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

Time 2 hours

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

Chemistry

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.
- 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.
- Good luck with your examination.

Turn over ▶

P66056A

1/1/1/1/1/

P 6 6 0 5 6 A 0 1 2 8

Pearson

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
																	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

1
H
hydrogen
1

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 The box shows the names of some substances.

bromine	carbon dioxide	copper	iodine
methane	nitrogen	sulfur dioxide	water

(a) Complete the table by choosing substances from the box that match the description.

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

(5)

Description	Substance
a good conductor of electricity	Copper
an element that has a basic oxide	Copper
a substance used as a fuel	methane
a major cause of acid rain	Sulphur dioxide
a non-metallic element that is a solid at room temperature	Iodine.

(b) Describe a test for carbon dioxide.

(2)

Bubble the gas through limewater. If Carbon dioxide is present, the limewater will turn Cloudy.

(Total for Question 1 = 7 marks)

2 (a) Table 1 gives some information about three subatomic particles.

(i) Complete Table 1 by giving the missing information.

(3)

Subatomic particle	Relative mass	Relative charge
electron	0.0005	-1
proton	1	+1
neutron	1	0

Table 1

(ii) Give the name of the part of the atom containing protons and neutrons.

(1)

Nucleus

(b) Table 2 shows the numbers of protons, neutrons and electrons in the species U, V, W, X, Y and Z.

Species	Number of protons	Number of neutrons	Number of electrons
U	8	10	8
V	9	10	10
W	11	12	10
X	11	12	11
Y	12	12	12
Z	12	13	12

Table 2

Use the information in Table 2 to answer these questions.

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

(i) Give the letter of the species that has six electrons in its outer shell.

(1)

U

(ii) Give the mass number of Z.

(1)

25

(iii) Give the letter of the species that is a positive ion.

(1)

W

(iv) Give the letters of the two species that are isotopes of the same element.

(1)

Y Z

(c) A sample of neon contains two isotopes, ^{20}Ne and ^{22}Ne

The relative abundances of the two isotopes in the sample are

^{20}Ne 91.2% ^{22}Ne 8.80%

Calculate the relative atomic mass of this sample of neon.

Give your answer to one decimal place.

(3)

$A_r = 0.912(20) + 0.0880(22)$

$= 20.176$

relative atomic mass = 20.2 (1 d.p.)

(Total for Question 2 = 11 marks)

3 Some sugar is added to cold water in a beaker.

After some time, all the sugar dissolves and spreads throughout the water.

(a) (i) Name the process that occurs which causes the sugar to spread throughout the water.

(1)

diffusion

(ii) State two ways to make the sugar dissolve more quickly.

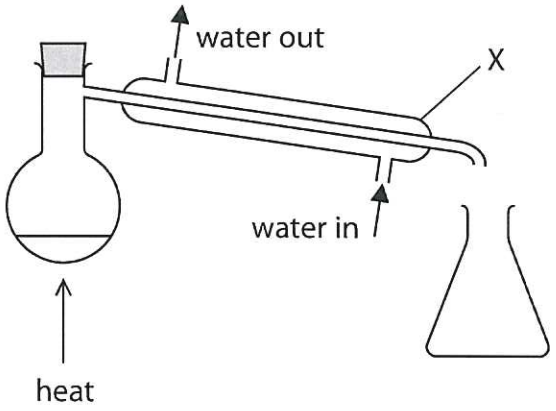
(2)

1 Stir the Sugar - water mixture

2 Heat the mixture

Grind the Sugar to increase its surface area.

(b) Pure water can be obtained from the sugar solution using this apparatus.



(i) Name the process used to obtain pure water from the sugar solution.

(1)

distillation.

(ii) Explain the purpose of the piece of apparatus labelled X.

