Write your name here

Surname	Other names

Pearson Edexcel International GCSE

Centre Number	Candidate Number

Chemistry

Unit: 4CH0
Science (Double Award) 4SC0
Paper: 1CR

Tuesday 13 May 2014 – 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.
- Keep an eye on the time.
- 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 ▶

P43530A
P 4 3 5 3 0 A 0 1 3 6

1/1/1/

PEARSON

THE PERIODIC TABLE

Period	1	2					Group						3	4	5	6	7	0
1							1 H Hydrogen 1											4 He Helium 2
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
3	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
4	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
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Key
Relative atomic mass
Symbol
Name
Atomic number

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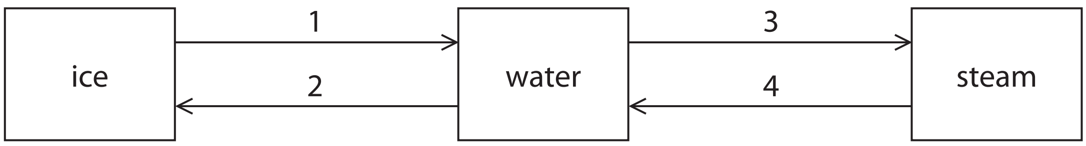
Answer ALL questions.

1 The compound with the formula H_2O can exist in three states of matter. The names of these three states are shown in the boxes.

The numbers 1, 2, 3 and 4 represent changes of state.



(a) The particles of H_2O are arranged differently in each state.

(i) In which state are the particles furthest apart?

(1)

....

(ii) In which state do the particles have the least energy?

(1)

....

(iii) In which state are the particles arranged in a regular pattern?

(1)

....

(b) (i) Change of state 1 is called

(1)

☒ **A** boiling

☒ **B** condensing

☒ **C** freezing

☒ **D** melting

(ii) Change of state 4 is called

(1)

☒ **A** boiling

☒ **B** condensing

☒ **C** freezing

☒ **D** melting

(c) The term sublimation is also used for a change of state.

Sublimation is the change of state from

(1)

☒ **A** solid to liquid

☒ **B** liquid to gas

☒ **C** gas to liquid

☒ **D** solid to gas

(d) Heat energy is released when steam changes to water.

(i) What term is used to describe this type of energy change?

(1)

....

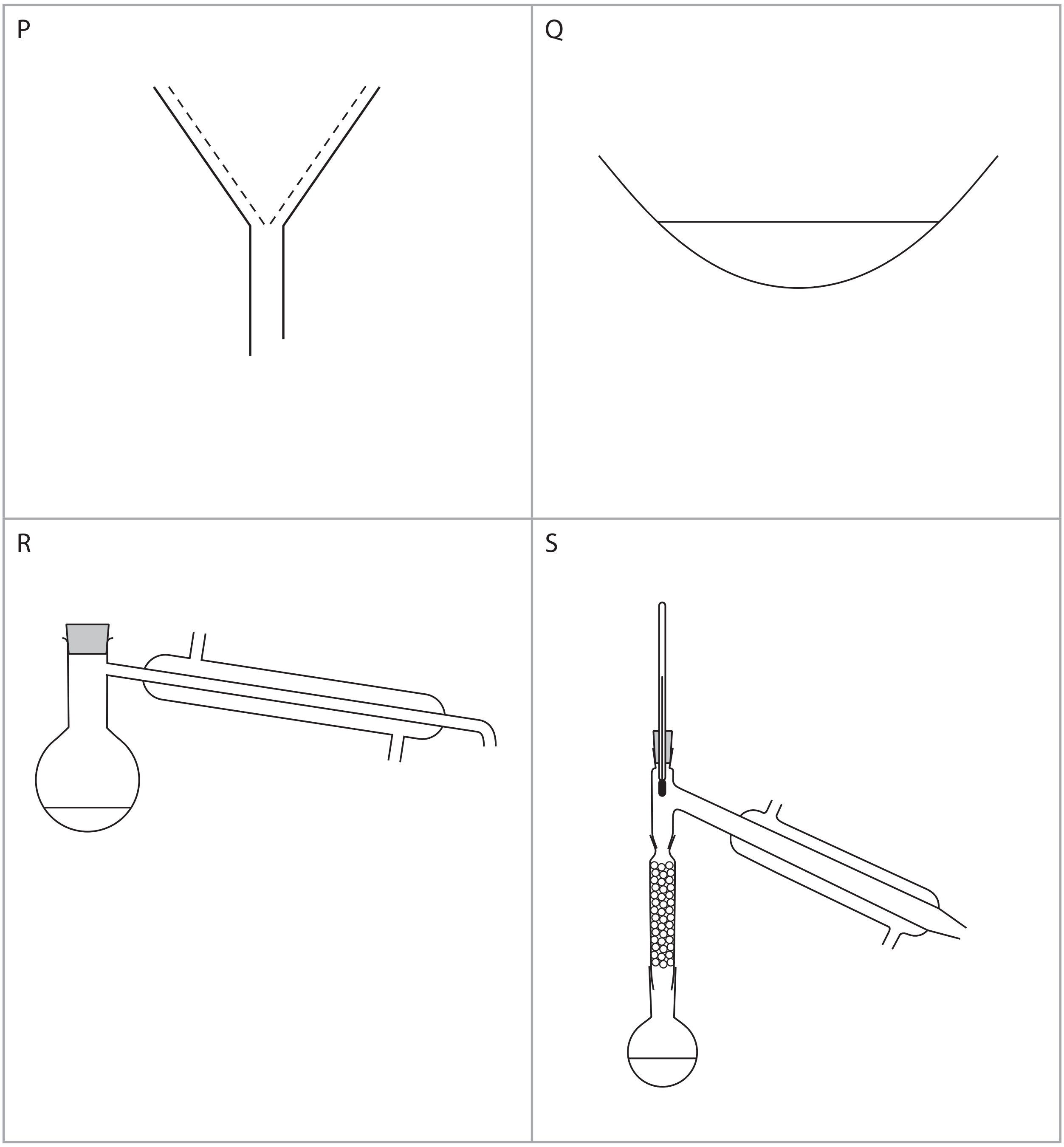
(ii) Write an equation, including state symbols, for the change of state from steam to water.

