Write your name here

Surname	Other names

Pearson Edexcel International GCSE (9 - 1)

Centre Number	Candidate Number

Chemistry

Paper 2

Sample Assessment Materials for first teaching September 2017

Time: 1 hour 15 minutes

Paper Reference

4CH1/2C

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.*
- Calculators may be used.
- 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 70.
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

S52916A

S 5 2 9 1 6 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.

BLANK PAGE

Answer ALL questions. Write your answers in the spaces provided.

1 The table shows some properties of four substances, **P**, **Q**, **R** and **S**.

Substance	Melting point /°C	Boiling point /°C	Conducts electricity when	
			solid	liquid
P	3410	5930	yes	yes
Q	734	1435	no	yes
R	−95	69	no	no
S	2507	3900	no	no

Use the information in the table to answer the following questions.
You may use each letter once, more than once or not at all.

Choose a substance that:

(a) is a solid at 3000 °C.

(1)

☒ **A** substance **P**

☒ **B** substance **Q**

☒ **C** substance **R**

☒ **D** substance **S**

(b) is a liquid at 25 °C.

(1)

☒ **A** substance **P**

☒ **B** substance **Q**

☒ **C** substance **R**

☒ **D** substance **S**

(c) is an ionic compound.

(1)

- ☒ **A** substance **P**
- ☒ **B** substance **Q**
- ☒ **C** substance **R**
- ☒ **D** substance **S**

(d) is a metal.

(1)

- ☒ **A** substance **P**
- ☒ **B** substance **Q**
- ☒ **C** substance **R**
- ☒ **D** substance **S**

(Total for Question 1 = 4 marks)

2 This is a method used to measure the solubility of a solid in water:

- add an excess of solid to some water in a boiling tube and stir
- measure the temperature of the saturated solution formed
- weigh an empty evaporating basin
- pour some of the saturated solution into the evaporating basin
- weigh the basin and contents
- heat the evaporating basin to remove all of the water
- weigh the evaporating basin and remaining solid.

(a) The table shows the results of an experiment using this method.

mass of evaporating basin / g	89.6
mass of evaporating basin + saturated solution / g	115.8
mass of evaporating basin + solid / g	94.9

Calculate the mass of solid obtained and the mass of water removed.

(2)

mass of solid = ... g

mass of water = ... g

(b) In another experiment, at a different temperature, the mass of solid obtained is 10.5 g and the mass of water removed is 16.8 g.

Calculate the solubility of the solid, in g per 100 g of water, at this temperature.

(2)

solubility = ... g per 100 g of water

(c) If the evaporating basin is heated too strongly some of the solid decomposes to form a gas.

Explain how this strong heating would affect the value of the calculated solubility of the solid.

(3)

(Total for Question 2 = 7 marks)

3 Astatine, bromine, chlorine, fluorine and iodine are all halogens.
They are found in Group 7 of the Periodic Table.

(a) Predict which halogen has the lightest colour.

(1)

.....

(b) Name a halogen that is a solid at room temperature.

(1)

.....

(c) Bromine can be obtained from the bromide ions in sea water.
Chlorine is bubbled into sea water.
The chlorine oxidises the bromide ions to bromine atoms.
The bromine atoms then form bromine molecules.

(i) Complete the equation to show how bromine **atoms** are formed from bromide ions.

(1)

$$Cl_2 + \text{.....} \; Br^- \rightarrow 2Cl^- + \text{.....} \; Br$$

(ii) State why this reaction is described as the oxidation of bromide ions.

(1)

.....

.....

(iii) Write an equation to show how bromine atoms form bromine molecules.

(1)

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(d) Boron and fluorine form a covalent compound that has the molecular formula BF_3

Draw a dot-and-cross diagram to show the arrangement of the outer electrons in a molecule of BF_3

Use crosses (✕) to represent the outer electrons of boron. Use dots (•) to represent the outer electrons of fluorine.

(2)

(Total for Question 3 = 7 marks)

4 A technician finds a white solid in an unlabelled beaker.

She knows that the solid is one of the following substances:

- potassium chloride
- potassium sulfate
- sodium chloride
- sodium sulfate.

Describe how the technician can use chemical tests to identify the solid in the beaker.

(6)

(Total for Question 4 = 6 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

5 Zinc metal is obtained from sulfide ores.
The most common ore of zinc is sphalerite, which contains zinc sulfide (ZnS) and a small amount of cadmium sulfide (CdS).

The stages involved in the extraction of zinc from sphalerite are:

Stage 1 Sphalerite is strongly heated in air.

$$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$$

$$2CdS(s) + 3O_2(g) \rightarrow 2CdO(s) + 2SO_2(g)$$

Stage 2 The mixture of oxides is reacted with sulfuric acid.

$$ZnO(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2O(l)$$

$$CdO(s) + H_2SO_4(aq) \rightarrow CdSO_4(aq) + H_2O(l)$$

Stage 3 Zinc dust is added to the solution containing zinc sulfate and cadmium sulfate to remove the cadmium ions.

$$Cd^{2+}(aq) + Zn(s) \rightarrow Cd(s) + Zn^{2+}(aq)$$

Stage 4 The solid cadmium is filtered off and the pure zinc sulfate solution is electrolysed.

(a) State how the reaction in stage 3 shows that zinc is more reactive than cadmium.

(1)

.....

.....

(b) (i) During the electrolysis in stage 4, zinc is deposited on the cathode.

Write an ionic half-equation for the reaction that occurs.

(1)

.....

(ii) Complete the ionic half-equation for the reaction occurring at the anode.

