

Write your name here

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Other names

Pearson Edexcel
International GCSE

Centre Number

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Candidate Number

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Chemistry

Unit: 4CH0

Science (Double Award) 4SC0

Paper: 1CR

Thursday 18 May 2017 – Morning

Time: 2 hours

Paper Reference

4CH0/1CR
4SC0/1CR
You must have:

Ruler

Calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 120.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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THE PERIODIC TABLE

0

7

6

5

4

3

Group

2

1

Period

4	He	2
	Helium	

1	H	1
	Hydrogen	

1	7	Li	Lithium	3	9	Be	Beryllium	4	20	Ne	Neon	10
2	23	Na	Sodium	11	24	Mg	Magnesium	12	39	K	Potassium	19
3	39	K	Potassium	19	40	Ca	Calcium	20	55	Mn	Manganese	25
4	86	Rb	Rubidium	37	88	Sr	Strontium	38	91	Zr	Zirconium	40
5	133	Cs	Caesium	55	137	Ba	Barium	56	181	Ta	Tantalum	73
6	223	Fr	Francium	87	226	Ra	Radium	88	227	Ac	Actinium	89
7	238	U	Uranium	92	235	Pu	Plutonium	94	239	Np	Neptunium	93
	244	Am	Americium	95	247	Cm	Curium	96	254	Bk	Berkelium	97
	254	Cf	Californium	98	259	Es	Einsteinium	99	264	Fm	Fermium	100
	267	Lr	Lawrencium	103	271	Db	Dubnium	105	288	Hs	Hassium	108
	289	Uu	Ununennium	111	294	Uub	Unbibium	112	304	Uut	Untrium	113
	311	Uuh	Unhennium	115	315	Uuq	Unquadium	117	329	Uus	Unseptium	119
	329	Uuo	Unoctium	120	344	Uuh	Unhennium	121	360	Uuq	Unquadium	123
	361	Uuh	Unhennium	125	375	Uuq	Unquadium	127	397	Uuh	Unhennium	131
	401	Uuq	Unquadium	133	417	Uuh	Unhennium	135	433	Uuq	Unquadium	137
	437	Uuh	Unhennium	143	453	Uuq	Unquadium	145	479	Uuh	Unhennium	151
	491	Uuq	Unquadium	153	515	Uuh	Unhennium	157	547	Uuq	Unquadium	161
	579	Uuh	Unhennium	163	595	Uuq	Unquadium	167	639	Uuh	Unhennium	171
	687	Uuq	Unquadium	173	711	Uuh	Unhennium	175	759	Uuq	Unquadium	179
	827	Uuh	Unhennium	183	859	Uuq	Unquadium	187	903	Uuh	Unhennium	191
	959	Uuq	Unquadium	193	1015	Uuh	Unhennium	197	1079	Uuq	Unquadium	201
	1127	Uuh	Unhennium	203	1183	Uuq	Unquadium	207	1251	Uuh	Unhennium	211
	1263	Uuq	Unquadium	213	1327	Uuh	Unhennium	217	1391	Uuq	Unquadium	221
	1427	Uuh	Unhennium	223	1491	Uuq	Unquadium	227	1559	Uuh	Unhennium	231
	1583	Uuq	Unquadium	233	1651	Uuh	Unhennium	237	1715	Uuq	Unquadium	241
	1715	Uuh	Unhennium	243	1783	Uuq	Unquadium	247	1847	Uuh	Unhennium	251
	1851	Uuq	Unquadium	253	1919	Uuh	Unhennium	257	1983	Uuq	Unquadium	261
	1995	Uuh	Unhennium	263	2063	Uuq	Unquadium	267	2127	Uuh	Unhennium	271
	2151	Uuq	Unquadium	273	2219	Uuh	Unhennium	277	2283	Uuq	Unquadium	281
	2295	Uuh	Unhennium	283	2359	Uuq	Unquadium	287	2415	Uuh	Unhennium	291
	2431	Uuq	Unquadium	293	2495	Uuh	Unhennium	297	2559	Uuq	Unquadium	301
	2575	Uuh	Unhennium	303	2639	Uuq	Unquadium	307	2703	Uuh	Unhennium	311
	2695	Uuq	Unquadium	313	2779	Uuh	Unhennium	317	2835	Uuq	Unquadium	321
	2815	Uuh	Unhennium	323	2899	Uuq	Unquadium	327	2955	Uuh	Unhennium	331
	2935	Uuq	Unquadium	333	2999	Uuh	Unhennium	337	3075	Uuq	Unquadium	341
	3055	Uuh	Unhennium	343	3119	Uuq	Unquadium	347	3155	Uuh	Unhennium	351
	3175	Uuq	Unquadium	353	3239	Uuh	Unhennium	357	3275	Uuq	Unquadium	361
	3295	Uuh	Unhennium	363	3359	Uuq	Unquadium	367	3415	Uuh	Unhennium	371
	3415	Uuq	Unquadium	373	3479	Uuh	Unhennium	377	3555	Uuq	Unquadium	381
	3535	Uuh	Unhennium	383	3599	Uuq	Unquadium	387	3675	Uuh	Unhennium	391
	3655	Uuq	Unquadium	393	3719	Uuh	Unhennium	397	3795	Uuq	Unquadium	401
	3775	Uuh	Unhennium	403	3839	Uuq	Unquadium	407	3915	Uuh	Unhennium	411
	3895	Uuq	Unquadium	413	3959	Uuh	Unhennium	417	4035	Uuq	Unquadium	421
	4015	Uuh	Unhennium	423	4079	Uuq	Unquadium	427	4155	Uuh	Unhennium	431
	4135	Uuq	Unquadium	433	4199	Uuh	Unhennium	437	4275	Uuq	Unquadium	441
	4255	Uuh	Unhennium	443	4319	Uuq	Unquadium	447	4395	Uuh	Unhennium	451
	4375	Uuq	Unquadium	453	4439	Uuh	Unhennium	457	4515	Uuq	Unquadium	461
	4495	Uuh	Unhennium	463	4559	Uuq	Unquadium	467	4635	Uuh	Unhennium	471