(1)

....

(Total for Question 1 = 8 marks)

2 The diagram shows four pieces of apparatus used in the separation of mixtures.



(a) (i) The apparatus labelled P is used for

(1)

- ☒ **A** crystallisation
- ☒ **B** filtration
- ☒ **C** fractional distillation
- ☒ **D** simple distillation

(ii) The apparatus labelled S is used for

(1)

☒ **A** crystallisation

☒ **B** filtration

☒ **C** fractional distillation

☒ **D** simple distillation

(b) (i) Which method of separation should be used to obtain sand from a mixture containing salt, sand and water?

(1)

☒ **A** crystallisation

☒ **B** filtration

☒ **C** fractional distillation

☒ **D** simple distillation

(ii) Which method of separation should be used to obtain pure water from a mixture containing salt, sand and water?

(1)

☒ **A** crystallisation

☒ **B** filtration

☒ **C** fractional distillation

☒ **D** simple distillation

(iii) Which method of separation should be used to obtain copper(II) sulfate from a mixture containing copper(II) sulfate and water?

(1)

☒ **A** crystallisation

☒ **B** filtration

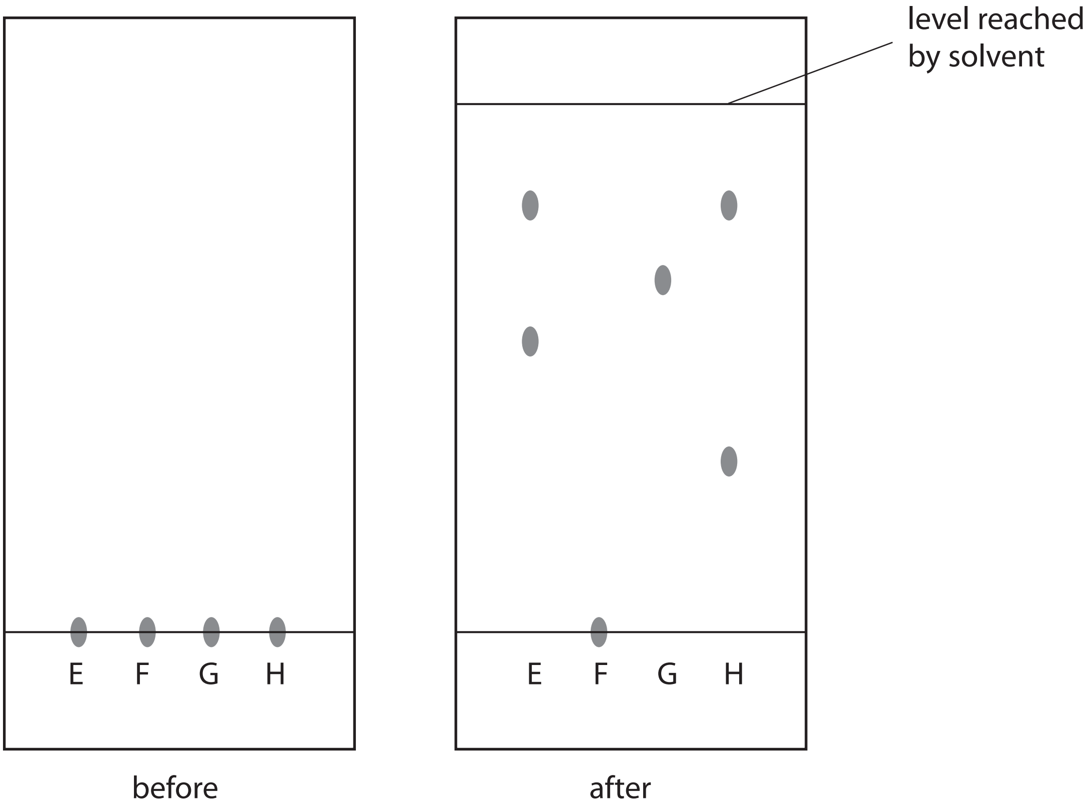
☒ **C** fractional distillation

☒ **D** simple distillation

(c) Food colourings contain one or more food dyes.

A student used paper chromatography to separate the dyes contained in food colourings. She placed spots of three known food colourings (E, F and G) and one unknown food colouring (H) on the chromatography paper.

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



(i) Describe how the student should complete the experiment after placing the four spots on the paper.

(3)

....