(2)

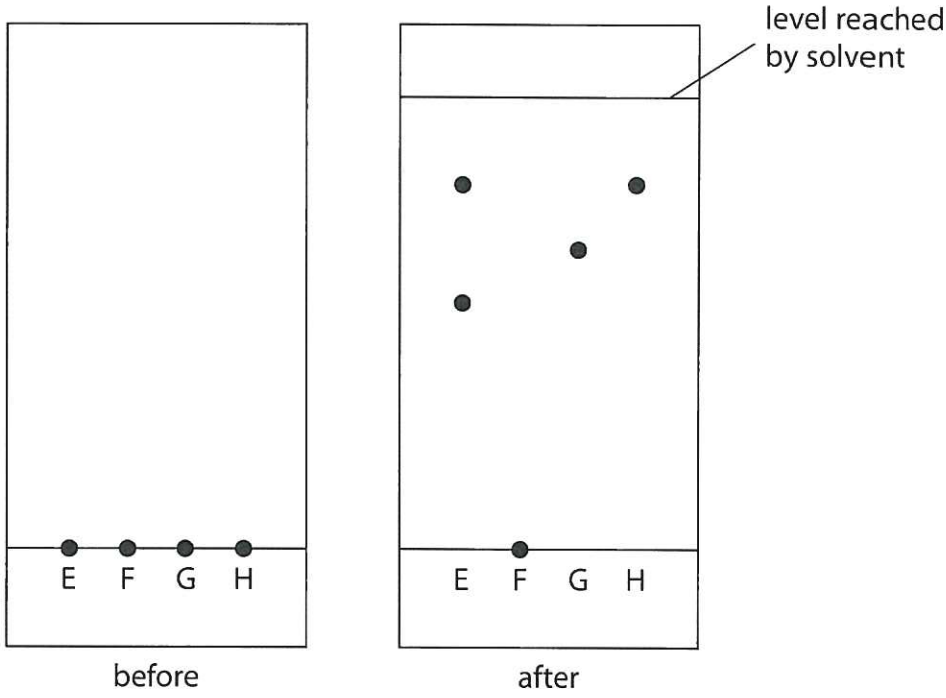
Water Vapour is Cooled in the Condenser, causing it to Condense.

(Total for Question 3 = 6 marks)

BLANK PAGE

4 A student uses paper chromatography in an experiment to separate the dyes in four different food colourings, E, F, G and H.

The diagram shows the appearance of the paper before and after the experiment.



(a) (i) Describe how the student should complete the experiment after putting a spot of each food colouring on the paper.

(3)

Pour some solvent into a beaker.

Place the paper in the solvent, ensuring the dots of food colouring are above the level of the solvent.

Leave the paper in the solvent until the solvent ~~leave~~ level reaches near the top of the paper.

Remove the paper from the solvent beaker and leave to dry.

(ii) Deduce the number of dyes in food colouring H.

(1)

1

(iii) Suggest why food colouring F does not move during the experiment.

(1)

F is insoluble in the solvent.

(iv) Explain which two food colourings contain the dye that is likely to be the most soluble in the solvent.

(2)

E and H contain a dye that moved furthest up the paper.

(b) Determine which food colouring contains a dye with R_f value closest to 0.67

Show your working.

(3)

Distance travelled by solvent = 6cm (from diagram)

Distance travelled by dye = 0.67 × 6 = 4.02 cm

~~This~~ The dye in food colouring G moves ~4cm so has an R_f value closest to 0.67.

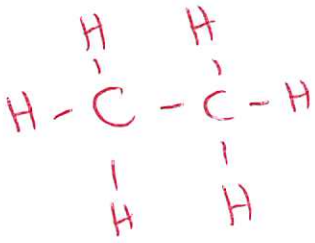
(Total for Question 4 = 10 marks)

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

5 This question is about alkanes and alkenes.

(a) (i) Complete the boxes by giving the missing information about the alkane with the molecular formula C_2H_6

(3)

molecular formula	C_2H_6
name	Ethane
empirical formula	CH_3
displayed formula	

(ii) Complete the chemical equation for the complete combustion of the alkane C_2H_6

(1)

$$\text{.....}C_2H_6 + \frac{7}{2}O_2 \rightarrow 2\,CO_2 + 3\,H_2O$$

(iii) Incomplete combustion occurs when the air supply is limited.

Give the names of two products of incomplete combustion.