	4615	Uuq	Unquadium	473	4679	Uuh	Unhennium	477	4755	Uuq	Unquadium	481
	4735	Uuh	Unhennium	483	4799	Uuq	Unquadium	487	4875	Uuh	Unhennium	491
	4855	Uuq	Unquadium	493	4919	Uuh	Unhennium	497	4995	Uuq	Unquadium	501
	4975	Uuh	Unhennium	503	5039	Uuq	Unquadium	507	5115	Uuh	Unhennium	511
	5095	Uuq	Unquadium	513	5159	Uuh	Unhennium	517	5235	Uuq	Unquadium	521
	5215	Uuh	Unhennium	523	5279	Uuq	Unquadium	527	5355	Uuh	Unhennium	531
	5335	Uuq	Unquadium	533	5399	Uuh	Unhennium	537	5475	Uuq	Unquadium	541
	5455	Uuh	Unhennium	543	5519	Uuq	Unquadium	547	5595	Uuh	Unhennium	551
	5575	Uuq	Unquadium	553	5639	Uuh	Unhennium	557	5715	Uuq	Unquadium	561
	5695	Uuh	Unhennium	563	5759	Uuq	Unquadium	567	5835	Uuh	Unhennium	571
	5815	Uuq	Unquadium	573	5879	Uuh	Unhennium	577	5955	Uuq	Unquadium	581
	5935	Uuh	Unhennium	583	5999	Uuq	Unquadium	587	6075	Uuh	Unhennium	591
	6055	Uuq	Unquadium	593	6119	Uuh	Unhennium	597	6195	Uuq	Unquadium	601
	6175	Uuh	Unhennium	603	6239	Uuq	Unquadium	607	6315	Uuh	Unhennium	611
	6295	Uuq	Unquadium	613	6359	Uuh	Unhennium	617	6435	Uuq	Unquadium	621
	6415	Uuh	Unhennium	623	6479	Uuq	Unquadium	627	6555	Uuh	Unhennium	631
	6535	Uuq	Unquadium	633	6599	Uuh	Unhennium	637	6675	Uuq	Unquadium	641
	6655	Uuh	Unhennium	643	6719	Uuq	Unquadium	647	6795	Uuh	Unhennium	651
	6775	Uuq	Unquadium	653	6839	Uuh	Unhennium	657	6915	Uuq	Unquadium	661
	6895	Uuh	Unhennium	663	6959	Uuq	Unquadium	667	7035	Uuh	Unhennium	671
	7015	Uuq	Unquadium	673	7079	Uuh	Unhennium	677	7155	Uuq	Unquadium	681
	7135	Uuh	Unhennium	683	7199	Uuq	Unquadium	687	7275	Uuh	Unhennium	691
	7255	Uuq	Unquadium	693	7319	Uuh	Unhennium	697	7395	Uuq	Unquadium	701
	7375	Uuh	Unhennium	703	7439	Uuq	Unquadium	707	7515	Uuh	Unhennium	711
	7495	Uuq	Unquadium	713	7559	Uuh	Unhennium	717	7675	Uuq	Unquadium	721
	7615	Uuh	Unhennium	723	7699	Uuq	Unquadium	727	7795	Uuh	Unhennium	731
	7735	Uuq	Unquadium	733	7819	Uuh	Unhennium	737	7935	Uuq	Unquadium	741
	7855	Uuh	Unhennium	743	7959	Uuq	Unquadium	747	8075	Uuh	Unhennium	751
	7975	Uuq	Unquadium	753	8099	Uuh	Unhennium	757	8215	Uuq	Unquadium	761
	8095	Uuh	Unhennium	763	8239	Uuq	Unquadium	767	8355	Uuh	Unhennium	771
	8215	Uuq	Unquadium	773	8379	Uuh	Unhennium	777	8495	Uuq	Unquadium	781
	8335	Uuh	Unhennium	783	8519	Uuq	Unquadium	787	8635	Uuh	Unhennium	791
	8455	Uuq	Unquadium	793	8659	Uuh	Unhennium	797	8775	Uuq	Unquadium	801
	8575	Uuh	Unhennium	803	8799	Uuq	Unquadium	807	8915	Uuh	Unhennium	811
	8695	Uuq	Unquadium	813	8939	Uuh	Unhennium	817	9075	Uuq	Unquadium	821
	8815	Uuh	Unhennium	823	9079	Uuq	Unquadium	827	9215	Uuh	Unhennium	831
	8935	Uuq	Unquadium	833	9239	Uuh	Unhennium	837	9375	Uuq	Unquadium	841
	9055	Uuh	Unhennium	843	9379	Uuq	Unquadium	847	9515	Uuh	Unhennium	851
	9175	Uuq	Unquadium	853	9499	Uuh	Unhennium	857	9655	Uuq	Unquadium	861
	9295	Uuh	Unhennium	863	9639	Uuq	Unquadium	867	9795	Uuh	Unhennium	871
	9415	Uuq	Unquadium	873	9779	Uuh	Unhennium	877	9935	Uuq	Unquadium	881
	9535	Uuh	Unhennium	883	9919	Uuq	Unquadium	887	10075	Uuh	Unhennium	891
	9655	Uuq	Unquadium	893	10159	Uuh	Unhennium	897	10215	Uuq	Unquadium	901
	9775	Uuh	Unhennium	903	10299	Uuq	Unquadium	907	10355	Uuh	Unhennium	911
	9895	Uuq	Unquadium	913	10439	Uuh	Unhennium	917	10495	Uuq	Unquadium	921
	10015	Uuh	Unhennium	923	10579	Uuq	Unquadium	927	10635	Uuh	Unhennium	931
	10135	Uuq	Unquadium	933	10719	Uuh	Unhennium	937	10775	Uuq	Unquadium	941
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	10375	Uuq	Unquadium	953	10999	Uuh	Unhennium	957	11055	Uuq	Unquadium	961
	10495	Uuh	Unhennium	963	11139	Uuq	Unquadium	967	11195	Uuh	Unhennium	971
	10615	Uuq	Unquadium	973	11279	Uuh	Unhennium	977	11335	Uuq	Unquadium	981
	10735	Uuh	Unhennium	983	11419	Uuq	Unquadium	987	11475	Uuh	Unhennium	991
	10855	Uuq	Unquadium	993	11559	Uuh	Unhennium	997	11615	Uuq	Unquadium	1001

Key

Relative atomic mass
Symbol
Name
Atomic number

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Answer ALL questions.

