OCR
Oxford Cambridge and RSA

F

Tuesday 7 November 2017 – Afternoon

GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B

B721/01 Additional Science modules B3, C3, P3 (Foundation Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 15 minutes

* B 7 2 1 0 1 *

* 5 9 6 4 5 0 6 1 7 1 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The Periodic Table can be found on the back page.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document consists of **28** pages. Any blank pages are indicated.

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

$$\text{efficiency} = \frac{\text{useful energy output } (\times 100\%)}{\text{total energy input}}$$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

power = force × speed

$$KE = \frac{1}{2}mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

$$mgh = \frac{1}{2}mv^2$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

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Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

SECTION A – Module B3

1 **(a)** The blood has parts that do different jobs.

Finish the table by writing in the **part of the blood** which does each **job**.

One has been done for you.

Job	Part of the blood
clots blood	platelets
transports food	
defends the body	

[2]

(b) **(i)** Sickle cell anaemia is a disorder of the blood.
Sickle cell anaemia is caused by red blood cells that do not form properly.

The packed cell volume (PCV) is a measure of the percentage of red blood cells in a set volume of blood.

The PCV for humans is between 40 and 45.
A person with a PCV lower than 30 could have sickle cell anaemia.

Look at the data in the table below.

It shows PCV readings for three people, Leroy, Winston and Jake.

	Packed Cell Volume in percentage (PCV%)		
	Leroy	**Winston**	**Jake**
	32	29	43
	21	36	45
	31	28	42
	20	39	42
Mean	……..	……..	43

Complete the table and use this to decide who is most likely to have sickle cell anaemia.

..... **[3]**

(ii) Sickle cell anaemia is caused by a gene mutation.

What is a gene mutation?

..... **[1]**

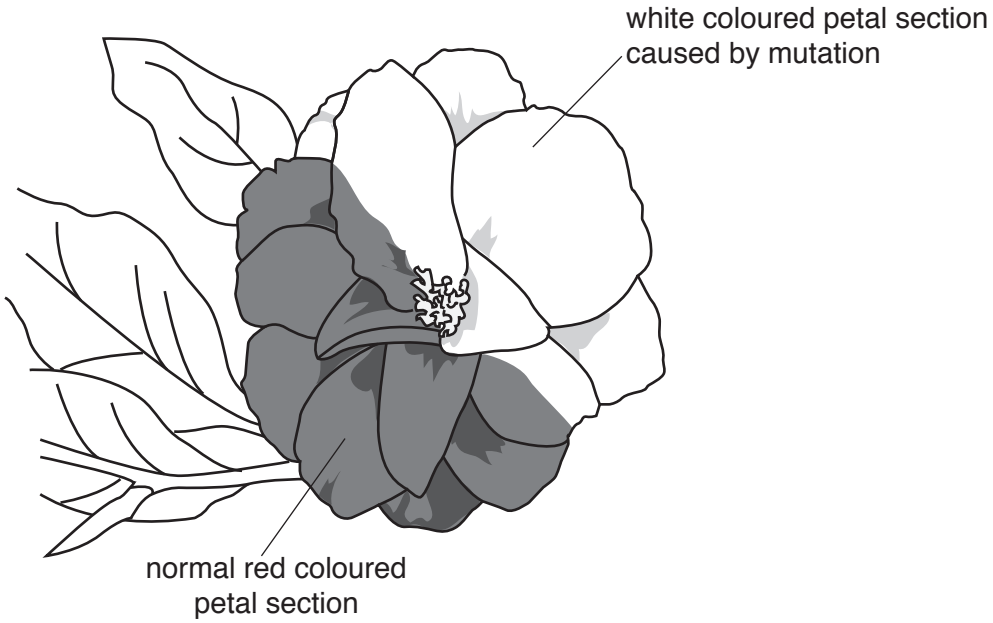
(c) Mutations occur spontaneously, but they can be made to happen more often.

