Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Time 2 hours

Paper reference 4CH1/1C 4SD0/1C

Chemistry

Unit: 4CH1
Science (Double Award) 4SD0
PAPER: 1C

You must have:
Calculator, ruler

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.

Information

- The total mark for this paper is 110.
- 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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L:1/1/1/

P 7 0 7 0 1 A 0 1 3 2

Pearson

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.

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Answer ALL questions.

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 ☒.

1 This question is about mixtures and compounds.

(a) The box gives some methods used to separate mixtures.

chromatography	crystallisation
fractional distillation	simple distillation

Choose methods from the box to answer the following questions.

Each method may be used once, more than once or not at all.

(i) Identify a method to separate a single food dye from a mixture of food dyes.

(1)

.....

(ii) Identify a method to separate gasoline from crude oil.

(1)

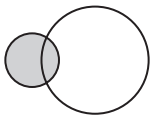
.....

(iii) Identify a method to separate water from copper(II) sulfate solution.

(1)

.....

(b) The diagram represents a molecule.



Explain why this molecule is a compound.

(2)

(c) The molecular formula of another compound is $C_3H_5N_3O_9$

(i) State the number of different elements in $C_3H_5N_3O_9$

(1)

(ii) Determine the number of atoms in a molecule of $C_3H_5N_3O_9$

(1)

(Total for Question 1 = 7 marks)

2 This question is about rusting.

(a) A simplified formula for rust is Fe_2O_3

(i) Name the two substances needed for iron to rust.

(2)

1 .....

2 .....

(ii) Give the chemical name for rust.

(1)

.....

(iii) What type of reaction occurs in the rusting of iron?

(1)

☒ **A** combustion

☒ **B** neutralisation

☒ **C** oxidation

☒ **D** thermal decomposition

(b) Some iron objects are coated with a layer of zinc to prevent rusting.

(i) Name this type of rust prevention.

(1)

.....

(ii) Explain how this type of rust prevention continues to protect iron when the layer of zinc is damaged.

(2)

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(iii) Give two other methods used to prevent iron from rusting.

(2)

1 .....

.....

2 .....

.....

(Total for Question 2 = 9 marks)

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3 This question is about states of matter.

(a) The box gives words relating to changes of state.

condensation	cooling	evaporation
freezing	melting	sublimation

Complete the table by giving the correct word from the box for each change of state.

(3)

Change of state	Name of change
solid to liquid	
solid to gas	
liquid to solid	

(b) When ammonia gas and hydrogen chloride gas mix, they react together to form a white solid called ammonium chloride.

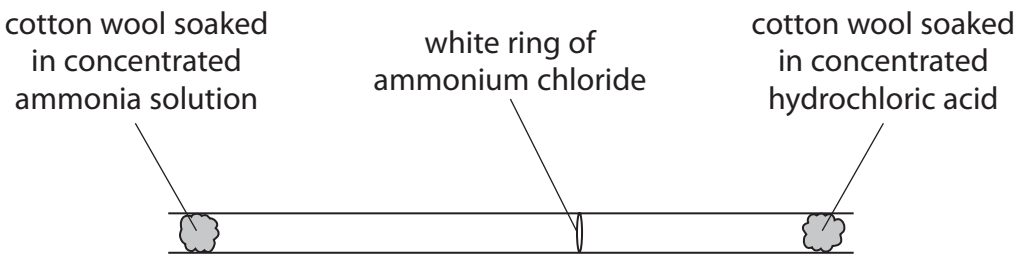
The equation for the reaction is

$$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$$

A teacher soaks a piece of cotton wool in concentrated ammonia solution and another piece of cotton wool in concentrated hydrochloric acid.

The teacher places the two pieces of cotton wool at opposite ends of a glass tube at the same time.

After several minutes, a white ring of solid ammonium chloride forms.



(i) State the name given to the spreading out of gas particles.

(1)

.....

(ii) State how the diagram shows that the particles of ammonia gas are travelling at higher speeds than the particles of hydrogen chloride gas.

(1)

.....

.....

(iii) Gas particles travel at high speeds.

