MODEL ANSWERS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE (9–1)

Centre Number | | | | | |

Candidate Number | | | | |

Thursday 16 May 2019

Morning (Time: 2 hours)

Paper Reference **4CH1/1CR 4SD0/1CR**

Chemistry

Unit: 4CH1

Science (Double Award) 4SD0

Paper: 1CR

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.
- 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 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 ▶

P60252A

1/1/1/1/1/1/1/1/1/

P 6 0 2 5 2 A 0 1 2 4

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.

Answer ALL questions.

1 This question is about the three states of matter, solid, liquid and gas.

(a) Solids, liquids and gases can be changed from one state to another.

The box gives the names of some changes of state.

condensing	evaporation	melting	sublimation

Use words from the box to complete the sentences.

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

(i) The change from solid to liquid is called Melting (1)

(ii) The change from liquid to gas is called Evaporation (1)

(iii) The change from solid to gas is called Sublimation. (1)

(b) Describe the arrangement and the movement of particles in a solid. (3)

The particles are close together and regularly arranged.

The particles don't move around but vibrate about a fixed position.

(Total for Question 1 = 6 marks)

2 This question is about some elements in Group 1 of the Periodic Table.

(a) The table gives some statements about the reaction of potassium with water.

Place ticks (✓) in three boxes to show which three statements are correct.

(3)

Statement	
potassium reacts more vigorously than sodium when added to water	✓
potassium sinks to the bottom of the water	
bubbles of oxygen gas are produced	
a lilac flame is seen	✓
potassium moves around	✓
a solution of potassium oxide is formed	

(b) After the reaction of potassium with water is complete, a few drops of universal indicator are added to the solution formed. The universal indicator turns purple.

(i) Suggest a value for the pH of the solution.

(1)

11-14

(ii) Give the formula of the ion responsible for this pH value.

(1)

OH^-

(c) Sodium burns in oxygen to produce sodium oxide.

Complete the equation for this reaction.

(1)

4 Na + 1 O_2 → 2 Na_2O

(Total for Question 2 = 6 marks)

3 A student uses paper chromatography to investigate the dyes in five different inks, V, W, X, Y and Z.

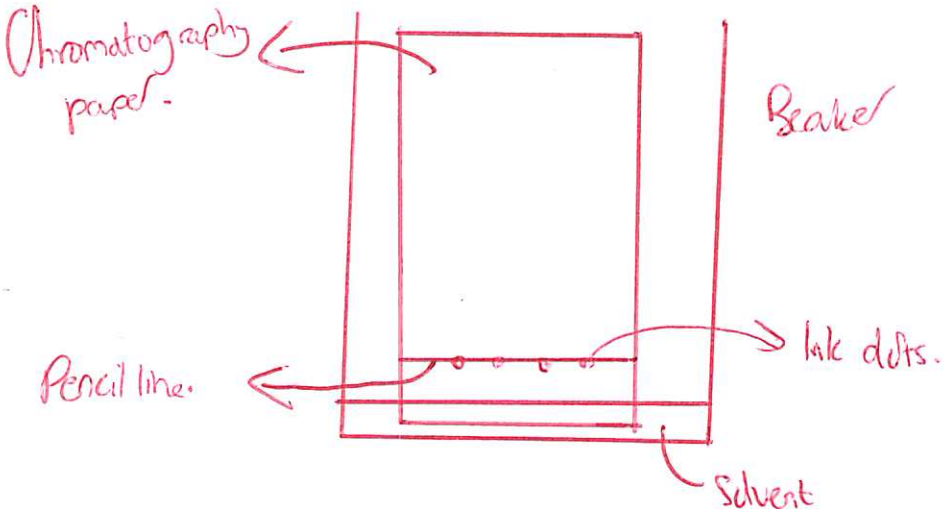
This is what she uses.

- a beaker
- a piece of chromatography paper with a pencil line drawn near the bottom of the paper
- a solvent
- inks V, W, X, Y and Z

(a) Describe how the student should set up and carry out her experiment.

You may draw a diagram to help with your answer.

(4)



Put Seperate Spots of each of the inks on the pencil line.
Pour Some Solvent into the bottom of the beaker.
Place the paper in the beaker So that the Spots are just above the level of the Solvent.
Leave until the Solvent has risen up the paper to near the top and then take the paper out.