....

....

....

....

....

....

....

....

(ii) Suggest why food colouring F did not move during the experiment.

(1)

....

....

(iii) How many food dyes are there in food colouring E?

(1)

....

(iv) How many known food dyes are there in food colouring H?

(1)

....

(v) Dyes are often identified by their R_f values.

$$R_f = \frac{\text{distance moved by dye}}{\text{distance moved by solvent}}$$

Record the results for the dye in G and calculate its R_f value.

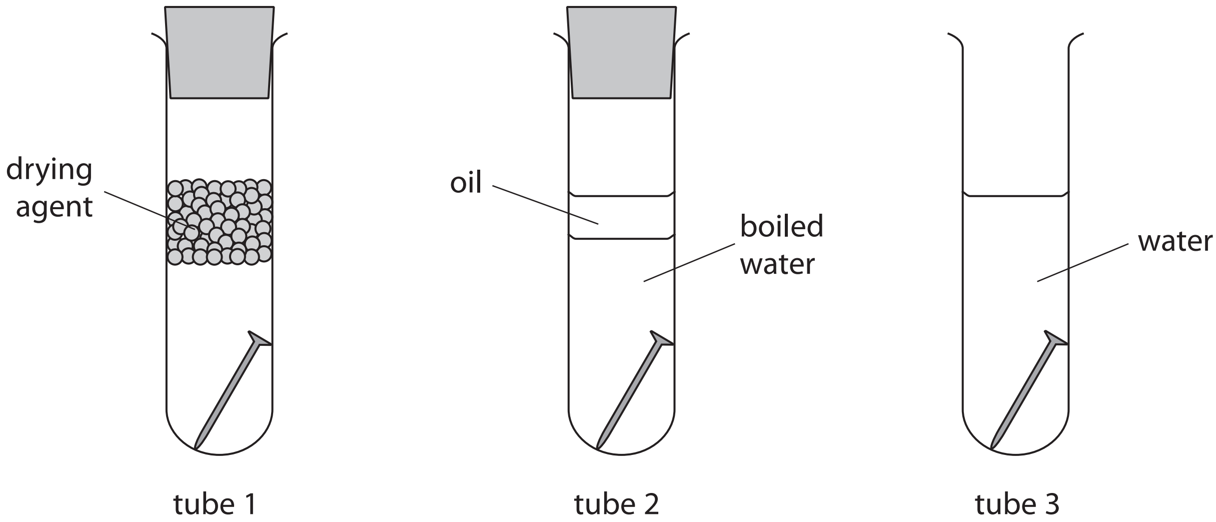
(3)

distance moved by dye in mm	
distance moved by solvent in mm	
R_f value of G	

(Total for Question 2 = 14 marks)

3 This question is about ways of preventing iron nails from rusting.

(a) This experiment is set up with three iron nails.



(i) What is the name of the main compound in rust?

(1)

....

(ii) Why does the nail in tube 1 not rust?

(1)

....

....

(iii) What is the purpose of the layer of oil in tube 2?

(1)

....

....

(b) Zinc can be used to coat iron nails to prevent them from rusting.

(i) What is the name of this process?

(1)

....

(ii) If the layer of zinc on the nail is scratched, sacrificial protection prevents the iron from rusting.

Explain, with the help of two ionic half-equations, how this type of sacrificial protection works.

Use symbols from the box in your equations. You may use each symbol once, more than once or not at all.

Fe	Zn	Fe^{2+}	Zn^{2+}	e^-	+	−	→

(4)

....

....

....

....

....

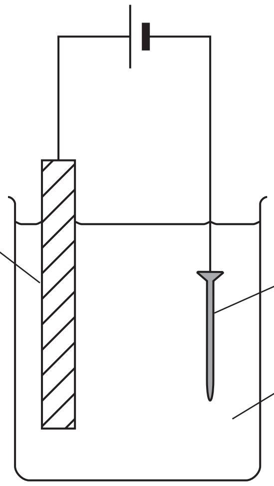
....

....

....

(c) Electroplating is another method of rust prevention.

This apparatus can be used to electroplate an iron nail.



(i) Equation 1 shows the reaction at the copper rod.

Equation 1 $Cu \rightarrow Cu^{2+} + 2e^-$

Name this type of reaction, giving a reason for your answer.

(2)

type of reaction ....

reason ....

....

(ii) Equation 2 shows the reaction at the iron nail.

Equation 2 $Cu^{2+} + 2e^- \rightarrow Cu$

Use equations 1 and 2 to explain why the colour of the copper(II) sulfate solution does not change during the experiment.

(2)

....

....

....

....

(Total for Question 3 = 12 marks)

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

(a) Which statement about lithium is correct?

(1)

☒ **A** It is a good electrical conductor and forms an acidic oxide

☒ **B** It is a poor electrical conductor and forms an acidic oxide

☒ **C** It is a good electrical conductor and forms a basic oxide

☒ **D** It is a poor electrical conductor and forms a basic oxide

(b) A small piece of sodium is added to a large trough of water.

(i) State two observations that could be made.

(2)

1 ....

....

2 ....

....

(ii) Complete the equation for this reaction by inserting the appropriate state symbols.

(2)

$$2Na(s) + 2H_2O(\ldots\ldots) \rightarrow 2NaOH(\ldots\ldots) + H_2(\ldots\ldots)$$

(c) Potassium reacts in a similar way to sodium, but is more reactive.