Give a reason why the white ring of ammonium chloride takes several minutes to form.

(1)

.....

.....

(iv) Concentrated ammonia solution and concentrated hydrochloric acid are corrosive.

Give one safety precaution the teacher should take.

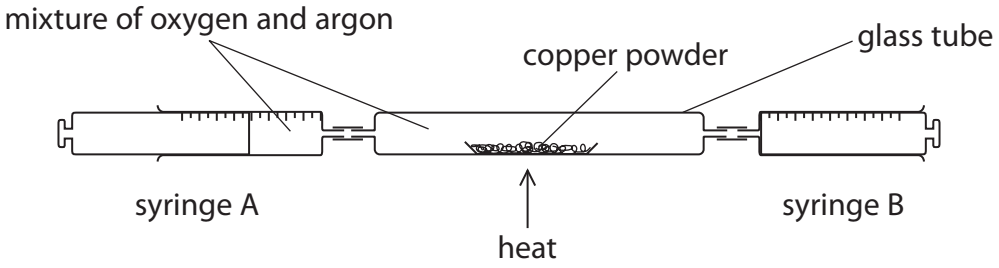
(1)

.....

.....

(Total for Question 3 = 7 marks)

4 A teacher uses this apparatus to find the percentage of oxygen in a gaseous mixture of oxygen and argon.



This is the teacher's method.

Step 1 heat the copper powder

Step 2 push the plunger on syringe A to pass the mixture of oxygen and argon over the hot copper so that the mixture moves into syringe B

Step 3 push the plunger on syringe B to pass the mixture of oxygen and argon over the hot copper so that the mixture moves into syringe A

Step 4 record the reading on syringe A

Step 5 repeat Steps 2, 3 and 4 a number of times

The volume of gas decreases as the oxygen reacts with the copper.

Argon is unreactive so does not react with the copper.

The copper powder turns black.

(a) (i) Give a reason why the copper powder is heated.

(1)

.....

.....

(ii) State why argon is unreactive.

(1)

.....

.....

(iii) Give the name of the black powder that forms when the oxygen reacts with the copper.

(1)

.....

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

Reading number	Reading on syringe A in cm^3
Start	78
1	70
2	67
3	65
4	63
5	61
6	60
7	59
8	58
9	58
10	58

(i) State how the results show that all the oxygen has reacted.

(1)

.....

.....

(ii) The volume of gas in the glass tube and connecting tubes is 175 cm^3.

Use this value and the results table to calculate the percentage of oxygen in the mixture of oxygen and argon.

(3)

percentage of oxygen = ... %

(iii) Suggest one reason why the calculated percentage of oxygen in the mixture may not be accurate.

(1)

.....

.....

(Total for Question 4 = 8 marks)

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5 (a) Complete the table to show the relative mass and relative charge of a proton and a neutron.

(2)

	Proton	Electron	Neutron
Relative mass		1/2000	
Relative charge		−1	

(b) Magnesium has three isotopes.

(i) State the meaning of the term **isotopes**.

(2)

.....

.....

.....

.....

(ii) The symbol for an atom of one isotope of magnesium is

$$^{26}_{12}Mg$$

Give the number of protons, neutrons and electrons in one atom of this isotope.

(2)

number of protons

.....

number of neutrons

.....

number of electrons

.....

(iii) A sample of magnesium contains these percentages of the three isotopes.

Mg-24 = 79.00 % Mg-25 = 10.00 % Mg-26 = 11.00 %

Use this information to show that the relative atomic mass of magnesium is 24.32

(2)

(iv) One mole of magnesium has a mass of 24.32 g.
There are 6.022×10^{23} atoms in one mole.

Calculate the mass, in grams, of one atom of magnesium.

Give your answer to 4 significant figures.

(2)

mass = ... g

(c) The equation for the reaction between magnesium and oxygen is

$$2Mg + O_2 \rightarrow 2MgO$$

Determine the maximum amount, in moles, of magnesium oxide that can be produced from 0.50 mol of magnesium and 0.20 mol of oxygen.