(2)

1 Carbon Monoxide

2 Carbon

Steam / Water (Vapour)

(b) An alkene with molecular formula C_4H_8 reacts with bromine to form a compound with molecular formula $C_4H_8Br_2$

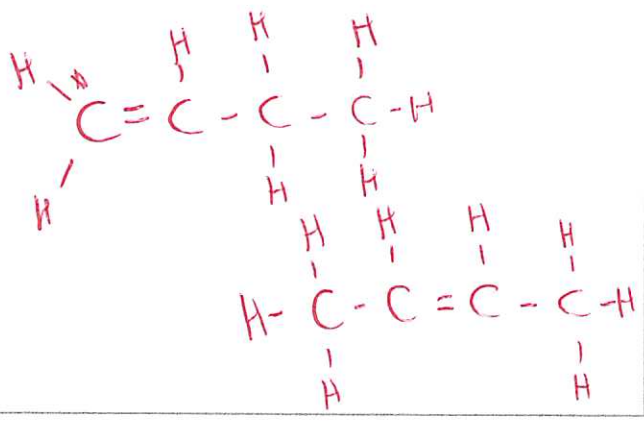
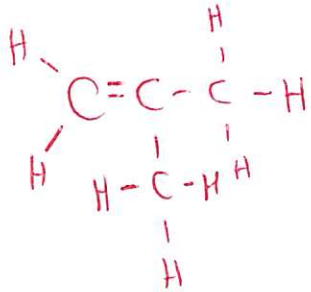
(i) What is the name of this type of reaction?

(1)

- [X] **A** addition
- [ ] **B** decomposition
- [ ] **C** precipitation
- [ ] **D** substitution

(ii) Draw displayed formulae for two different alkenes with the molecular formula C_4H_8

(2)

alkene 1	alkene 2
	

(iii) State the term used for compounds with the same molecular formula but different structural formulae.

(1)

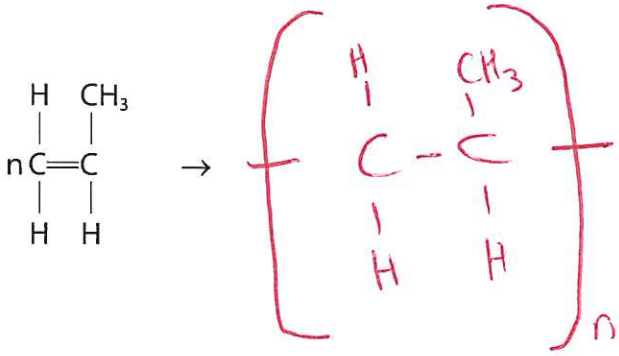
Isomers

.....

(c) The alkene C_3H_6 can be polymerised to form the polymer poly(propene).

(i) Complete the equation for this polymerisation reaction.

(2)



(ii) Two ways of disposing of polymers such as poly(propene) are

- burying them in landfill sites
- burning them to release heat energy

Discuss the environmental problems caused by these two methods of disposal.

(3)

Polymers buried in landfill will remain in the ground indefinitely as they are inert and non-biodegradable.

Burning the polymers produces toxic gases.

(Total for Question 5 = 15 marks)

BLANK PAGE

6 This question is about some of the Group 1 elements and their compounds.

(a) A teacher adds a small piece of lithium to water in a trough.

(i) Give three observations that are made when lithium reacts with water.

(3)

1 fizzing Lithium gets smaller / disappears.

2 Lithium moves Steam produced.

3 Lithium floats

(ii) After the reaction has finished, the teacher adds a few drops of universal indicator to the solution in the trough.

Explain the colour of the universal indicator after it is added to the solution.

(2)

Universal indicator turns purple as there are hydroxide ions present.

(iii) Write a chemical equation for the reaction of lithium with water.

(2)

$2Li + 2H_2O \rightarrow 2LiOH + H_2$

(b) A student does a flame test to see if a white solid contains sodium ions.

She cleans a platinum wire before using it for the flame test.

(i) Explain why the student needs to clean the platinum wire.

(2)

The cleaning removes any impurities that may be on the wire that would otherwise interfere with the colour of the flame.