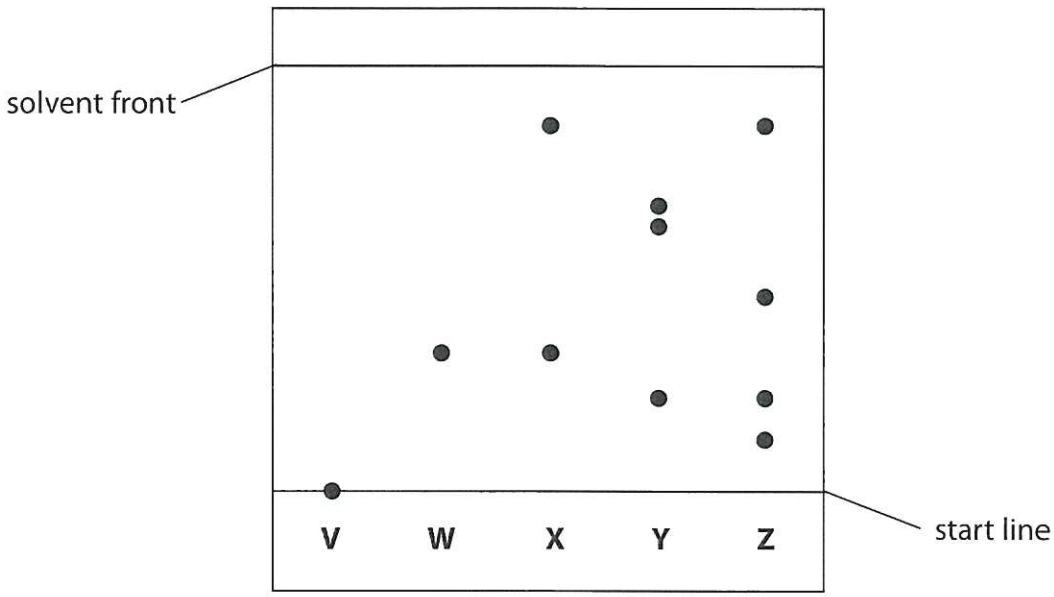
(b) Explain why the line on the paper is drawn in pencil rather than in ink.

(2)

Ink might dissolve in the Solvent.

Ink would Contaminate the results.

(c) The chromatogram shows the results for inks V, W, X, Y and Z.



(i) Explain which ink contains a dye that is insoluble in the solvent.

(2)

V - It didn't move.

(ii) Explain which two inks contain the dye that is likely to be the most soluble in the solvent.

(2)

X & Z - They both have a spot that travelled the furthest up the paper.

(iii) Explain which two inks may contain only one dye.

(2)

V & W - They only form one spot each on the paper.

(d) One dye in ink Y moves 4.3 cm when the solvent front moves 6.5 cm.

Calculate the R_f value for this dye.

Give your answer to 2 significant figures.

(3)

$R_f = \frac{4.3}{6.5} = 0.6615$

R_f value = 0.66 (2 s.f.)

(Total for Question 3 = 15 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

4 This question is about hydrocarbons.

(a) State the meaning of the term **hydrocarbon**.

(2)

A Compound Containing Carbon and hydrogen only.

(b) One homologous series of hydrocarbons is the alkanes.

Pentane (C_5H_{12}) is an alkane.

(i) When pentane burns completely in oxygen, carbon dioxide and water are produced.

Give a chemical equation for this combustion reaction.

(2)

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

(ii) Incomplete combustion can occur when the oxygen supply is limited.

Give the names of two products of the incomplete combustion of pentane.

(2)

1 Carbon monoxide

2 Carbon Water.

(iii) One of the products of incomplete combustion is a poisonous gas.

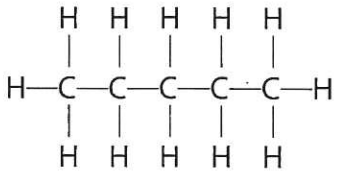
State why this gas is poisonous to humans.

(1)

Limits the capacity of blood to transport oxygen.

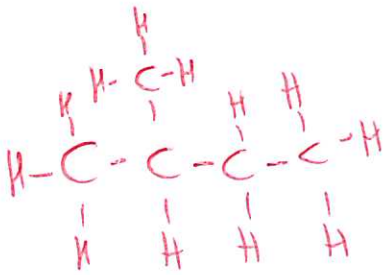
(iv) C_5H_{12} has three isomers.