1 Bromine is an element in Group 7 of the Periodic Table.

(a) Which of these is the formula for a molecule of bromine?

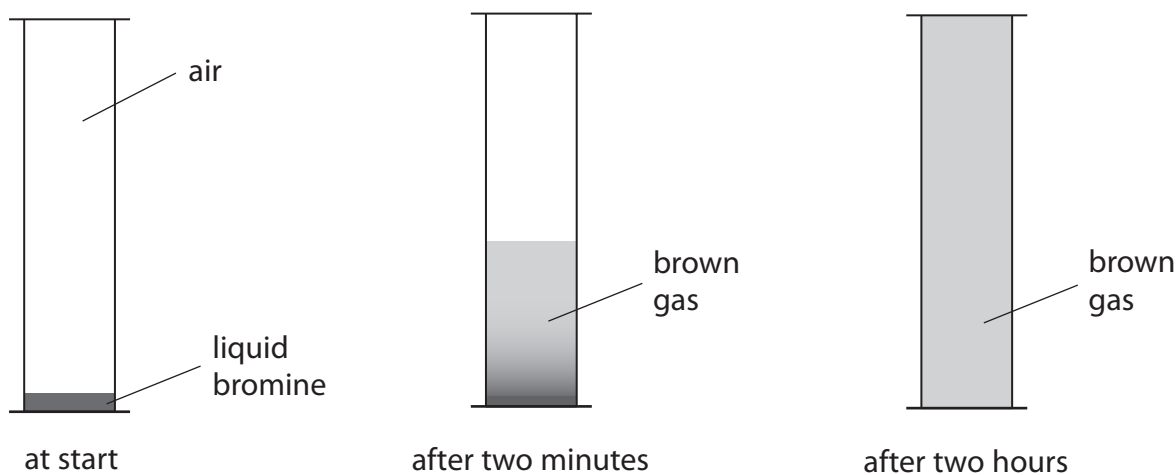
(1)

- ☐ A 2Br
- ☐ B Br²
- ☐ C Br2
- ☐ D Br₂

(b) A small amount of liquid bromine is placed in a gas jar containing air.
The jar is then sealed.

After two minutes, a brown gas is seen just above the surface of the liquid.

After two hours, the whole gas jar is full of the brown gas.



(i) Which of these is the process that causes the brown gas to fill the gas jar?

(1)

- ☐ A condensation
- ☐ B diffusion
- ☐ C evaporation
- ☐ D sublimation

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(ii) Explain, using the particle theory, the observations seen in the gas jar.

(2)

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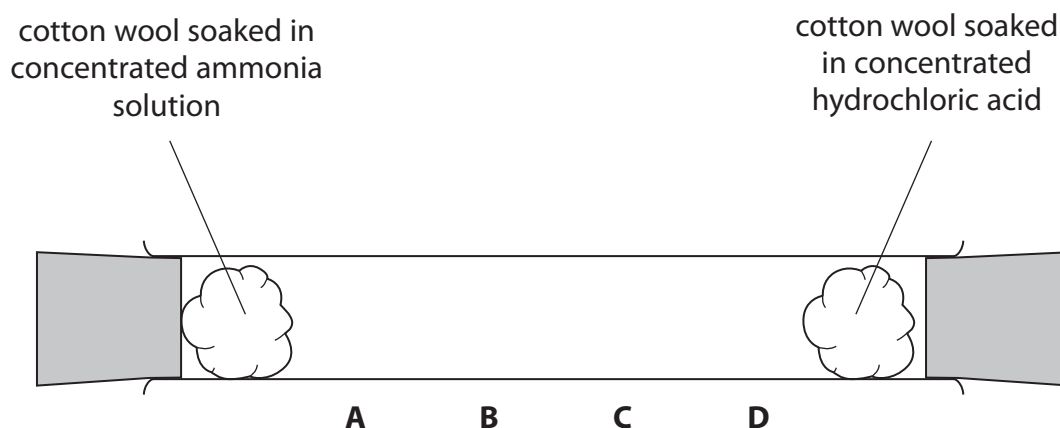
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(c) This apparatus is used to demonstrate the movement of ammonia gas and hydrogen chloride gas.



The gases are given off by the solutions at each end of the tube.

When the gases meet, they form a white solid.

Which letter shows the position where the white solid forms?

(1)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 1 = 5 marks)



- 2 Iron is a metal that has many uses.
One problem with iron is that it can rust when exposed to air.

(a) Name the two substances that must be present in air for iron to rust.

(2)

1

2

(b) These are four methods of preventing iron from rusting

- painting
- oiling
- galvanising
- coating in plastic

The table lists three items made from iron.

Complete the table by giving the best method of preventing each item from rusting.

You may use each method once, more than once or not at all.

(3)

Item	Method
bicycle chain	
bridge	
car body	

(c) Which of these metals is used to galvanise iron?

(1)

- ☐ A aluminium
- ☐ B lead
- ☐ C tin
- ☐ D zinc

(Total for Question 2 = 6 marks)



- 3 (a) The box shows some methods that can be used to separate mixtures.

crystallisation	dissolving	filtration
fractional distillation	paper chromatography	simple distillation

The table lists some separations.

Complete the table by giving the best method for each separation.

You may use each method once, more than once or not at all.

(4)

Separation	Method
to obtain sand from a mixture of sand and water	
to separate crude oil into its components	
to obtain pure water from sea water	
to obtain ethanol from a mixture of ethanol and water	

- (b) When a mixture of ethanol and water is separated, two colourless liquids, A and B, are obtained.

Liquid A is ethanol containing a small amount of water.

Liquid B is pure water.

- (i) Describe a chemical test to show that liquid A contains water.

(2)

.....

.....

.....

.....

- (ii) Describe a physical test to show that liquid B is pure water.

(2)

.....

.....