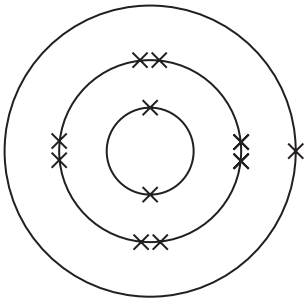
(1)

amount = ... mol

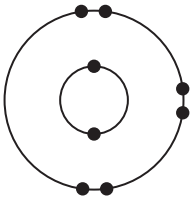
(Total for Question 5 = 11 marks)

6 This question is about sodium oxide, Na_2O

(a) The diagram shows the electronic configuration of atoms of sodium and oxygen.



Sodium



Oxygen

Describe the changes in the electronic configuration of the atoms of sodium and oxygen to form the ions in sodium oxide.

(3)

.....

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.....

.....

.....

.....

(b) Calculate the relative formula mass (M_r) of sodium oxide, Na_2O, using information from the Periodic Table.

(1)

M_r = ...

(c) Explain why solid sodium oxide does not conduct electricity.

(2)

(d) Give a test to show that sodium oxide contains sodium ions.

(2)

(e) When sodium oxide is heated it reacts to form sodium metal and sodium peroxide, Na_2O_2

Complete the equation for this reaction.

(1)

$Na_2O \rightarrow$

(Total for Question 6 = 9 marks)

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7 This question is about soluble and insoluble compounds.

A precipitate is an insoluble compound formed when solutions of soluble compounds react after mixing.

(a) Different solutions are mixed in separate test tubes.

Tube 1 copper(II) sulfate solution and calcium chloride solution

Tube 2 magnesium nitrate solution and potassium sulfate solution

Tube 3 sodium carbonate solution and copper(II) sulfate solution

In which of the tubes will a precipitate form?

(1)

☒ **A** 1 and 2 only

☒ **B** 2 and 3 only

☒ **C** 1 and 3 only

☒ **D** 1, 2 and 3

(b) A student mixes solutions, containing equal amounts in moles, of silver nitrate and sodium chloride.

The equation for the reaction between silver nitrate solution and sodium chloride solution is

$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

(i) State the colour of the precipitate of silver chloride.

(1)

.....

.....

(ii) The student wants to obtain pure, dry crystals of sodium nitrate.

Crystals of sodium nitrate decompose at temperatures above 300 °C.

Describe a method the student could use to obtain pure, dry crystals of sodium nitrate.

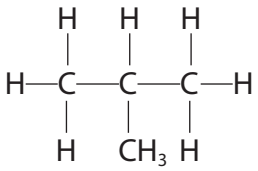
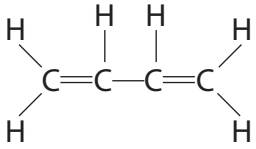
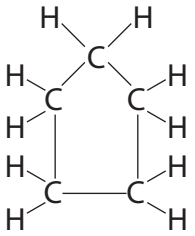
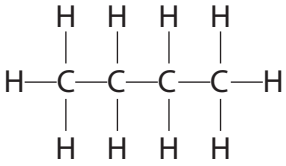
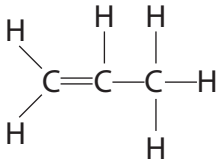
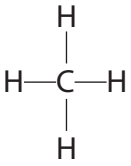
(5)

(iii) Give an advantage of mixing solutions containing equal amounts, in moles, of silver nitrate and sodium chloride.

(1)

(Total for Question 7 = 8 marks)

8 The table shows the structures of six organic compounds.

A 	B 	C 
D 	E 	F 

(a) (i) Give the letter of a compound **not** shown as a displayed formula.

(1)

.....

(ii) Give the letter of a saturated compound with the general formula C_nH_{2n}

(1)

.....

(iii) Name compound E.

(1)

.....

(iv) Explain why compound A and compound D are isomers.

(2)

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(b) Compound F reacts with bromine in the presence of ultraviolet radiation.

(i) Complete the equation for the reaction.

(1)

$CH_4 + Br_2 \rightarrow$

(ii) Give the name of this type of reaction.

(1)

.....

(c) (i) Another compound, G, has this percentage composition by mass.