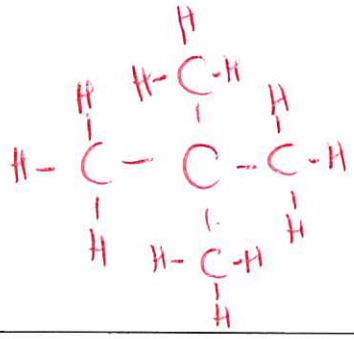
The displayed formula for one of these isomers is



Draw the displayed formulae of the other two isomers.

(2)





(c) Another homologous series of hydrocarbons is the alkenes.

Alkenes are unsaturated hydrocarbons.

(i) Give the general formula for the alkenes.

(1)

C_nH_{2n}

(ii) State the meaning of the term **unsaturated**.

(1)

Contains a Carbon-Carbon double bond.

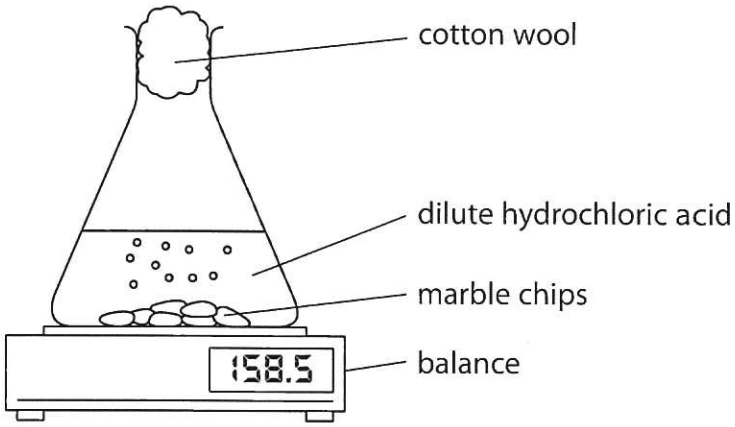
(iii) Describe a test to show that a hydrocarbon is unsaturated.

(2)

Add bromine water, the bromine water will decolorise (orange to colourless) if unsaturated hydrocarbon is present.

(Total for Question 4 = 13 marks)

5 A student uses this apparatus to investigate the rate of reaction between marble chips and dilute hydrochloric acid.



(a) During the reaction, the reading on the balance decreases because mass is lost from the flask.

(i) Explain how using the cotton wool increases the accuracy of this investigation.

(2)

Cotton wool stops acid spray from leaving the flask - without cotton wool, the mass loss would be too large.

(ii) Why is mass lost from the flask?

(1)

- ☐ **A** acid particles are moving
- ☒ **B** gas is given off
- ☐ **C** heat energy is produced
- ☐ **D** marble chips are dissolving

(b) This is the equation for the reaction between marble chips and dilute hydrochloric acid.

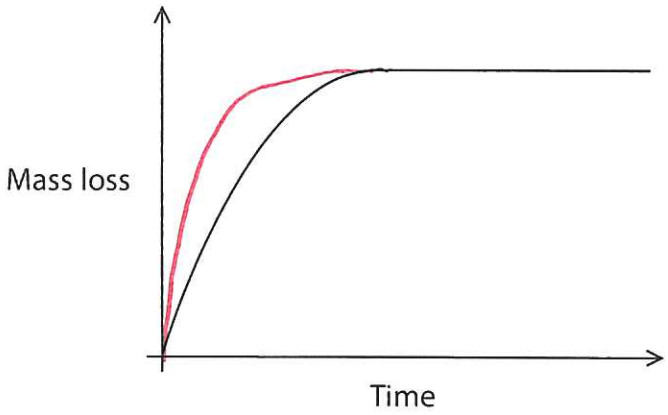
Complete the equation by adding the state symbols.

(2)

$CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$ (aq) + H_2O (l) + CO_2 (g)

(c) The student uses large marble chips in the investigation.

This is a graph of his results.



The student repeats the experiment using the same total mass of smaller marble chips.

On the graph, draw the curve that would be obtained.

[assume the marble chips are in excess]

(2)

(d) The rate of this reaction can be altered by increasing the temperature or by increasing the concentration of the hydrochloric acid.

(i) Explain, using the particle collision theory, how increasing the concentration of the hydrochloric acid would affect the rate of this reaction.

(3)

The rate of this reaction would increase as there are more particles in the same volume. This leads to more frequent successful collisions.