State one observation that could be made when a small piece of potassium is added to a large trough of water, but would not be observed with sodium.

(1)

....

....

(d) Explain why elements in Group 1 have similar reactions.

(1)

....

....

(Total for Question 4 = 7 marks)

5 This question is about elements in Group 7 of the Periodic Table.

(a) Complete the table to show the physical state at room temperature of fluorine and astatine, and the colour of liquid bromine.

(2)

Element	Colour	Physical state at room temperature
fluorine	pale yellow	
chlorine	pale green	gas
bromine		liquid
iodine	dark grey	solid
astatine	black	

(b) Chlorine reacts with hydrogen to form hydrogen chloride.

A piece of magnesium ribbon is added to hydrogen chloride in three separate experiments under different conditions.

The table below shows the observations made under these different conditions.

Experiment	Conditions	Observations
1	Hydrogen chloride gas	No visible change
2	Hydrogen chloride dissolved in water	The magnesium ribbon gets smaller and bubbles are seen
3	Hydrogen chloride dissolved in methylbenzene	No visible change

(i) Write the formulae of two ions formed in the solution produced in experiment 2.

(2)

Positive ion ....

Negative ion ....

(ii) Identify the gas formed in experiment 2 and give a test for it.

(2)

gas ....

test ....

....

(iii) Silver nitrate solution and dilute nitric acid are added to the solution produced in experiment 2.

State what is observed and name the substance responsible for this observation.

Explain why dilute nitric acid is added.

(3)

observation ....

....

substance responsible ....

explanation ....

....

(iv) Explain why there is no reaction in experiment 3.

(1)

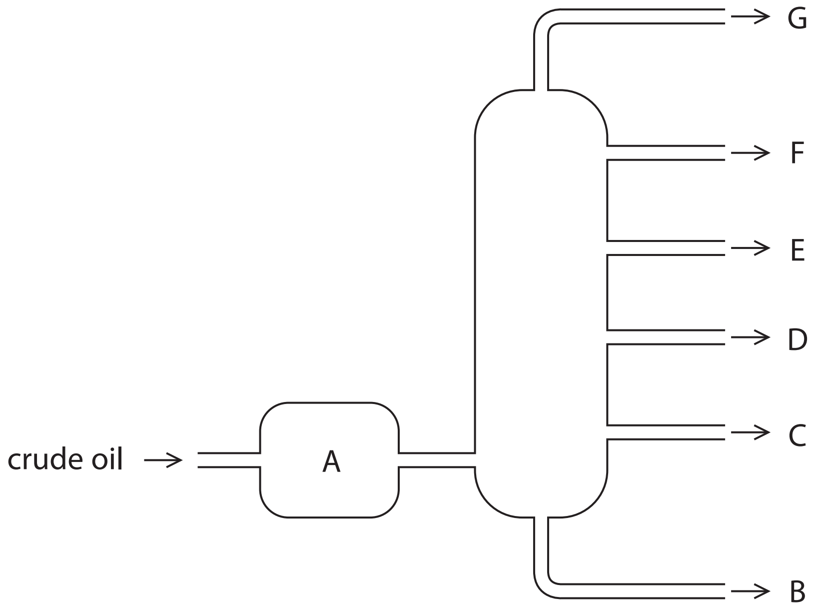
....

....

(Total for Question 5 = 10 marks)

6 Crude oil is an important source of organic compounds.

(a) The diagram shows how crude oil is separated into fractions in the oil industry.



(i) What happens to the crude oil in A?

(1)

....

....

....

(ii) Most of the compounds in crude oil are hydrocarbons.

What is meant by the term **hydrocarbons**?

(2)

....

....

(iii) Compare the hydrocarbons in fractions D and F in terms of

- boiling point
- size of molecules
- viscosity

(3)

(b) Some of the fractions are catalytically cracked. The general equation for some reactions in this process is

$$\text{alkane} \rightarrow \text{alkane} + \text{alkene}$$

(i) State two conditions used in catalytic cracking.

(2)

1 ....

....

2 ....

....

(ii) How does the bonding in an alkene molecule differ from the bonding in an alkane molecule?

(1)

....

....

(iii) The chemical equation for one cracking reaction is

$$C_{16}H_{34} \rightarrow C_8H_{18} + 2C_3H_6 + \text{compound Q}$$

Deduce the molecular formula of Q.

(1)

....

(c) The compound with molecular formula C_3H_6 can be used to make a polymer.

(i) Give the name of the compound C_3H_6

(1)

....

(ii) Complete the table of information about this compound.

(3)

Type of formula	**Formula**
molecular	C_3H_6
	C_nH_{2n}
	CH_2
displayed	

(iii) Complete this structure to show the part of the polymer formed from two molecules of C_3H_6

(2)

(Total for Question 6 = 16 marks)

7 Hydrogen peroxide solution decomposes very slowly at room temperature.

The equation for this reaction is

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Very few bubbles can be seen in the solution because of the slow decomposition.

The rate of this reaction is greatly increased by adding a catalyst.

(a) A student added a solid to some hydrogen peroxide solution to see if the solid acted as a catalyst.

He noticed that a lot of bubbles formed, and that the solid was still present at the end of the reaction.