C = 37.8 % H = 6.3 % Cl = 55.9 %

Show by calculation that the empirical formula of compound G is C_2H_4Cl

(3)

(ii) The relative formula mass (M_r) of G is 127

Determine the molecular formula of G.

(2)

molecular formula = ...

(d) Compound E is used to make an addition polymer.

(i) Complete the equation to show part of the polymer formed from two molecules of compound E.

(2)

(ii) Give one problem caused by the disposal of addition polymers.

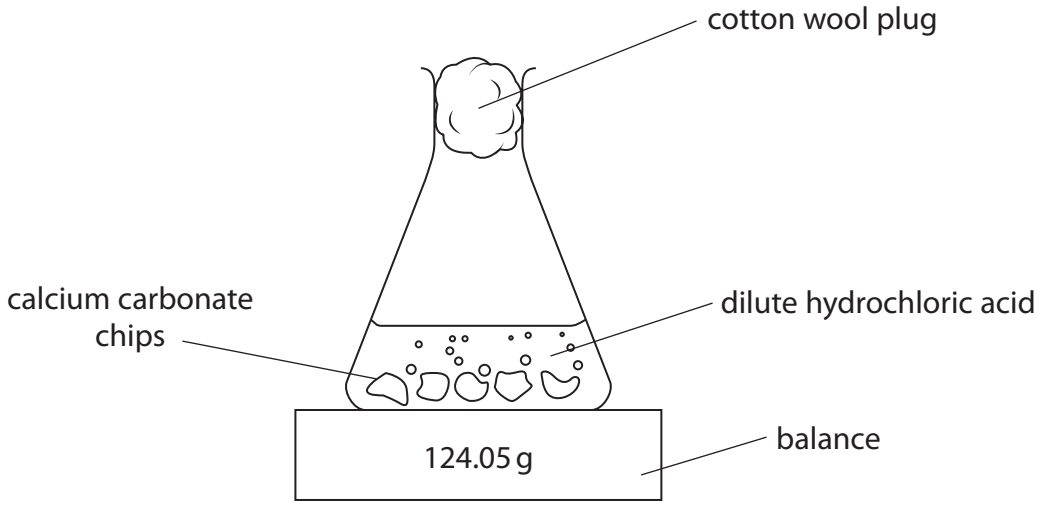
(1)

.....

.....

(Total for Question 8 = 15 marks)

9 A student uses this apparatus to investigate the rate of reaction between calcium carbonate chips and dilute hydrochloric acid.



Every 20 seconds the student records the reading on the balance.

(a) Explain why using a cotton wool plug increases the accuracy of the student's results.

(2)

.....

.....

.....

.....

(b) Complete the equation for the reaction by adding the state symbols.

(2)

$CaCO_3$(.....) + 2HCl(.....) → $CaCl_2$(aq) + H_2O(.....) + CO_2(.....)