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.....

(Total for Question 3 = 8 marks)



4 The Periodic Table consists of elements arranged in order of increasing atomic number.

(a) (i) What is meant by the term **atomic number**?

(1)

- ☐ A the number of neutrons in an atom
- ☐ B the number of protons in an atom
- ☐ C the number of protons plus the number of electrons in an atom
- ☐ D the number of protons plus the number of neutrons in an atom

(ii) Elements in the same group of the Periodic Table have similar chemical properties.

This is because their atoms contain the same number of

(1)

- ☐ A protons
- ☐ B neutrons
- ☐ C electrons in the outer shell
- ☐ D protons and neutrons

(b) The elements in the periods of the Periodic Table show a change in properties across the period from left to right.

The table gives information about some elements in Period 2.

	Li	Be	B	C	N	F
melting point	low	high	high			
structure		giant	giant			molecular
acid-base character of the oxide		basic	acidic			

Complete the table by writing one of these words in each blank space.

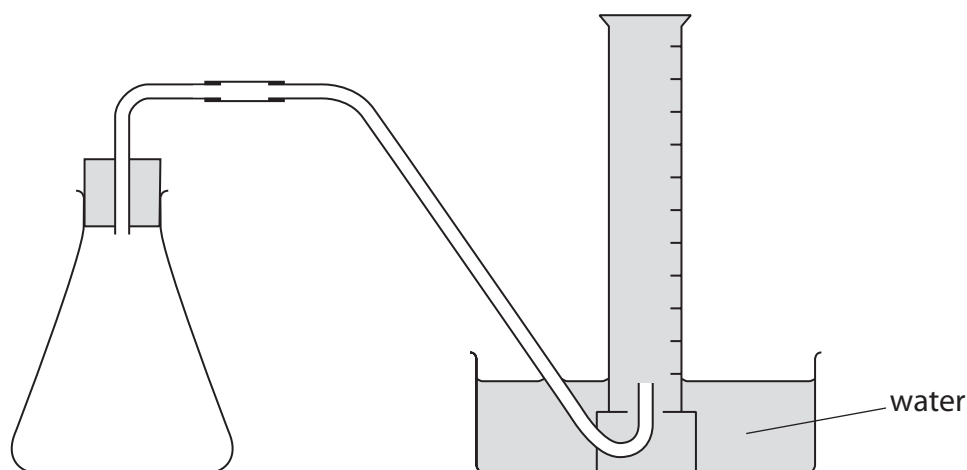
- high or low for melting point
- giant or molecular for structure
- acidic or basic for acid-base character of the oxide

(3)

(Total for Question 4 = 5 marks)



- 5 A student uses this apparatus to investigate the rate of reaction between an excess of magnesium and two different dilute acids, X and Y.



This is the method given to the student.

- place 0.5 g of magnesium ribbon into the conical flask
- use a measuring cylinder to add 50 cm³ of dilute acid X and then replace the bung
- record the total volume of gas collected every 20 seconds for two minutes
- repeat the method using 50 cm³ of dilute acid Y instead of dilute acid X
- in each experiment, keep the temperature the same and the magnesium in excess

- (a) The student decides to use a burette, rather than a measuring cylinder, to add the acid to the conical flask.

- (i) Using a burette would be an improvement only if another change is made to the method.

State the other change needed to the method.

(1)

- (ii) State the advantage of using a burette.

(1)



(b) The table shows the student's results.

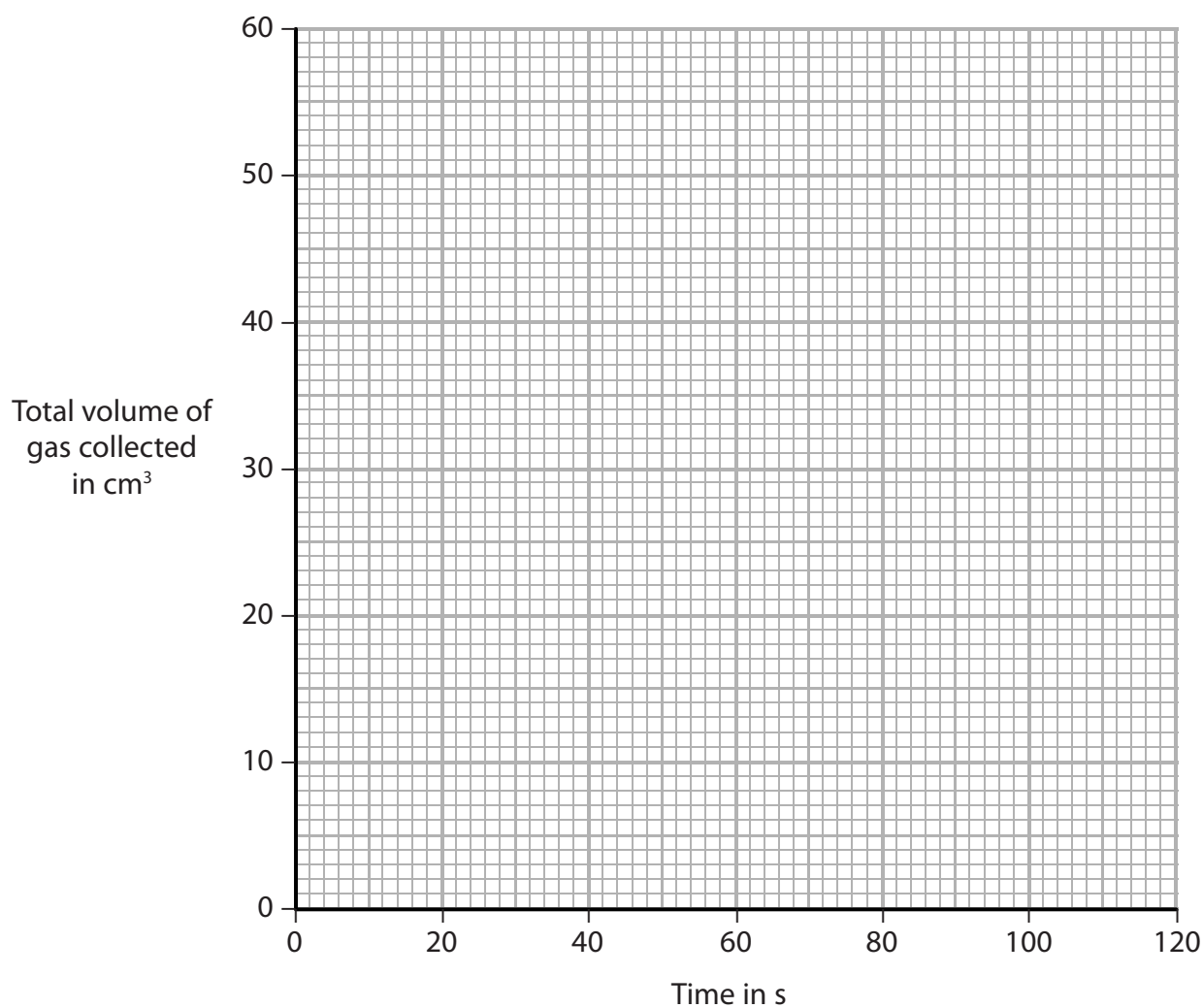
	Time in s	0	20	40	60	80	100	120
Acid X	Total volume of gas collected in cm ³	0	6	11	15	18	20	21
Acid Y	Total volume of gas collected in cm ³	0	12	22	30	37	43	48