(ii) Which of these is the colour of the flame if the solid contains sodium ions? (1)

- ☐ **A** green
- ☐ **B** lilac
- ☐ **C** red
- ☒ **D** yellow

(c) Potassium sulfate (K_2SO_4) is an ionic compound.

(i) Give the formula of each ion in potassium sulfate. (1)

potassium ion K^+ sulfate ion SO_4^{2-}

(ii) The melting point of potassium sulfate is 1069°C.

Explain why potassium sulfate has a high melting point.

Refer to structure and bonding in your answer. (4)

Potassium Sulphate has a giant ionic structure with strong ionic bonding between the ions - this is caused by the strong electrostatic attraction between the oppositely charged ions. Lots of energy is required to break these bonds.

(Total for Question 6 = 15 marks)

7 A student investigates the reaction between magnesium and hydrochloric acid.

He uses this method.

Step 1 add 25 cm^3 of dilute hydrochloric acid to a polystyrene cup

Step 2 record the temperature of the acid

Step 3 find the mass of a 10 cm strip of magnesium ribbon

Step 4 add the magnesium ribbon to the hydrochloric acid

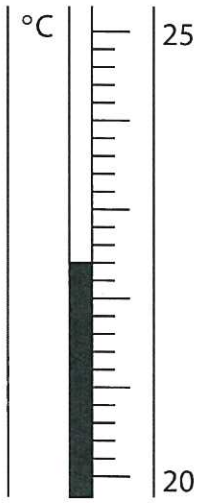
Step 5 when all the magnesium has reacted, record the highest temperature reached

(a) Complete the word equation for the reaction.

(1)

magnesium + hydrochloric acid → Magnesium Chloride + hydrogen.

(b) The thermometer shows the temperature of the acid at the start of the experiment.



(i) Complete the table by giving the temperatures to the nearest 0.1 °C.

(2)

temperature of the acid at the start in °C	22.4
highest temperature reached in °C	43.2
temperature rise in °C	20.8

(ii) Show that the heat energy change (Q) for this reaction is about 2200 J.

[mass of 1.0 cm^3 of solution = 1.0 g]

[for the solution, c = 4.2 J/g/°C]

(2)

$Q = mc\Delta T$

$= 25 \times 4.2 \times 20.8$

$= 2184 J$

(iii) The mass of magnesium used by the student was 0.12 g.

Calculate the value of the enthalpy change (ΔH), in kilojoules per mole of magnesium, for the reaction between magnesium and hydrochloric acid.

Include a sign in your answer.

(4)

$n(Mg) = \frac{0.12}{24} = 0.0050 \text{ mol}$

$\Delta H = \frac{Q}{n} = \frac{2184}{0.0050} = 436800 \text{ J mol}^{-1}$

$= 436.8 \text{ kJ mol}^{-1}$

$\Delta H =$ - 436.8 kJ/mol

(Total for Question 7 = 9 marks)

8 (a) A scientist finds an unlabelled bottle on a shelf.

She thinks the bottle contains a solution of ammonium sulfate, $(NH_4)_2SO_4$

Describe tests the scientist could do to show that the solution is ammonium sulfate.

(6)

Add Sodium hydroxide Solution to a Sample of the Solution from the unlabelled bottle. Test the gas with damp red litmus paper which will turn blue if ammonium ions are present.

Add dilute nitric acid to a Sample of the Solution from the unlabelled bottle, followed by the addition of barium nitrate Solution. A white precipitate will form if Sulphate ions are present.

(b) Ammonium sulfate is often used as a fertiliser.

It is prepared by reacting ammonia (NH_3) with sulfuric acid (H_2SO_4).

(i) Name the type of reaction that occurs between ammonia and sulfuric acid.

(1)

Neutralisation.

(ii) Write a chemical equation for the reaction of ammonia with sulfuric acid.

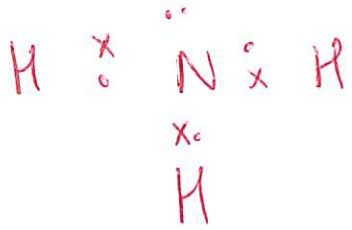
(1)

$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

(iii) Draw a dot-and-cross diagram to show the bonding in a molecule of ammonia.