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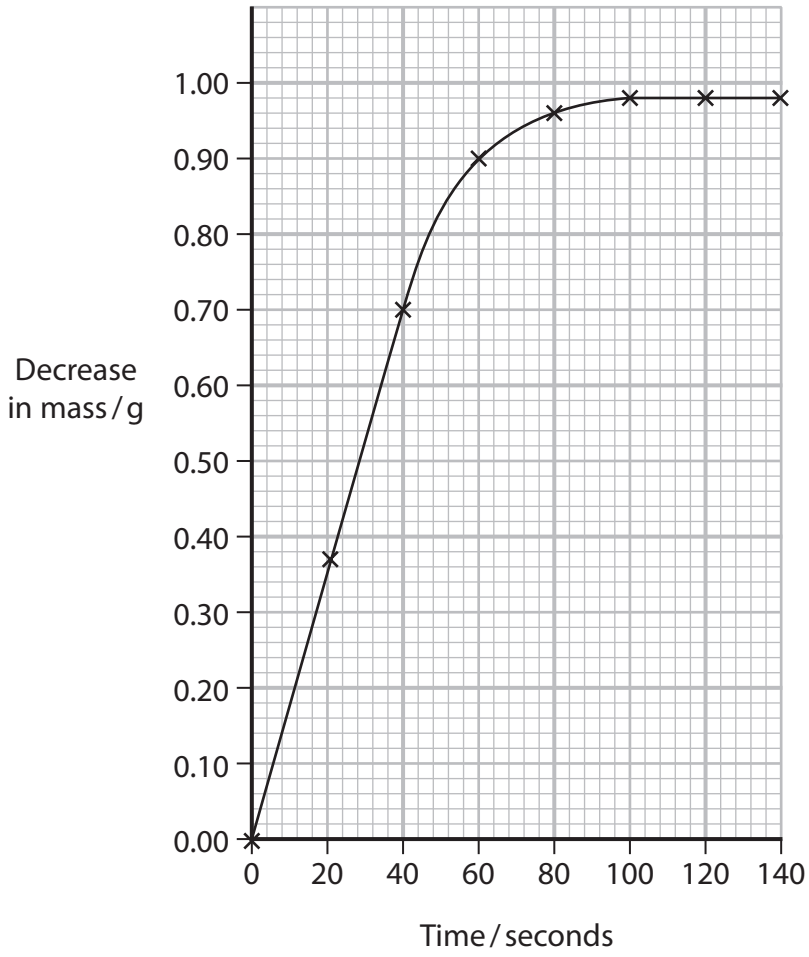
(c) The student uses the balance readings to find the decrease in mass of the flask and contents.

The graph shows the student's results.



(i) Give a reason why there are some calcium carbonate chips remaining in the flask when the reaction stops.

(1)

.....

.....

(ii) State how the student would know when the reaction has stopped.

(1)

.....

.....

(iii) Use the graph to determine the amount, in moles, of carbon dioxide produced during the reaction.

[M_r of CO_2 = 44]

(2)

amount = ... mol

(iv) Use the graph to calculate the rate of reaction, in grams per second, at time 60 seconds.

Show your working on the graph.

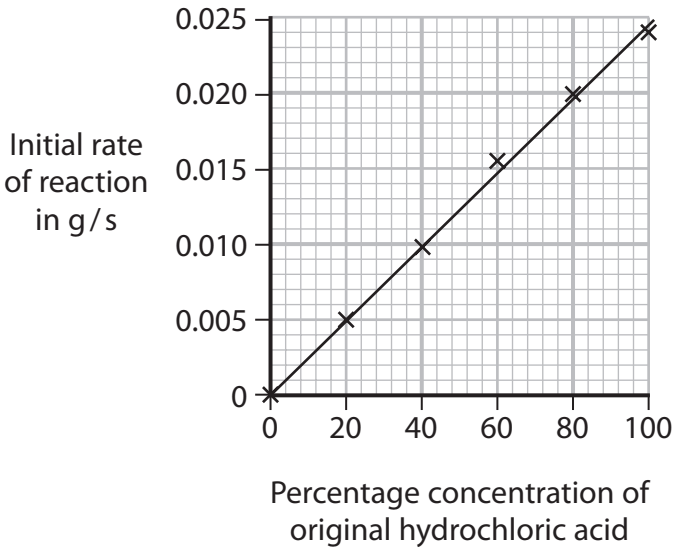
(3)

rate of reaction = ... g / s

(d) The student repeats the investigation by diluting the original hydrochloric acid.

The student then determines the initial rate of reaction at different percentage concentrations of the original hydrochloric acid.

The graph shows the student's results.



(i) Describe the relationship between the initial rate of reaction and percentage concentration of the original hydrochloric acid.

(2)

.....

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(ii) Explain why changing the concentration of hydrochloric acid has an effect on the initial rate of reaction.

(2)

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(Total for Question 9 = 15 marks)

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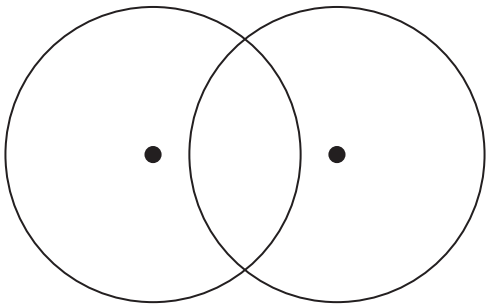
10 This question is about substances with covalent bonds.