Plot the results for each acid on the grid.

Draw a curve of best fit for each set of points.

Label each curve as acid X or acid Y.

(4)



(c) Explain how the curves show which acid has the greater concentration.

(2)

.....

.....

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.....

.....

.....

(d) Use the graph to find the total volume of gas collected at 70 s for acid X.

Show on the graph how you obtained your answer.

(2)

volume of gas = cm³

(e) The average (mean) rate of the reaction for acid Y can be calculated using the expression

$$\text{average rate} = \frac{\text{total volume of gas collected}}{\text{time to collect the gas}}$$

Calculate the average rate, in cm³/s, for the first 30 s for acid Y.

(2)

average rate = cm³/s

(Total for Question 5 = 12 marks)



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6 Copper and iron are metals. They have the typical properties of metals, including a high melting point and good electrical conductivity.

- (a) (i) Draw a labelled diagram to show the arrangement of the particles involved in the bonding within a metal.

(3)

- (ii) Explain why metals have good electrical conductivity.

(2)

- (iii) Suggest why some metals have high melting points.

(2)

- (b) Copper and iron both form compounds containing ions with a 2+ charge.

Sodium hydroxide is used to distinguish between solutions containing Cu^{2+} and Fe^{2+} ions.

What would be observed when aqueous sodium hydroxide is added separately to each solution?

(2)

Cu^{2+}

Fe^{2+}



(c) Copper can be found naturally as a pure metal.

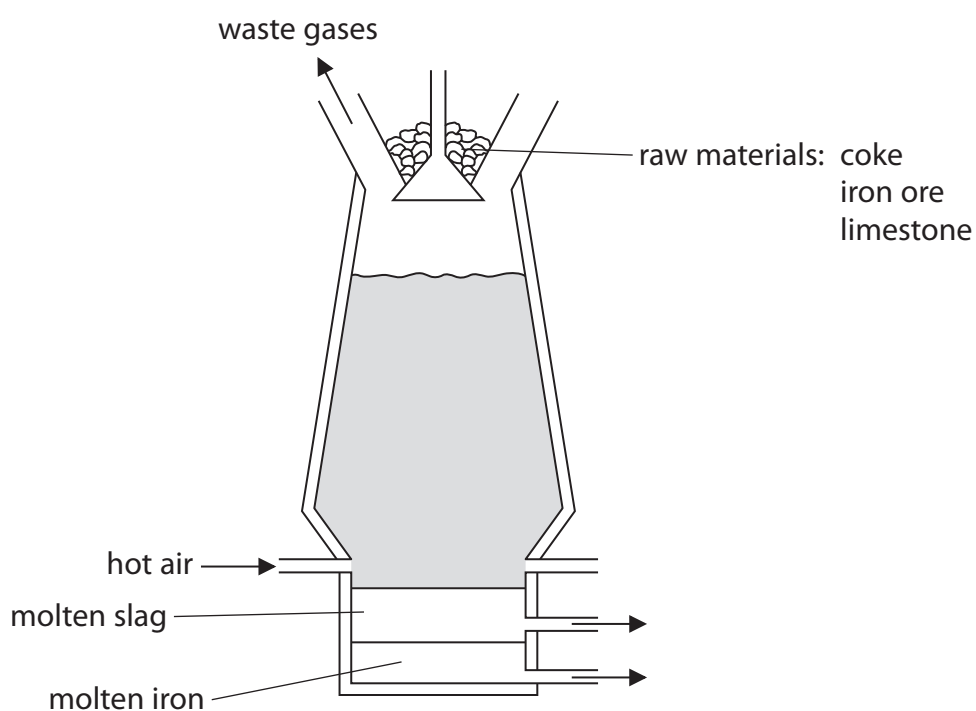
Iron is found only in compounds and has to be extracted by chemical reactions.

(i) Suggest why copper can be found as a pure metal.

(1)

(ii) The most common method of extracting iron is by the reduction of iron(III) oxide in a blast furnace.

The diagram shows a blast furnace.

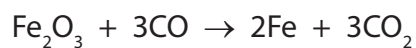


Write a chemical equation to show how carbon monoxide forms in the blast furnace.

(1)



(iii) The equation for the reaction between iron(III) oxide and carbon monoxide is



Explain which element is reduced in this reaction.