Outline a method to show that the solid acted as a catalyst and not as a reactant.

(2)

....

....

....

....

....

....

(b) The student investigated the effect that changing the concentration of the hydrogen peroxide solution has on the rate of the reaction.

He used solid manganese(IV) oxide as the catalyst in each experiment.

This is the method he used.

- pour some hydrogen peroxide solution into a conical flask on a top-pan balance
- add the catalyst and place some cotton wool loosely in the neck of the flask
- record the balance reading and start a timer
- record the balance reading every minute until the mass no longer changes
- repeat the experiment several times using different concentrations of hydrogen peroxide solution

(i) State one property of each substance that the student should keep the same in each experiment.

(2)

hydrogen peroxide solution ....

....

manganese(IV) oxide ....

....

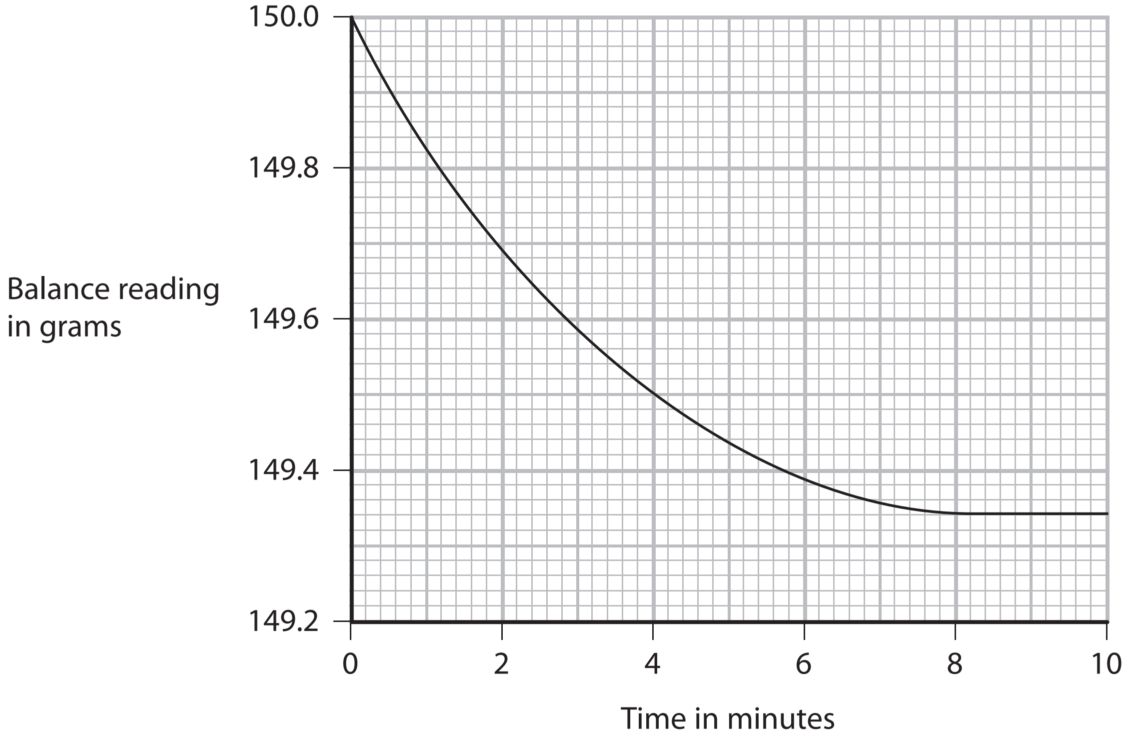
(ii) What is the purpose of the cotton wool?

(1)

....

....

(c) The graph shows the results of one of the student's experiments.



(i) Why does the balance reading decrease during the experiment?

(1)

....

....

(ii) What does the slope of the curve indicate about the reaction?

(1)

....

....