Write down **one** way mutations can be made to happen more often.

..... **[1]**

(d) Look at the picture.

It shows a flower which has a gene mutation.



Suggest how the gene mutation causes parts of the flower to have two different colours.

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..... **[1]**

(e) Flowering plants are multicellular organisms.

Write about the advantages of being multicellular.

.....

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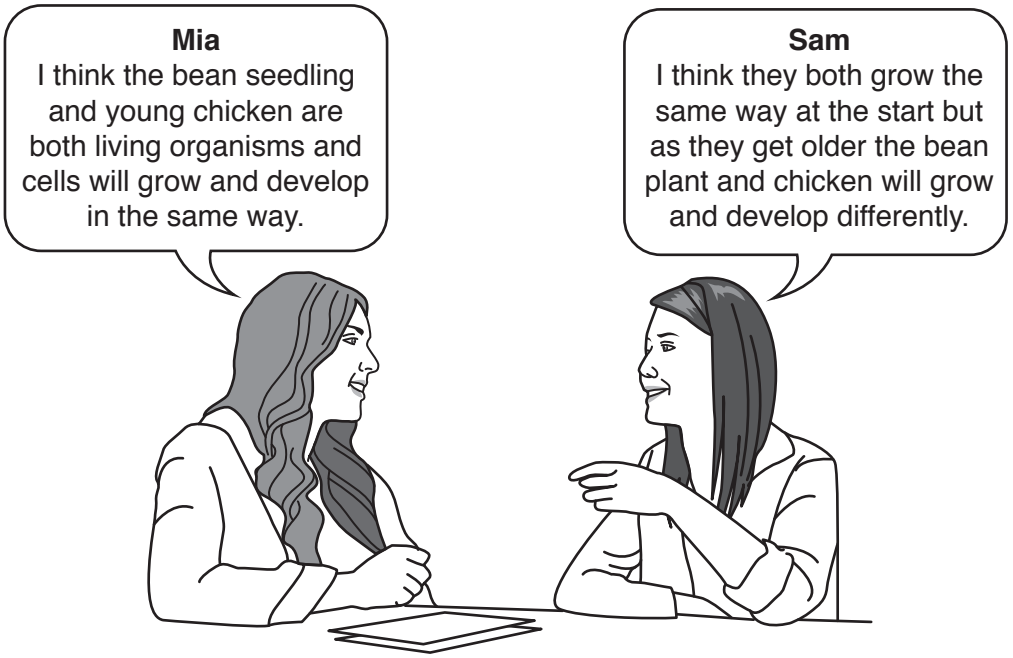
..... **[2]**

2 Mia and Sam are discussing growth and development in plants and animals.
They look at pictures of a bean seedling and a young chicken.

bean seedling

chicken just hatching



7

Which student has given the best description of growth and development in the bean and the chicken?

Describe the differences between growth and development.
Support your answer by writing about how plants and animals grow and develop.

The quality of written communication will be assessed in your answer to this question.

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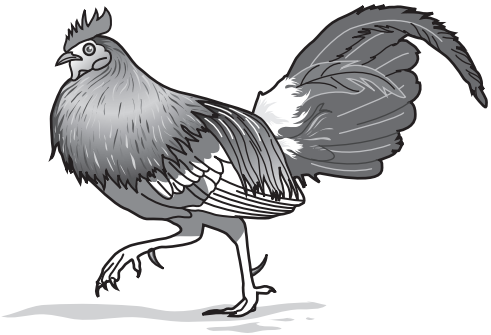
..... **[6]**

3 **(a)** Look at the pictures.



wild red jungle fowl

domestic Leghorn chicken

Selective breeding of red jungle fowl was used to produce Leghorn chickens with all white feathers.

Describe this process of selective breeding.

.....

.....

.....

..... **[3]**

(b) Scientists sometimes clone plants. They do this when they want to mass produce plants that are difficult to grow from seed.

Write down one **disadvantage** of cloning plants.