(ii) Explain, using the particle collision theory, how increasing the temperature would affect the rate of this reaction.

(3)

Rate increases as the mean kinetic energy of the particles increases so there are more frequent successful collisions.

(Total for Question 5 = 13 marks)

BLANK PAGE

6 Poly(chloroethene) is a polymer.

It is made from its monomer, chloroethene.

(a) Chloroethene has the percentage composition by mass

C = 38.4% H = 4.8% Cl = 56.8%

Show, by calculation, that the empirical formula of chloroethene is C_2H_3Cl

(3)

	C	H	Cl
mass	38.4	4.8	56.8
Ar	12	1	35.5
=	3.2 :	4.8 :	1.6
Smallest	1.6	1.6	1.6
=	2 :	3 :	1

∴ Empirical formula C_2H_3Cl

(b) The molecular formula of chloroethene is also C_2H_3Cl

Chloroethene can be prepared by a two-stage process.

In stage 1, ethene reacts with chlorine in the presence of an iron(III) chloride catalyst to form dichloroethane.

The reaction is exothermic.

$$C_2H_4 + Cl_2 \rightarrow C_2H_4Cl_2$$

(i) Give the formula of iron(III) chloride.

(1)

$FeCl_3$

(ii) State the purpose of using a catalyst.

(1)

Increase rate of reaction.

(iii) State the meaning of the term **exothermic**.

(1)

Gives out heat energy.

(iv) What type of reaction occurs in stage 1 between ethene and chlorine?

(1)

☒ **A** addition

☐ **B** displacement

☐ **C** neutralisation

☐ **D** substitution

(v) In stage 2, dichloroethane decomposes into chloroethene and hydrogen chloride.

Give a chemical equation for this reaction.

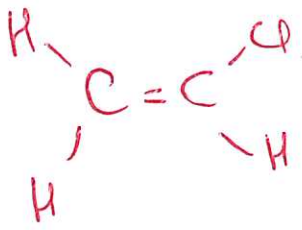
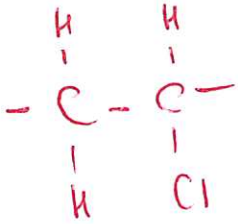
(1)

$C_2H_4Cl_2 \rightarrow C_2H_3Cl + HCl$

(c) (i) Draw the displayed formula of

- chloroethene
- the repeat unit of poly(chloroethene)

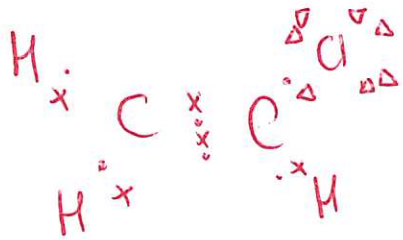
(3)

chloroethene	repeat unit of poly(chloroethene)
	

(ii) Draw a dot-and-cross diagram to represent a molecule of chloroethene.

Show only the outer electrons of each atom.

(2)



(Total for Question 6 = 13 marks)

7 A student makes some magnesium nitrate crystals from magnesium oxide and dilute nitric acid.

The equation for the reaction is

$$MgO(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2O(l)$$

(a) (i) Give the formula of each ion in magnesium nitrate.

(2)

Mg^{2+} and NO_3^-

(ii) A student has a beaker containing dilute nitric acid.

Describe a method that she could use to prepare a pure, dry sample of magnesium nitrate crystals from magnesium oxide.

(6)

Warm the acid in a beaker.
Add the magnesium oxide to the acid a little at a time until no more dissolves & it is in excess.
Stir the reaction mixture.
Filter to remove excess magnesium oxide solid.

Heat magnesium nitrate solution until crystals form on a glass rod.
Leave the solution to cool and filter out the crystals.
Dry the crystals on filter paper.

(b) Magnesium nitrate crystals contain water of crystallisation with the formula $Mg(NO_3)_2.6H_2O$

(i) Show by calculation that the relative formula mass of $Mg(NO_3)_2.6H_2O$ is 256.

(1)

$A_r = 24 + 2(14 + 3(16)) + 6(2 + 16)$

$= 256$

(ii) Show that the maximum mass of $Mg(NO_3)_2.6H_2O$ that could be made from 0.050 mol of nitric acid is about 6 g.

