b)			Scales & use of at least ½ of graph paper (1) All plots correctly plotted with ± ½ small square tolerance (2) 1 error (1) >1 error (0) Line of best fit within ± ½ small square division of all points (1) Don't accept thick, double, whispy lines Correct force used (1)	1 1	2 1		5	5	5
	(c)			Yes (no mark) Since straight line (1) through origin (1) **ecf**		2		2		2
	(d)			Matched values taken from graph (1) Substitution (1) Correct answer with consistent unit N/m or N/cm (1)	1	1 1		3	2	3
	(e)			Calculation of k ($2 \times$ their value) (1) Substitution (1) Calculation of correct force e.g. consistent units in substitution (1)	1 1	1		3	2	3
	(f)			Correct judgement of repeatability (1) Linked to similarity of repeats (1) Correct description of how accuracy was achieved e.g. avoiding parallax, measuring to nearest mm or reference to scatter about line of best fit (1)			3	3		3
	(g)			Effect of parallax when taking readings(1) Use a pointer / use a set square (1)		1	1	2		2

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(h)			Doubling force does not double extension (1) So not directly proportional (1)			2	2		2
				Section B total	**8**	**10**	**6**	**24**	**9**	**24**