(2)

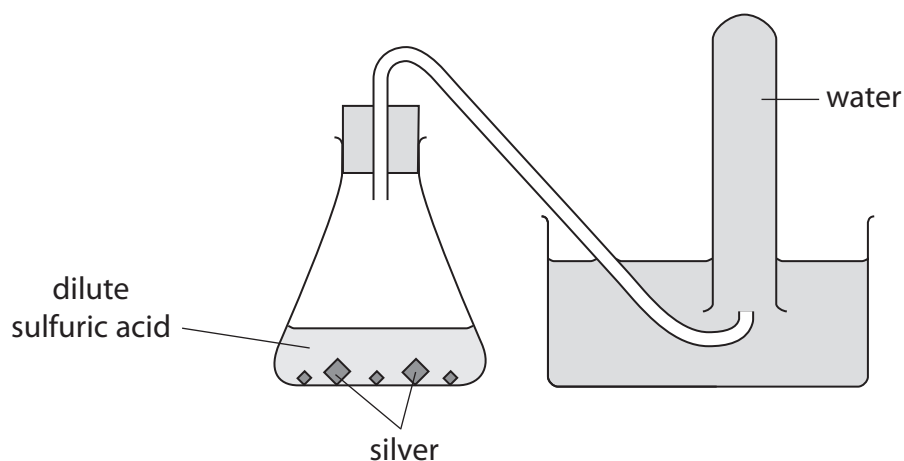
(iv) Describe how molten slag forms in the blast furnace.

(2)

(Total for Question 6 = 15 marks)



7 The diagram shows how a student attempts to prepare some hydrogen gas.



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(a) (i) State why no hydrogen is produced.

(1)

(ii) Which of these pairs of chemicals could be used to **safely** prepare hydrogen?

(1)

- ☐ A copper and dilute sulfuric acid
- ☐ B gold and dilute hydrochloric acid
- ☐ C potassium and dilute hydrochloric acid
- ☐ D zinc and dilute sulfuric acid



- (b) In an experiment, the student then successfully prepares some hydrogen and measures the volume of hydrogen collected.

She does the same experiment four times.

The table shows her results.

Experiment	Volume of hydrogen collected in cm ³
1	64
2	67
3	40
4	63

- (i) Explain which experiment produces an anomalous result.

(1)

.....

.....

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.....

- (ii) Calculate the average (mean) volume of hydrogen collected.

(2)

average volume = cm³

- (iii) Give a reason why it is important for the student to repeat the experiment.

(1)

.....

.....

(Total for Question 7 = 6 marks)



- 8 When iodine reacts with an excess of chlorine at -80°C , a compound forms.

The percentage composition by mass of this compound is

$$\text{I} = 54.4\% \quad \text{Cl} = 45.6\%$$

- (a) Show, by calculation, that the empirical formula of this compound is ICl_3

(2)

- (b) The molecular formula of this compound is I_2Cl_6

I_2Cl_6 is a yellow solid at room temperature and forms a liquid when heated.
A dynamic equilibrium exists in this liquid, represented by this equation.



- (i) When a reaction is in dynamic equilibrium, the forward and backward reactions occur at the same time.

State two other features of a reaction that is in dynamic equilibrium.

(2)

1

.....

2

.....

- (ii) Suggest why liquid I_2Cl_6 conducts electricity, but solid I_2Cl_6 does not.

(2)

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(Total for Question 8 = 6 marks)



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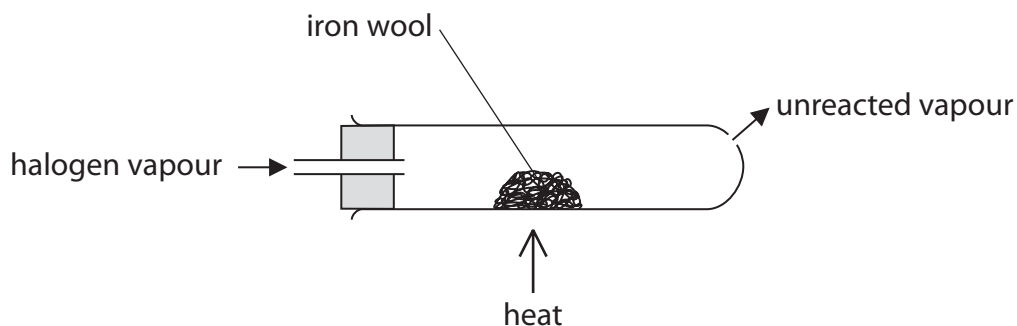


P 4 8 4 4 2 A 0 1 9 3 6

9 Bromine, chlorine and iodine are halogens in Group 7 of the Periodic Table.

The three halogens have similar chemical properties but different reactivities.

- (a) A teacher uses this apparatus to demonstrate the difference in reactivity between these halogens.



The teacher does each experiment in a fume cupboard.

The table shows the observation for each halogen.

Halogen	Observation
bromine	the iron wool glows brightly
chlorine	the iron wool glows very brightly
iodine	the iron wool glows dimly

- (i) Suggest why the teacher uses a fume cupboard.

(1)

- (ii) Use the information in the table to explain the order of reactivity of the three halogens.

(2)

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- (iii) A student states that the order of reactivity cannot be found from this experiment because bromine is a liquid, chlorine is a gas and iodine is a solid at room temperature.

Evaluate the student's statement.

(2)

.....

.....

.....

.....

.....

.....

- (b) Bromine, chlorine and iodine all react with hydrogen.

In each reaction, a hydrogen halide (HX) is formed, where X represents the halogen.

- (i) Write a chemical equation for the reaction between hydrogen and bromine.

(1)

.....

- (ii) Draw a dot and cross diagram to represent a molecule of hydrogen chloride, HCl.

Show only the outer shell electrons.

(2)

- (iii) Name the solution formed when hydrogen chloride dissolves in water.

(1)

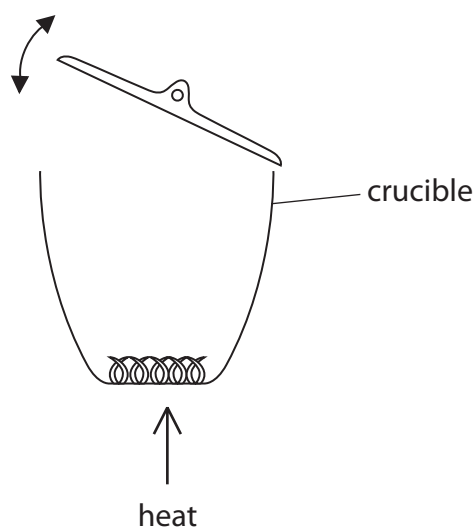
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(Total for Question 9 = 9 marks)

.....