..... **[1]**

(c) Understanding the structure of DNA has made modern cloning techniques possible.

The structure of DNA was first worked out by two scientists.

What are the names of these two scientists?

Put a tick (✓) in the box next to the correct answer.

Crick and Darwin ☐

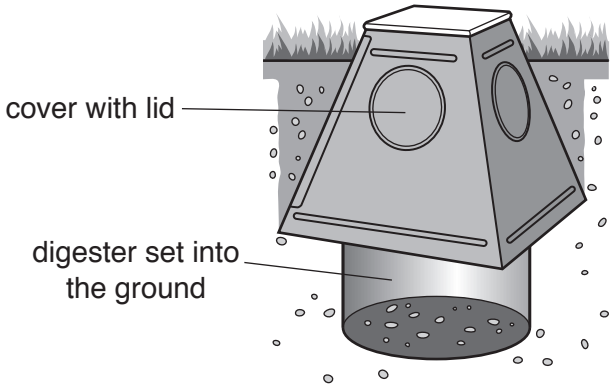
Darwin and Frankin ☐

Watson and Darwin ☐

Watson and Crick ☐ **[1]**

4 Look at the picture.

It shows a dog waste digester.



Read this information about the digester.

- After your pet has deposited 'waste', place it in the digester.
- Add an enzyme mixture and water, then place lid back on the digester.
- Digesters work outside, set into the ground.
- Some areas of the country can only use their digesters in warmer months.

(a) Explain why an enzyme mixture is added to the waste and why the digester can only work in warmer months.

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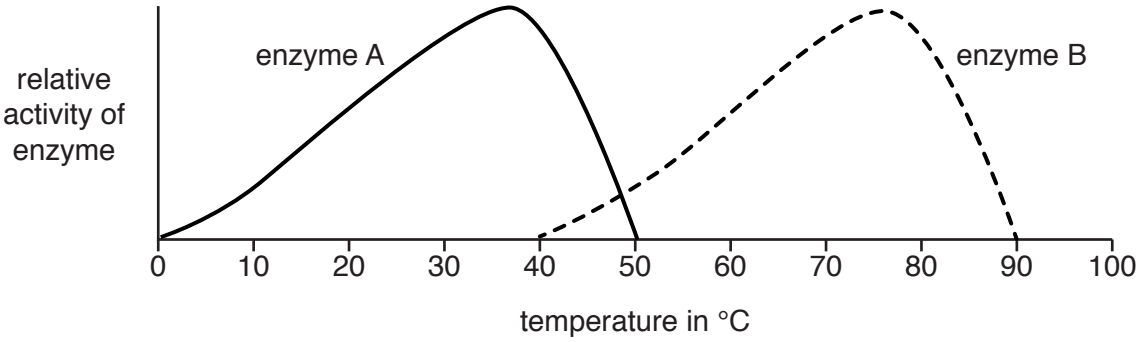
..... **[3]**

(b) Look at the graph.

It shows the relative activity of two enzymes at different temperatures.



Which enzyme would be best to use in a dog waste digester?

Put a letter **X** on one of the curves on the graph.

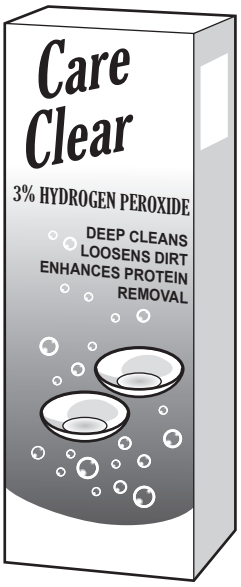
The letter **X** should be on

- the curve showing the best enzyme to use in the digester
- the part of the curve that shows the best temperature for this enzyme to work. **[1]**

SECTION B – Module C3

5 Louise wears contact lenses.

She uses a solution of hydrogen peroxide to sterilise her contact lenses.