Show outer electrons only.

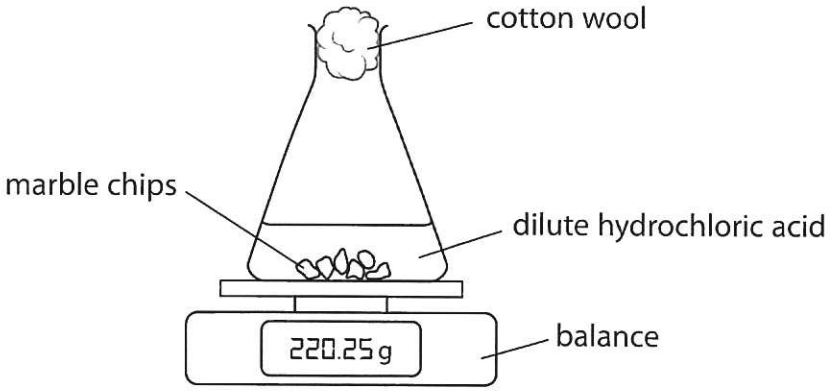
(2)



(Total for Question 8 = 10 marks)

BLANK PAGE

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



The equation for the reaction is

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

(a) During the reaction the mass of the contents of the flask decreases.

(i) State why the mass of the contents of the flask decreases.

(1)

Carbon dioxide gas escapes.

(ii) State the purpose of the cotton wool.

(1)

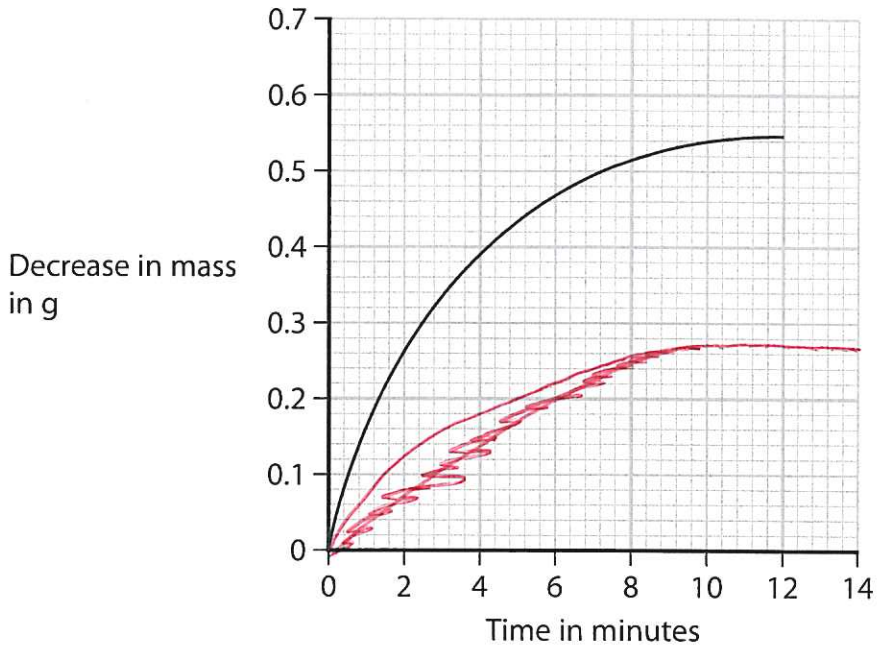
To prevent spray from leaving the flask.

(iii) Explain why sulfuric acid is not a suitable acid to use in this investigation.

(2)

Insoluble Calcium Sulphate would form a coating on the marble chips, preventing the reaction from further progressing.

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



(i) In the investigation the marble chips are in excess.

Explain the shape of the graph.

(4)

The curve is steepest at the start as this is when the acid concentration is highest. The gradient of the curve decreases as the acid concentration decreases. The curve has 0 gradient (is flat) when all acid has been used up.

(ii) The student repeats the experiment using the same volume of hydrochloric acid but of half the concentration of the original acid. All other conditions are kept the same.

On the grid, draw the curve the student would obtain.