(3)

$n(HNO_3) = 0.050$ mol

$n(Mg(NO_3)_2) = \frac{0.050}{2} = 0.025$ mol

$n(Mg(NO_3)_2.6H_2O) = 0.025$ mol

$m(Mg(NO_3)_2.6H_2O) = mr \times mol = 256 \times 0.025 = 6.4$ g

(iii) The actual mass of crystals that the student obtains is 4.8 g.

Calculate the percentage yield of $Mg(NO_3)_2.6H_2O$ in this experiment.

(2)

$\%\ yield = \frac{4.8}{6.4} \times 100$

$= 75\%$

75

percentage yield = ... %

(Total for Question 7 = 14 marks)

8 A student investigates the neutralisation reaction between sodium hydroxide and nitric acid.

This is her method.

- pour 20 cm^3 of sodium hydroxide solution into a polystyrene cup
- record the temperature of the sodium hydroxide solution
- add 5 cm^3 of dilute nitric acid to the cup
- stir the mixture and record the highest temperature reached
- add further 5 cm^3 portions of dilute nitric acid, recording the highest temperature reached each time, until a total of 40 cm^3 of acid has been added

(a) (i) Give a word equation for this neutralisation reaction.

(1)

Sodium Hydroxide + Nitric acid → Sodium nitrate + water.

(ii) Explain why a polystyrene cup is used rather than a beaker.

(2)

Polystyrene is an insulator so less heat is lost to the surroundings.

(iii) Give a safety precaution that the student should take when using sodium hydroxide solution.

(1)

wear eye protection / gloves.

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

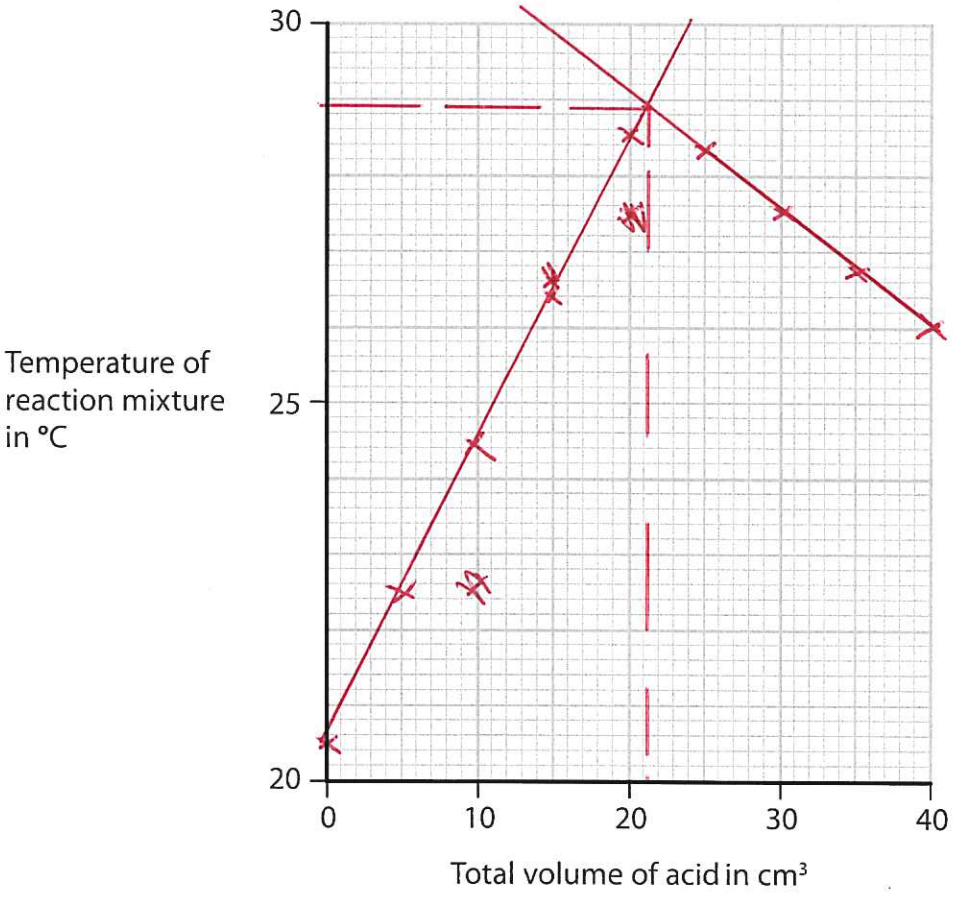
Total volume of acid in cm^3	0	5	10	15	20	25	30	35	40
Temperature of reaction mixture in °C	20.5	22.5	24.4	26.4	28.5	28.3	27.5	26.7	26.0

(i) Plot the results on the grid.