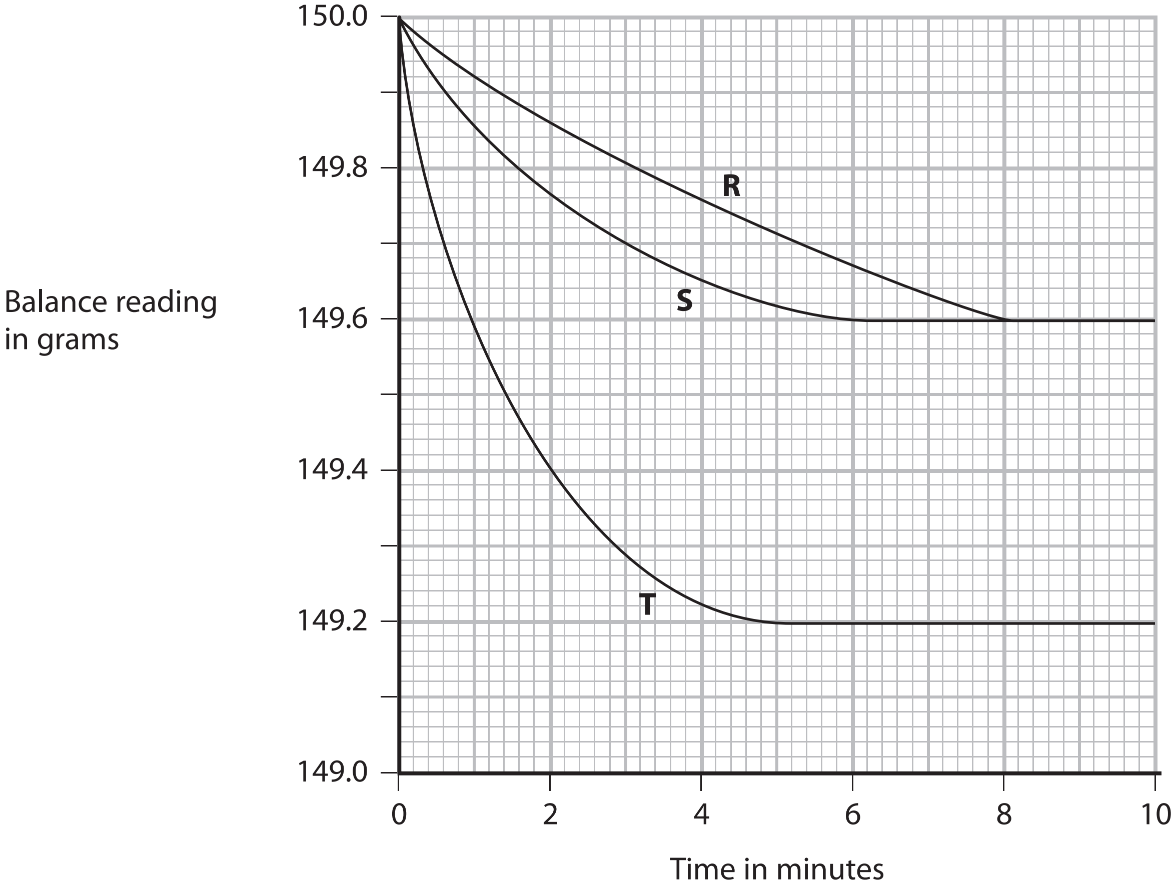
(iii) How long does the reaction take to complete?

(1)

....

....

(d) The results of some of the student's other experiments are shown on this graph.



(i) Which one of the experiments, R, S or T, was the fastest?

(1)

....

(ii) The concentration of the hydrogen peroxide solution in experiment S was 0.40 mol/dm^3.

Use the graph to deduce the concentration of the hydrogen peroxide solution in experiment T.

State how you deduced your answer.

(2)

concentration = ... mol/dm^3

....

....

....

....

(e) Another student repeated the investigation.

She recorded the time for the total mass of the beaker and contents to decrease by 0.50 g in each experiment. She then converted the times to relative rates of reaction.

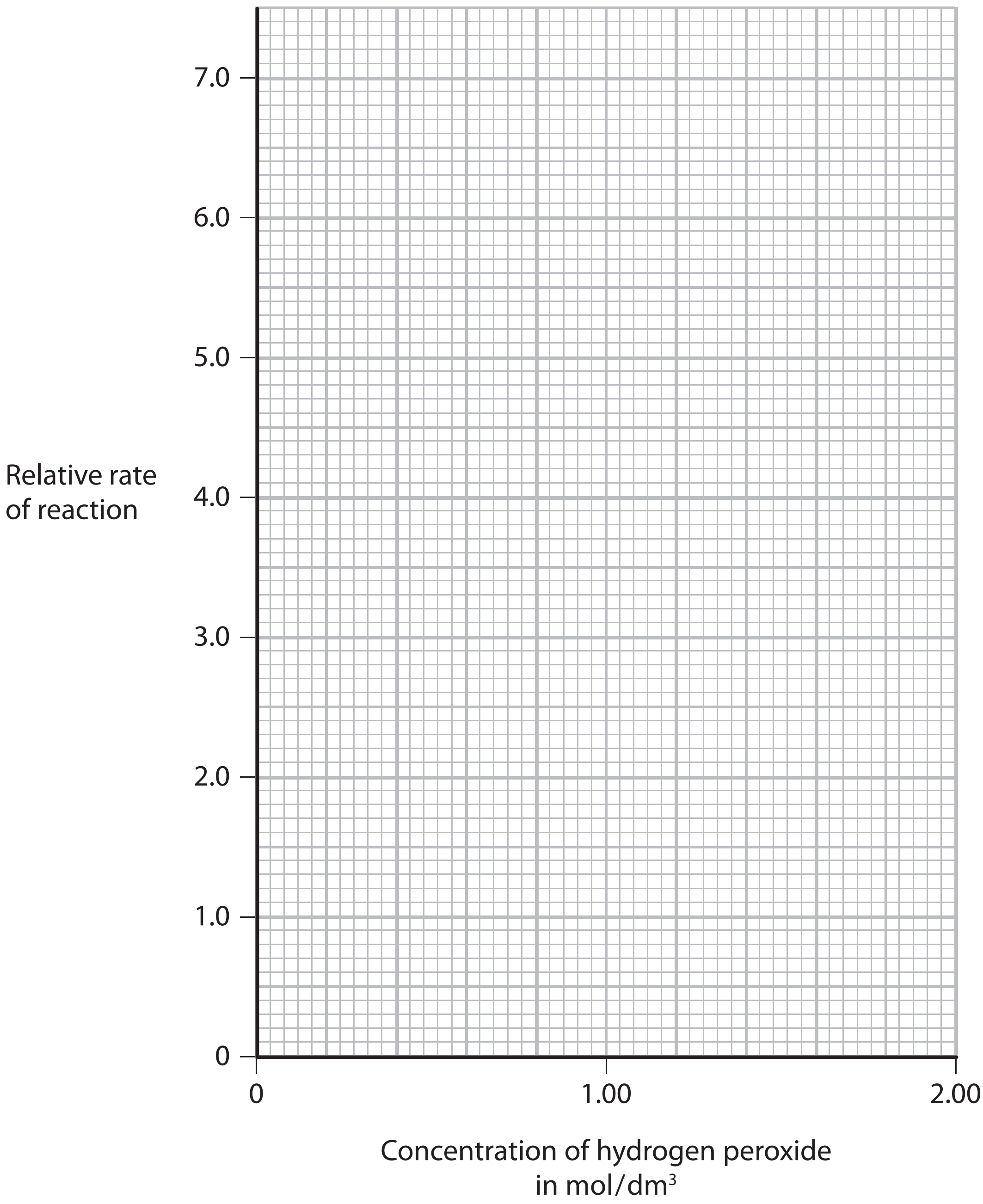
The table shows the concentrations she used and the relative rates of reaction she calculated.