(2)

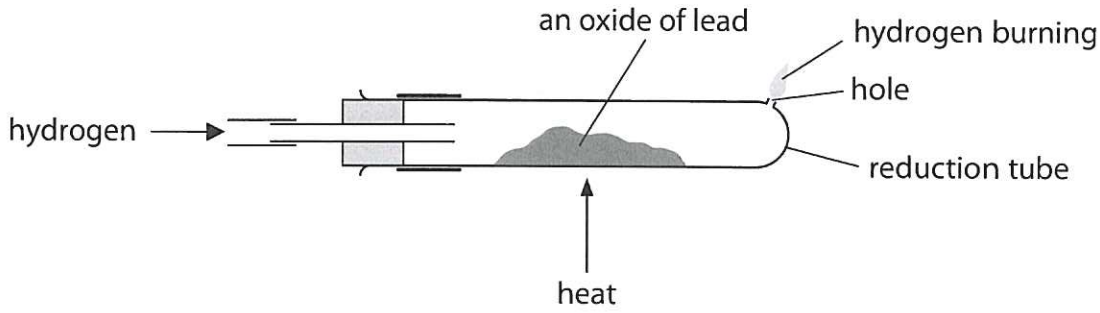
(c) Explain, using particle collision theory, how increasing the temperature affects the rate of a reaction.

(4)

The rate of reaction increases as the particles gain kinetic energy and there are more frequent collisions. There are more particles with energy greater than the activation energy and more successful collisions.

(Total for Question 9 = 14 marks)

10 (a) The diagram shows the apparatus a teacher uses to determine the formula of an oxide of lead.



This is the teacher's method.

Step 1 find the mass of the reduction tube

Step 2 add some of the lead oxide to the reduction tube

Step 3 find the mass of the reduction tube and lead oxide

Step 4 pass hydrogen gas over the lead oxide and ignite the hydrogen at the hole

Step 5 heat the lead oxide strongly for 10 minutes

Step 6 keep passing hydrogen through the reduction tube until the tube and contents are cool

Step 7 find the new mass of the reduction tube and its contents

(i) Give a reason why hydrogen is passed through the reduction tube until the tube and contents are cool.

(1)

This prevents the hot lead from reacting with oxygen and reverting to lead oxide.

(ii) Describe what the teacher should do next to make sure all the lead oxide has been reduced to lead.

(2)

Repeat the heating and reweigh until a constant mass is achieved.

(b) The teacher completes the experiment and obtains these results.

mass of reduction tube = 23.50 g

mass of tube + lead oxide = 28.64 g

mass of tube + lead = 28.16 g

(i) Calculate the mass of lead formed.

(1)

mass of lead = 4.66 g

(ii) Calculate the mass of oxygen removed from the lead oxide.

(1)

mass of oxygen = 0.48 g

(iii) Determine the empirical formula of the lead oxide.

(4)

	Pb	O
Mass	4.66	0.48
Mr	207	16
=	0.022512 :	0.03
Smallest	0.022512	0.022513
=	1 :	1.33
x3	3 :	4

empirical formula of the lead oxide Pb_3O_4

∴ Empirical formula Pb_3O_4

(c) The insoluble salt lead(II) chloride ($PbCl_2$) can be prepared by reacting a solution of lead(II) nitrate with dilute hydrochloric acid.

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

(1)

$$Pb(NO_3)_2(\text{aq}) + 2HCl(\text{aq}) \rightarrow PbCl_2(\text{s}) + 2HNO_3(\text{aq})$$

(ii) Show that the maximum mass of lead(II) chloride that can be made from 0.0370 mol of hydrochloric acid is about 5 g.

[M_r of $PbCl_2$ = 278]

(3)

$n(PbCl_2) = \frac{0.0370}{2} = 0.0185$ mol

$m(PbCl_2) = mr \times mol = (278) \times 0.0185$

$= 5.143\text{g} \approx 5\text{g}$

maximum mass = 5.143 g

(Total for Question 10 = 13 marks)

TOTAL FOR PAPER = 110 MARKS

BLANK PAGE

BLANK PAGE