- 10 A student uses this apparatus to find the mass of magnesium oxide that forms when a strip of magnesium ribbon is burned in air.



This is the student's method.

- weigh an empty crucible and lid
 - place a coiled strip of freshly cleaned magnesium ribbon in the crucible
 - weigh the crucible, lid and ribbon
 - heat the crucible strongly for several minutes, lifting the lid and quickly replacing it several times
 - leave the crucible, lid and contents to cool and then reweigh
- (a) (i) Describe the appearance of the freshly cleaned magnesium ribbon and the appearance of the magnesium oxide that forms.

(2)

magnesium ribbon

.....

magnesium oxide

.....

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- (ii) Explain why the student lifts the lid and quickly replaces it several times during the experiment.

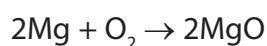
(2)

lifts lid

replaces lid

- (b) Calculate the mass of oxygen required to completely react with 0.6 g of magnesium to form magnesium oxide.

The equation for the reaction is



(2)

mass of oxygen = g

- (c) The mass of magnesium oxide that forms is less than expected.

This could be because some of the magnesium reacts with nitrogen to form magnesium nitride, Mg_3N_2

Write a chemical equation for the reaction between magnesium and nitrogen to form magnesium nitride.

(1)

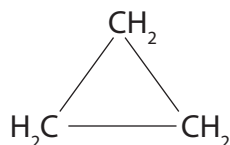
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11 The alkanes are a homologous series of hydrocarbons.

The cycloalkanes are another homologous series of hydrocarbons, where the carbon atoms are arranged in a ring structure.

Cyclopropane is the simplest cycloalkane. It can be represented as



The tables give the names and molecular formulae of the first three members of each series.

Name of alkane	Molecular formula
methane	CH_4
ethane	C_2H_6
propane	C_3H_8

Name of cycloalkane	Molecular formula
cyclopropane	C_3H_6
cyclobutane	C_4H_8
cyclopentane	C_5H_{10}

(a) One feature of a homologous series is that each member has the same general formula.

(i) What is the general formula for the homologous series of alkanes?

(1)

- ☐ **A** C_nH_n
- ☐ **B** $\text{C}_n\text{H}_{2n-2}$
- ☐ **C** C_nH_{2n}
- ☐ **D** $\text{C}_n\text{H}_{2n+2}$

(ii) What is the general formula for the homologous series of cycloalkanes?

Use the information from the cycloalkane table to help you answer the question.

(1)

- ☐ **A** C_nH_n
- ☐ **B** $\text{C}_n\text{H}_{2n-2}$
- ☐ **C** C_nH_{2n}
- ☐ **D** $\text{C}_n\text{H}_{2n+2}$

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(iii) State two other features of a homologous series of compounds.

(2)

1

2

(b) Alkanes and cycloalkanes are saturated hydrocarbons.

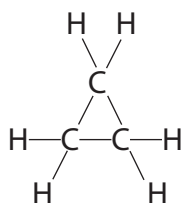
(i) State what is meant by the term **saturated**.

(1)

(ii) Draw the displayed formula for ethane, C_2H_6

(1)

(iii) The displayed formula for cyclopropane is



Draw a displayed formula for cyclobutane, C_4H_8

(1)



- (c) The reaction between cyclopropane and bromine is similar to the reaction between methane and bromine.

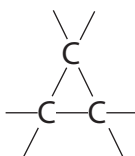
One product of the reaction between cyclopropane and bromine is hydrogen bromide, HBr.

- (i) State the condition required for this reaction to occur.

(1)

- (ii) Complete the displayed formula for the other product of this reaction.

(1)



(Total for Question 11 = 9 marks)



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- 12** A student is given a mixture of two solid ionic compounds, A and B. Each solid contains one cation and one anion.

Compound A is insoluble in water.

Compound B is soluble in water.

- (a) Describe how the student could separate the mixture to obtain solid A and a solution of B. (2)

.....

.....

.....

.....

- (b) The table shows the results of two tests the student does on a solution of B.

	Test	Observation
Test 1	add sodium hydroxide solution and warm	bubbles of gas that turn damp red litmus blue
Test 2	add silver nitrate solution	white precipitate forms
	add dilute nitric acid to the white precipitate	precipitate does not dissolve

- (i) Use the information in the table to identify the cation and the anion present in compound B.

(2)

cation

anion

- (ii) Identify the gas given off in test 1.

(1)

.....

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(c) The student adds dilute hydrochloric acid to solid A.

A gas that turns limewater milky is given off.

(i) Explain which anion is present in solid A.

(2)

.....

.....

.....

.....

(ii) Give a test to show that solid A contains calcium ions.

(2)

test

.....

result

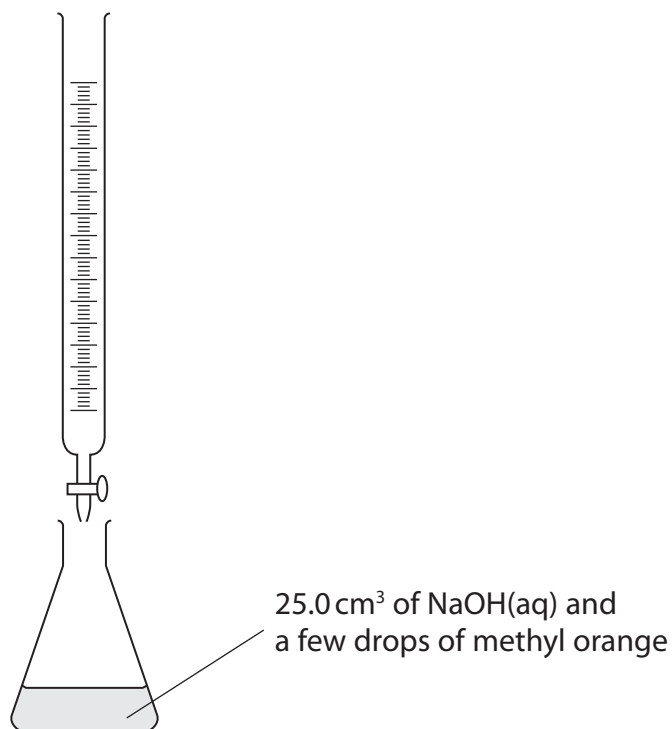
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(Total for Question 12 = 9 marks)



P 4 8 4 4 2 A 0 2 9 3 6

- 13 This apparatus can be used to find the volume of dilute sulfuric acid needed to neutralise 25.0 cm^3 of aqueous sodium hydroxide, NaOH.