Hydrogen peroxide slowly breaks down to make water and oxygen.

(a) (i) Write the **word equation** for this reaction.

..... **[1]**

(ii) Manganese(IV) oxide is a **catalyst** for this reaction.

What is meant by a catalyst?

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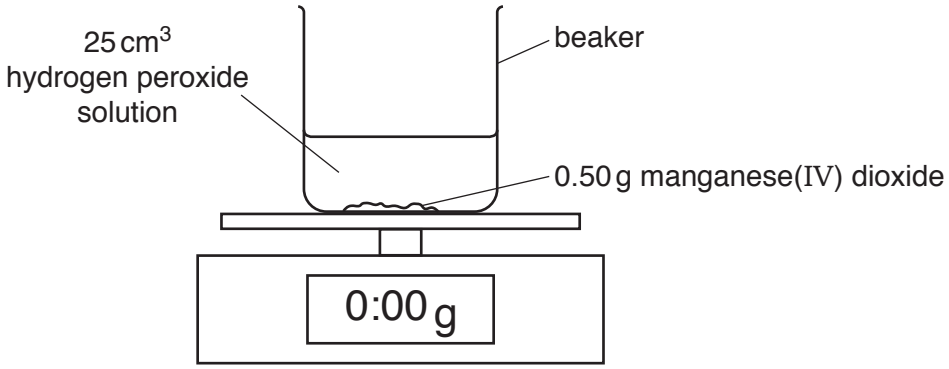
..... **[2]**

(b) Louise investigates the breakdown of hydrogen peroxide solution.

She puts 25 cm^3 of hydrogen peroxide solution into a beaker.

She places the beaker on a balance.

Louise then puts 0.50 g of manganese(IV) oxide into the hydrogen peroxide solution.