Draw a straight line of best fit through the first five points and another straight line of best fit through the last four points.

Make sure that the two lines cross.

(3)



(ii) The point where the lines cross shows

- the volume of acid needed to exactly neutralise the alkali
- the maximum temperature reached

Use your graph to determine these values.

(2)

volume of acid = ... 20.5 21.5 ..... cm^3

maximum temperature = ... 28.9 ..... °C

(Total for Question 8 = 9 marks)

9 (a) Diamond is a naturally-occurring form of carbon.

It has a giant molecular structure.

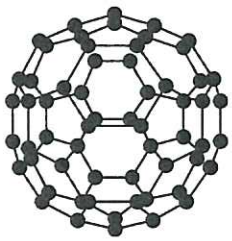
Explain, with reference to its structure and bonding, why diamond has a high melting point.

(3)

Many strong covalent bonds must be broken, requiring a large amount of thermal energy.

(b) C_{60} fullerene is another form of carbon.

The diagram shows a molecule of C_{60} fullerene.



(i) Explain why C_{60} fullerene has a much lower melting point than diamond.

(2)

Intermolecular forces are weak, requiring less thermal energy to overcome.

(ii) C_{60} fullerene is used by doctors when injecting medicines into their patients.

C_{60} fullerene allows medicines, which might damage some parts of the body, to reach the part of the body where they are needed.

Suggest why C_{60} fullerene is suitable for this purpose.

(1)

The medicine can fit inside the C_{60} molecule.

The C_{60} molecule won't react with the blood or medicine.

The C_{60} molecule is non-toxic.

(c) Graphite is another naturally-occurring form of carbon.
Graphite can be used in pencils because it is soft and can leave marks on paper.
Graphite can also be used as a conductor of electricity.

Explain why graphite is soft and conducts electricity.
Refer to structure and bonding in your answer.

(5)

There are weak forces between the layers, allowing the layers to slide over each other - hence graphite is soft.

Each Carbon atom is covalently bonded to 3 other Carbon atoms; So there is one delocalised electron per Carbon atom which can move, causing graphite to conduct electricity.

(Total for Question 9 = 11 marks)

10 A student investigates the reaction between zinc and copper(II) sulfate solution.

The equation for the reaction is

$$Zn + CuSO_4 \rightarrow Cu + ZnSO_4$$

This is his method.

- add exactly 25.0 cm^3 of copper(II) sulfate solution to a polystyrene cup
- record the temperature of the solution
- add about 5 g of zinc powder (an excess) and stir the mixture
- record the highest temperature reached

(a) (i) Suggest why it is not important to add an exact mass of zinc powder.

(1)

Zinc is in excess.

.....

.....

(ii) State the colour change of the solution.

(2)

from Blue to Colourless.

(b) The table shows the student's results

volume of copper(II) sulfate solution in cm^3	25.0
initial temperature of copper(II) sulfate solution in °C	19.0
final temperature of solution in °C	31.5

(i) Show that the heat energy change (Q) is about 1300 J.
[for the solution, c = 4.18 J/g/°C]

[mass of 1.00 cm^3 of solution = 1.00 g]

(3)

$Q = mc\Delta T = 25 \times 4.18 \times (31.5 - 19)$

$= 1310$ J

(ii) The mass of anhydrous copper(II) sulfate ($CuSO_4$) used to make 25.0 cm^3 of solution is 2.00 g.

Calculate the amount, in moles, of $CuSO_4$ in 2.00 g.

[M_r of $CuSO_4$ = 159.5]

(1)

$n(CuSO_4) = \frac{mass}{mr}$

$= \frac{2}{159.5}$

$= 0.0125$ mol

amount of $CuSO_4$ = 0.0125 mol

(iii) Calculate the value of the enthalpy change (ΔH), in kilojoules per mole, for the reaction between zinc and copper(II) sulfate.

Include a sign in your answer.

(3)

$\Delta H = \frac{Q}{n} = \frac{1310}{0.0125}$

$= -104$ kJ/mol

ΔH = -104 kJ/mol

(Total for Question 10 = 10 marks)

TOTAL FOR PAPER = 110 MARKS

BLANK PAGE