Relative rate of reaction	1.5	2.2	3.0	4.4	5.1	6.0	7.4
Concentration in mol/dm³	0.40	0.60	0.80	1.20	1.40	1.60	2.00

Plot a graph of these results on the grid.

Draw a straight line of best fit through the points.

(3)



(f) Explain, in terms of particles, why the rate of a reaction increases as the concentration of a reactant increases.

(2)

....

....

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....

....

....

(Total for Question 7 = 16 marks)

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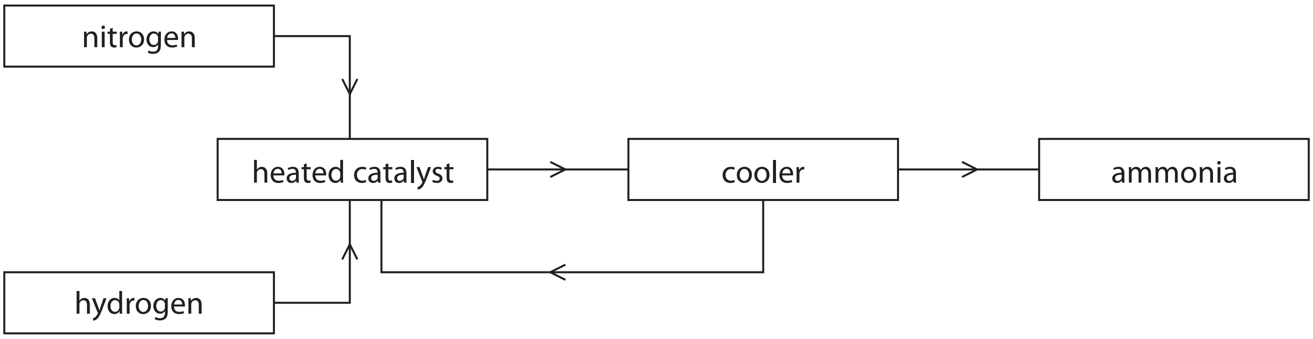
8 (a) The flow chart shows how ammonia is made using the Haber process.



(i) State one raw material that is used as the source of

(2)

nitrogen ....

hydrogen ....

(ii) Identify the catalyst and state the pressure, in atmospheres, used in the Haber process.

(2)

catalyst ....

pressure ....

(iii) Which substances pass from the cooler to the heated catalyst?

(1)

☒ **A** ammonia, hydrogen and nitrogen

☒ **B** hydrogen only

☒ **C** hydrogen and nitrogen

☒ **D** nitrogen only

(iv) When ammonia leaves the cooler it is

(1)

☒ **A** an aqueous solution

☒ **B** a gas

☒ **C** a liquid

☒ **D** a solid

(b) Hydrazine (N_2H_4) is a useful compound that can be manufactured from ammonia.

(i) Hydrogen peroxide can be used to convert ammonia to hydrazine.

Balance the equation for this reaction.

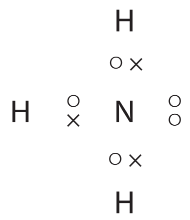
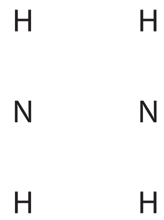
(1)

$$\ldots\ldots NH_3 + \ldots\ldots H_2O_2 \rightarrow \ldots\ldots N_2H_4 + \ldots\ldots H_2O$$

(ii) The bonding in ammonia and hydrazine can be represented by dot and cross diagrams. The diagram for ammonia has been drawn.

All the bonds in hydrazine are single bonds. Complete the diagram for hydrazine. Show only the outer electrons.

(2)

ammonia	hydrazine
	

(c) Hydrazine was used as the fuel in the first rocket-powered fighter aircraft in World War II.

It is now used as a propellant in spacecraft. It slowed the descent of the Phoenix spacecraft as it landed on Mars.

The equations for its use as a rocket fuel and as a propellant are shown in the table.

Use	Equation	ΔH in kJ/mol
rocket fuel	$N_2H_4 + O_2 \rightarrow N_2 + 2H_2O$	−660
propellant	$N_2H_4 \rightarrow N_2 + 2H_2$	−50

(i) How does the information in the table show that both reactions are exothermic?