- (a) Describe how to use the apparatus to find the volume of dilute sulfuric acid needed to neutralise the sodium hydroxide.

Assume that the apparatus is clean and does not need rinsing.

(4)

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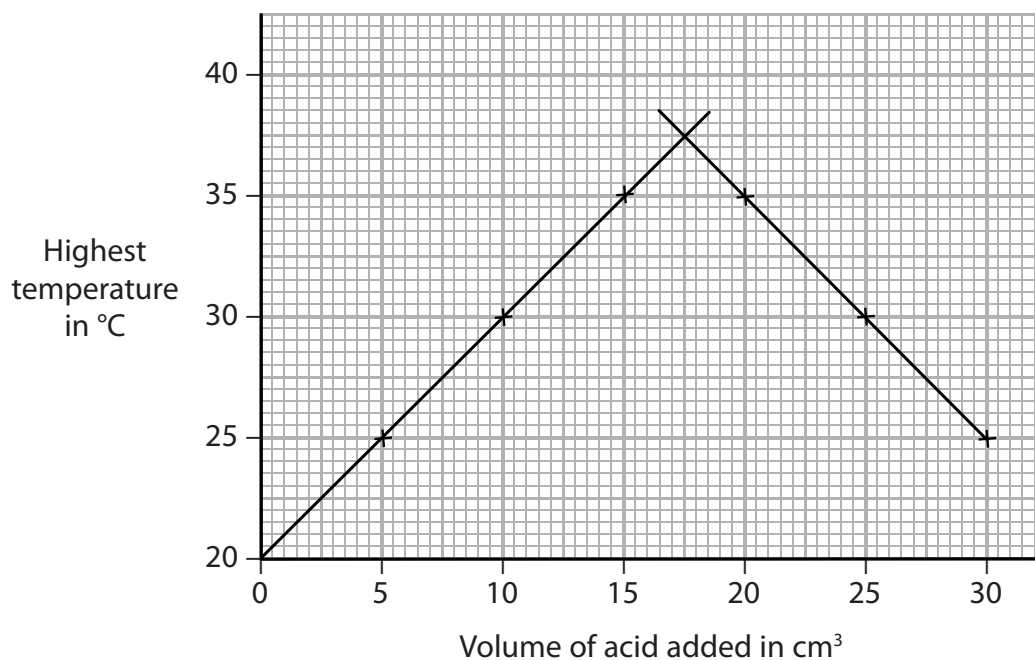


- (b) The volume of dilute sulfuric acid needed can also be found by measuring the highest temperature reached when the two solutions are mixed.

In a series of experiments, different volumes of dilute sulfuric acid are added separately to 25.0 cm³ samples of aqueous sodium hydroxide.

The graph shows the highest temperatures in each experiment.

In each reaction, the starting temperatures of the two solutions are the same.



Use the graph to answer these questions.

- (i) State the starting temperature of each experiment.

(1)

starting temperature = °C

- (ii) Find the volume of acid required to exactly neutralise the sodium hydroxide.

(1)

volume of acid = cm³

- (iii) Find the two different volumes of acid that produce an increase in temperature of 10°C.

(1)

..... and

(Total for Question 13 = 7 marks)



14 Lithium is an element in Group 1 of the Periodic Table.

Lithium is stored in oil to prevent it from coming into contact with air and water.

(a) When a piece of lithium is removed from the oil, dried and cut, the exposed surface (1)

- ☐ **A** bubbles and fizzes
- ☐ **B** changes from shiny to dull
- ☐ **C** bursts into flame
- ☐ **D** does not change

(b) When lithium is added to cold water in a beaker, hydrogen forms.

(i) State the test for hydrogen. (1)

(ii) A few drops of phenolphthalein indicator are added to the solution in the beaker.

Explain why the phenolphthalein turns pink. (2)



- (c) The table shows some information about lithium oxide and lithium carbonate.

Complete the table by giving the two missing formulae.

(2)

Name of compound	Formula of compound	Formula of cation in compound	Formula of anion in compound
lithium oxide		Li^+	O^{2-}
lithium carbonate	Li_2CO_3	Li^+	

- (d) Caesium is another element in Group 1 of the Periodic Table.

- (i) The table below lists some statements about the reaction of caesium with cold water compared to the reaction of lithium with cold water.

Place ticks (✓) in the boxes to show the two correct statements.

(2)

the reaction with caesium is more vigorous	
the reaction with caesium produces a different gas	
the reaction with caesium produces an acidic solution	
the reaction with caesium produces a different compound	
the reaction of caesium is endothermic	

- (ii) Write a chemical equation for the reaction of caesium with water.

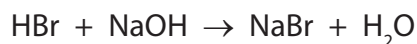
(2)

(Total for Question 14 = 10 marks)



15 Hydrobromic acid can be neutralised by adding sodium hydroxide solution.

The equation for the reaction is



A solution of hydrobromic acid has a concentration of 0.200 mol/dm^3 .

- (a) Calculate the amount, in moles, of HBr in 20.0 cm^3 of the hydrobromic acid solution. (2)

amount of HBr = mol

- (b) Calculate the volume of 0.100 mol/dm^3 sodium hydroxide solution needed to exactly neutralise the hydrobromic acid.

Give the unit.

(2)

volume of sodium hydroxide =

- (c) In another neutralisation reaction, a student uses 30.0 cm^3 of 0.200 mol/dm^3 aqueous sodium hydroxide solution.

Calculate the mass of sodium hydroxide contained in this solution.

(2)

mass of sodium hydroxide = g

(Total for Question 15 = 6 marks)

TOTAL FOR PAPER = 120 MARKS

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