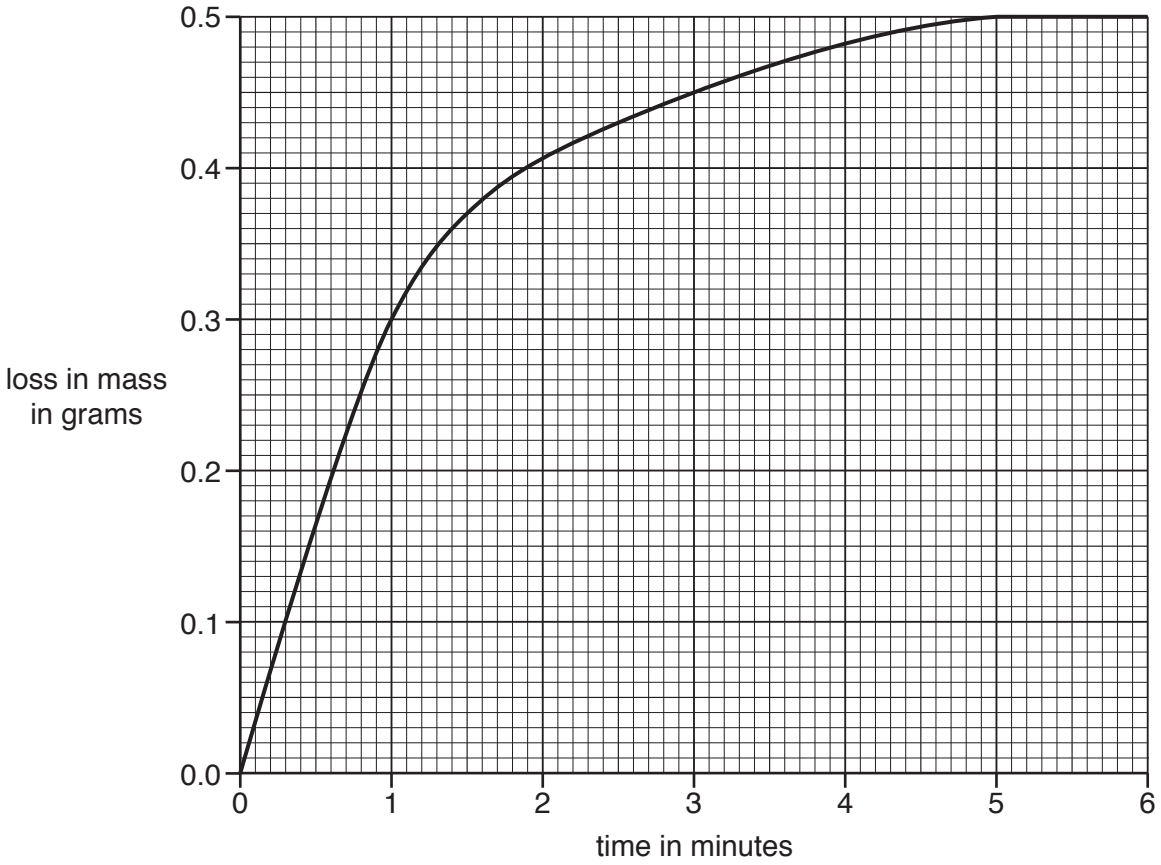


Louise records the loss in mass.

Look at her results.

Time in minutes	0	1	2	3	4	5	6
Loss in mass in g	0.00		0.41	0.45	0.48	0.50	0.50

Louise plots a graph of her results.



(i) Louise forgot to write down the loss in mass after 1 minute.

Use the graph to find out the loss in mass after 1 minute.

answer ..... g **[1]**

(ii) What time did the reaction finish?

answer ..... minutes **[1]**

(iii) Look at the graph.

What happens to the speed of the reaction as the time increases?

Choose from

decreases

stays the same

increases

answer ..... **[1]**

(c) Louise wants to make the breakdown of hydrogen peroxide go faster.

She does not want to change the

- catalyst
- volume of the hydrogen peroxide.

Write about **two other** methods that would make the reaction go faster.

Explain how the methods work using the reacting particle model.

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..... **[4]**

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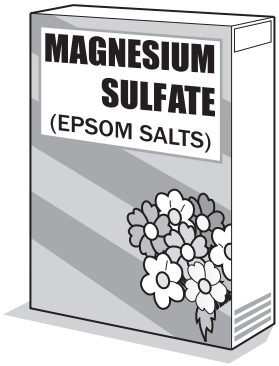
6 Magnesium sulfate is used by gardeners to help improve plant growth.



Look at the equations.

They show different reactions which make magnesium sulfate, $MgSO_4$.

Reaction 1 $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

Reaction 2 $MgO + H_2SO_4 \rightarrow MgSO_4 + H_2O$

Reaction 3 $MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$

(a) John calculates the atom economy for each reaction.

	Atom economy
Reaction 1	98.4%
Reaction 2	87.0%
Reaction 3	65.9%

Which reaction is the '**greenest**'?

Explain your answer.

.....

..... **[1]**

(b) John makes some magnesium sulfate, $MgSO_4$, using **reaction 1**.

He reacts 4.8 g of magnesium, Mg, with 19.6 g of sulfuric acid, H_2SO_4.

He makes 0.4 g of hydrogen, H_2.

Use the **principle of conservation of mass** to calculate how much magnesium sulfate, $MgSO_4$, John should make.

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..... **[1]**

(c) John makes some magnesium sulfate, $MgSO_4$, using **reaction 2**.

He measures out enough sulfuric acid to make 3.6 g of magnesium sulfate.

John reacts the sulfuric acid with excess magnesium oxide.

(i) After several minutes the reaction stops.

Explain why.

..... **[1]**

(ii) John predicts he should make 3.6 g of magnesium sulfate.

He actually makes 2.7 g.

Calculate his percentage yield.

answer ..... % **[2]**

(d) Magnesium sulfate is also used in a medicine called Epsom salts.

(i) It is important to know that the magnesium sulfate is **pure**.

Explain why.