(1)

....

....

(ii) Why is it not correct to describe hydrazine as a fuel when it is used as a propellant?

(1)

....

....

(d) Some spacecraft use MMH, a compound similar to hydrazine, as a propellant. MMH has the composition by mass of 26.1% carbon, 60.9% nitrogen and 13.0% hydrogen.

(i) Calculate the empirical formula of MMH.

(3)

empirical formula ....

(ii) The M_r of MMH is 46

What is the molecular formula of MMH?

(1)

....

(Total for Question 8 = 15 marks)

9 Molybdenum (Mo) is a metal. It is often used to make an alloy with iron.

Like iron, it is extracted from its oxide. Unlike iron, it occurs mainly as its sulfide.

(a) Molybdenum sulfide is converted into molybdenum oxide by heating in air. The equation for this reaction is

$$2MoS_2 + 7O_2 \rightarrow 2MoO_3 + 4SO_2$$

(i) Why is molybdenum said to be oxidised in this reaction?

(1)

....

....

(ii) The sulfur dioxide formed in the reaction could form acid rain if it escaped into the atmosphere.

Write a chemical equation for the formation of an acid from sulfur dioxide.

(1)

....

(b) The table shows the melting points of molybdenum oxide and sulfur dioxide.

	Melting point in °C
molybdenum oxide	800
sulfur dioxide	–75

The melting point indicates the type of bonding and structure in a compound.

(i) What is the type of bonding in a molecule of sulfur dioxide?

(1)

....

(ii) Explain why the melting point of sulfur dioxide is low.

(2)

....

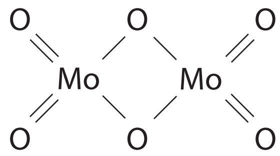
....

....

....

(iii) The melting point of molybdenum oxide suggests that it has ionic bonding. However, it is often represented as a molecular structure.

Deduce the molecular formula of molybdenum oxide as shown in this structure.



(1)

....

(c) The metallic structure of molybdenum gives it some typical properties.

(i) Describe the metallic structure of molybdenum.

(2)

....

....

....

....

(ii) Explain why molybdenum is a good conductor of electricity.

(2)

....

....

....

....

(iii) Explain why molybdenum is malleable.

(2)

....

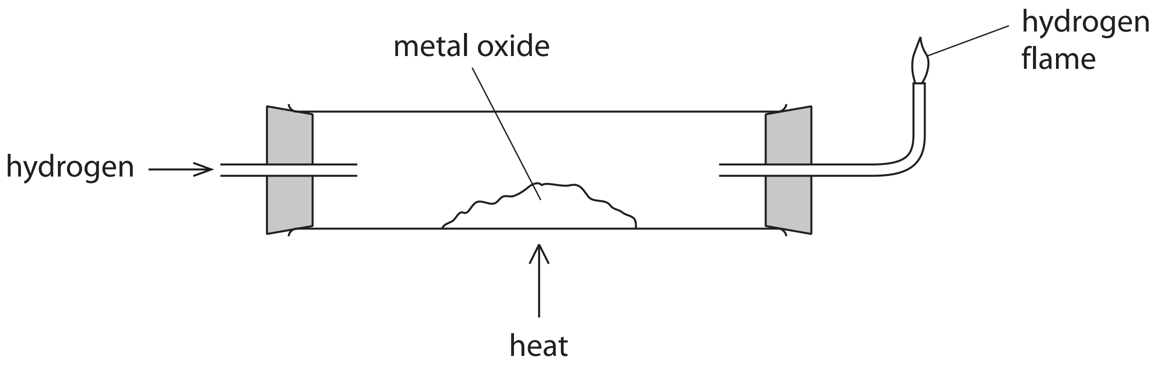
....

....

....

(Total for Question 9 = 12 marks)

10 This apparatus can be used to investigate the reduction of metal oxides.



The mass of the metal oxide is measured before and after heating it in hydrogen.

The results can be used to determine the formula of the oxide.

(a) The hydrogen gas burns as it leaves the tube.

(i) What substance is formed when hydrogen burns in air?

(1)

....

(ii) Why is it important to relight the flame if it goes out?

(1)

....

....

(b) These are the results for one experiment.

Mass of solid before heating = 4.2 g

Mass of solid after heating = 3.4 g

These results may not be sufficient to find the mass of metal for use in determining the formula of the metal oxide.

What further practical steps should be taken to confirm that an accurate value for the mass of metal has been obtained?

(2)

....

....

....

....

(c) In an experiment using a different metal oxide, a mass of 2.8 g of metal is obtained from 3.6 g of the metal oxide.

(i) Calculate the mass of oxygen in the sample of the metal oxide.

(1)

mass of oxygen = ... g

(ii) Calculate the amount, in moles, of oxygen atoms in the sample of the metal oxide.

(2)

amount of oxygen = ... mol

(iii) The formula of the metal oxide is MO, where M is the symbol of the metal.

Deduce the amount, in moles, of M in the sample of the metal oxide.

(1)

amount of M = ... mol

(iv) What is the relative atomic mass of M?

(2)

relative atomic mass of M = ...

(Total for Question 10 = 10 marks)

TOTAL FOR PAPER = 120 MARKS

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