(a) (i) Draw a dot and cross diagram to show the outer shell electrons in a molecule of nitrogen, N_2

(2)



(ii) Describe the forces of attraction in a covalent bond.

(2)

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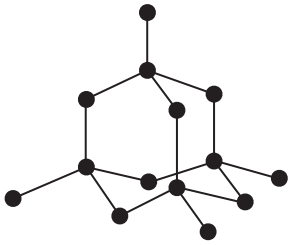
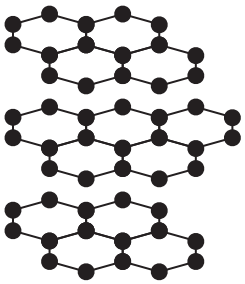
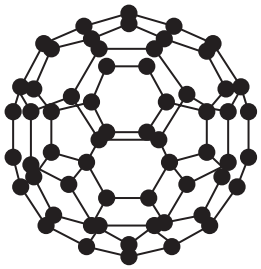
(b) The diagram shows three different structures of carbon.



Structure A



Graphite



C_{60} fullerene

(i) Name structure A.

(1)

.....

(ii) Graphite and C_{60} fullerene contain covalent bonds, but have different structures.

Explain why C_{60} fullerene has a much lower melting point than graphite.

Refer to structure and bonding in your answer.

(4)

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(Total for Question 10 = 9 marks)

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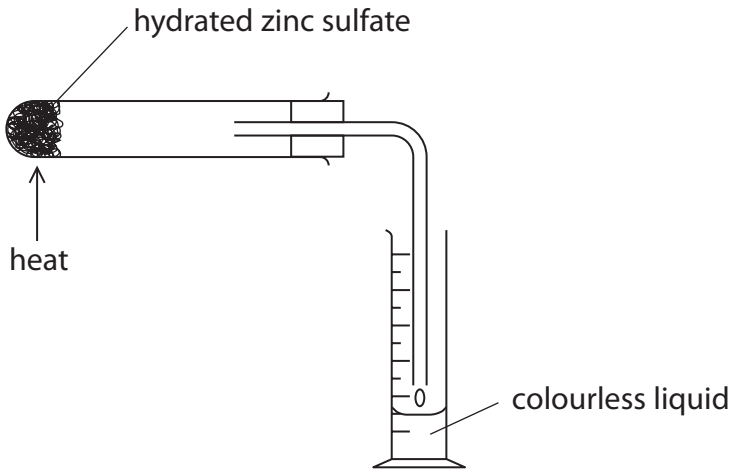
11 A student uses this apparatus to heat crystals of hydrated zinc sulfate and collect the liquid produced.



(a) (i) Describe a chemical test to show that the colourless liquid contains water.

(2)

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.....

.....

(ii) Describe a physical test to show the colourless liquid is pure water.

(2)

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.....

.....

.....

(b) The equation for the decomposition of hydrated zinc sulfate is

$$ZnSO_4 \cdot 7H_2O(s) \rightarrow ZnSO_4(s) + 7H_2O(l)$$

The student records these masses.

mass of boiling tube = 41.64 g

mass of boiling tube + $ZnSO_4 \cdot 7H_2O$ = 54.46 g

Calculate the maximum volume, in cm^3, of pure water that could be produced.

Give your answer to 1 decimal place.

[1.00 cm^3 of pure water has a mass of 1.00 g]

[M_r of $ZnSO_4 \cdot 7H_2O$ = 287 M_r of H_2O = 18]

(5)

maximum volume of pure water = ... cm^3

(c) In an experiment using a different mass of $ZnSO_4 \cdot 7H_2O$ the maximum volume of pure water that could be produced is 8.5 cm^3.

The student collected the pure water and calculated the percentage yield to be 20.3 %.

(i) Calculate the volume, in cm^3, of pure water collected.

(1)

volume of pure water = ... cm^3

(ii) Explain an improvement to the apparatus that would increase the percentage yield of pure water.

(2)

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(Total for Question 11 = 12 marks)

TOTAL FOR PAPER = 110 MARKS