..... **[1]**

(ii) How can John check that the magnesium sulfate is pure?

.....

..... **[1]**

7 Caitlin investigates the energy given out by four different liquid fuels.

She burns 1.0 g of fuel each time.

Look at her table of results.

Fuel	Starting temperature of water in °C	Final temperature of water in °C
Butanol	28	55
Ethanol	26	46
Methanol	25	35
Propanol	24	53

Describe, using a diagram, the experiment Caitlin does to get these results.

Caitlin thinks that **butanol** gives out the most energy. Use her results to explain if she is correct.

The quality of written communication will be assessed in your answer to this question.

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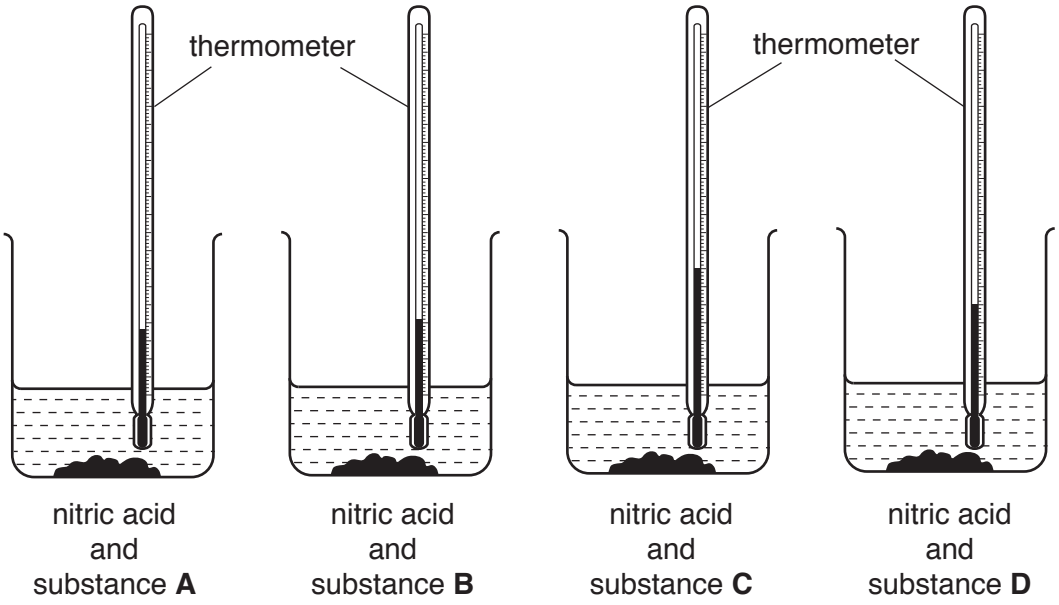
..... **[6]**

8 Henry investigates some reactions of nitric acid.

He puts 25 cm^3 of dilute nitric acid into four beakers.

He measures the temperature of the nitric acid.

He adds 1 g of a different substance to each beaker.



Look at Henry's results.

Complete the table.

Use **only one** tick (✓) for each substance.

Substance	Temperature of acid at start in °C	Temperature of acid at end in °C	Is the reaction exothermic?	Is the reaction endothermic?	Is there no reaction?
A	22	18			
B	21	21			
C	20	35			
D	18	25			

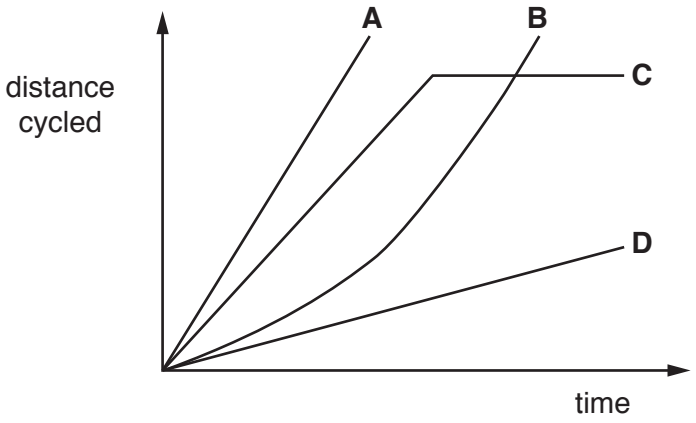
[2]

SECTION C – Module P3

9 Rajiv cycles to school and to his friends' houses.

Rajiv measures the distance he cycles during four different journeys, **A**, **B**, **C**, and **D**.

He uses these measurements to draw distance-time graphs on the same axes.



(a) Which graph shows some time when Rajiv is **not** moving?

Choose from

A **B** **C** **D**

answer ..... **[1]**

(b) The gradients (steepness) of the distance-time graphs are all different.

Describe what the gradient shows and explain the difference between the motion shown in graph **A** and the motion shown in graph **D**.

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..... **[2]**

(c) Direction is important when describing the journeys Rajiv makes.

(i) Rajiv and his friend Chen cycle in the same direction.

The arrows show the direction they cycle.

Calculate their relative velocity.

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relative velocity ..... m/s **[1]**

(ii) Rajiv and Chen keep cycling at the same **speed** of 15 m/s and 12 m/s, **but** their relative velocity changes.

Suggest what Rajiv has done to change their relative velocity.

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..... **[1]**

10 Claire is a builder and she needs a new van.

She finds information about four different vans.

Van	Mass in kg	Maximum acceleration in m/s^2
Boom	4000	0.75
Class	3500	0.75
Dash	3000	0.75
Effect	2500	0.75

(a) Claire wants a van which can produce a large driving **force**.

Which van should she choose?

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Explain your answer using calculations.

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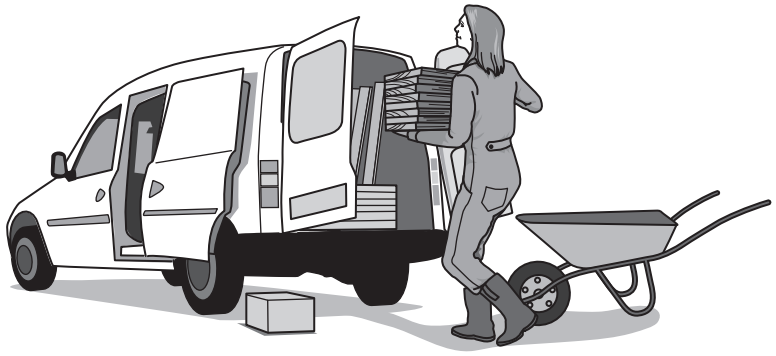
..... **[2]**

(b) Claire puts building materials into her new van.



The building materials have a mass of 100 kg.

(i) Explain why the van **cannot** accelerate at 0.75 m/s^2 when it is full of building materials.

.....

..... **[1]**

(ii) **Stopping distance = thinking distance + braking distance**

The braking distance increases when her van is full of materials.

The thinking distance does **not** change.

Explain why Claire needs to know how the brakes of her van perform.

Include information about road safety in your answer.

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..... **[3]**

11 Car manufacturers test cars.

(a) They publish fuel consumption figures and environmental information.

Car	Fuel consumption in km per litre (highest number is best)	Air pollutant score (0/10 is best)
A	10.2	4/10
B	9.1	6/10
C	24.6	1/10

These cars are all different types

- type **1** has a large engine size, a roof box and uses petrol
- type **2** has a high power rating, pulls a caravan and uses a low emission fuel
- type **3** is a hybrid (electrically powered and uses petrol).

Use the information to link the three cars (**A**, **B** and **C**) to the correct car types (**1**, **2** and **3**).

Explain your reasons.

The quality of written communication will be assessed in your answer to this question.

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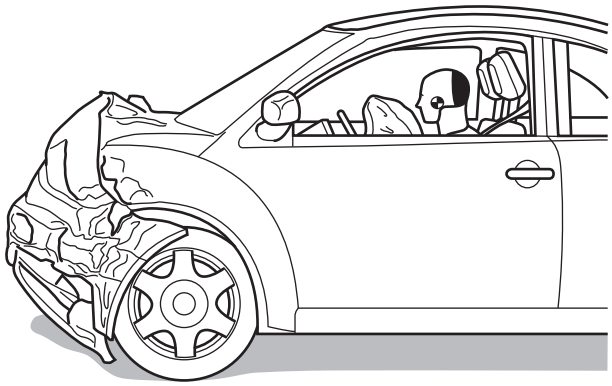
..... **[6]**

(b) Crumple zones are also tested.



Explain, in terms of **momentum**, how crumple zones reduce the chance of an injury during a crash.

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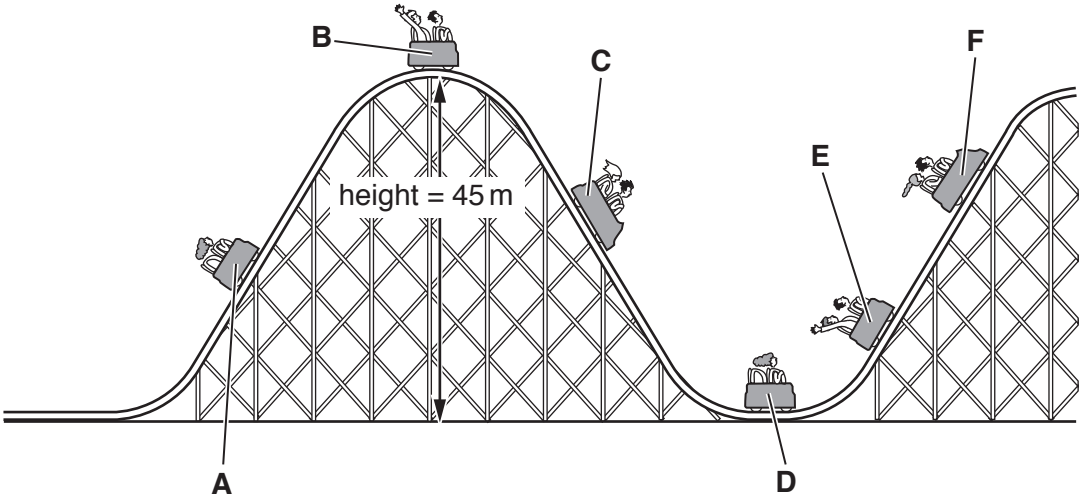
..... **[2]**

12 The kinetic energy (KE) and gravitational potential energy (GPE) of a roller coaster car change during a roller coaster ride.

(a) Letters **A**, **B**, **C**, **D**, **E** and **F** show the position of the roller coaster car at different times.



Match the sentence with the letter.

Two have been done for you.

Sentence	Letter
The lowest point where KE is a maximum and GPE is zero.	
Car has enough KE to continue up the slope.	
Driving force increases GPE.	**A**
GPE transferred to KE as the car speeds up.	
Maximum GPE and near zero KE.	
KE decreases and GPE increases as the car slows down.	**F**

[2]

(b) The roller coaster car has GPE because of its mass and position in the Earth's gravitational field.

Mass of the car is 1000 kg.

Maximum height of the roller coaster is 45 m.

$g = 10\,m/s^2$

Calculate the GPE when the car is at the highest part of the track.

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GPE ..... J **[2]**

(c) What happens to the KE of the car if the mass of the car is doubled?

Choose from

KE doubles

KE halves

KE quadruples

KE stays the same

answer ..... **[1]**

(d) Describe how increasing the **speed** of the car affects the KE of the car.

Choose from

KE decreases

KE increases

KE stays the same

answer ..... **[1]**

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.