..... $H_2O \rightarrow$ .....$H^+ + O_2 +$ ..... e^-

(1)

(iii) Explain how the pH of the solution surrounding the anode changes during the electrolysis.

(2)

.....

.....

.....

.....

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

(c) Zinc is mixed with copper to make the alloy brass.

Explain why brass is harder than pure copper.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question 5 = 8 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

6 The mineral nesquehonite is a form of hydrated magnesium carbonate.

The formula, $MgCO_3.xH_2O$, shows that nesquehonite contains water of crystallisation.

When a sample of nesquohonite is heated gently, the water of crystallisation is given off and anhydrous magnesium carbonate is left.

Six students are each given a sample of nesquehonite of mass 6.1 g. The students heat their samples for different times. The samples are then allowed to cool before being reweighed.

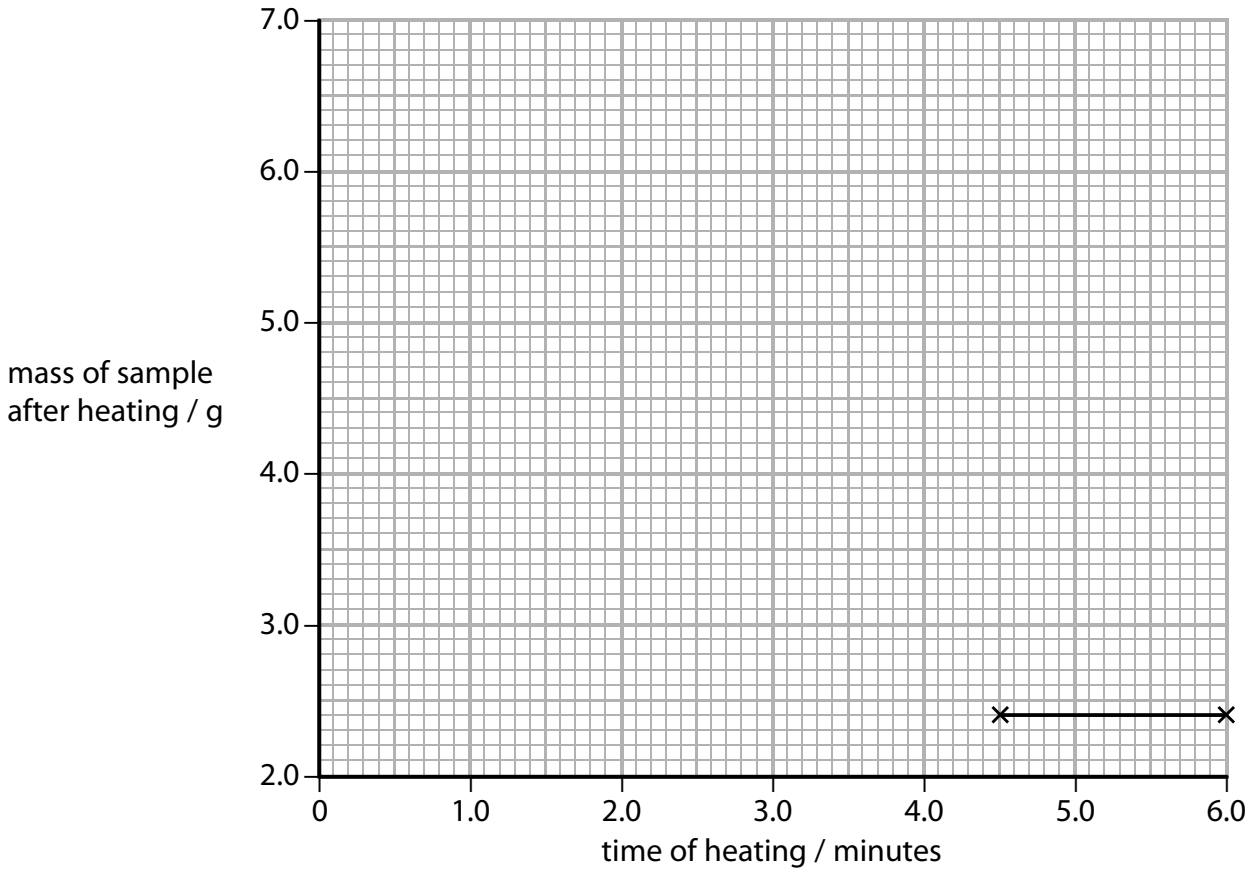
The table shows their results.

time of heating / minutes	0	1.0	2.0	3.0	4.0	4.5	6.0
mass of sample after heating / g	6.1	5.3	4.5	3.7	2.8	2.4	2.4

(a) Plot these results on the grid provided. The last two points have been plotted for you.

Draw a straight line of best fit for the points you have plotted.

(2)



(b) Predict the mass of sample remaining after heating for 2.5 minutes.
Show on the graph how you obtain your answer.

(2)

mass after 2.5 minutes = ... g

(c) State why the last two masses in the table are exactly the same.

(1)

.....

.....

(d) A sample of nesquehonite contains 1.68 g of $MgCO_3$ and 1.08 g of H_2O.
Calculate the value of x in the formula $MgCO_3.xH_2O$
[M_r of $MgCO_3$ = 84; M_r of H_2O = 18]

(3)

x = ...

(e) When anhydrous magnesium carbonate is heated strongly, it decomposes.
The equation for the reaction is:

$$MgCO_3(s) \rightarrow MgO(s) + CO_2(g)$$

Calculate the volume of carbon dioxide formed in cm^3, at rtp, when 4.2 g of anhydrous magnesium carbonate are completely decomposed.
[M_r of $MgCO_3$ = 84]
[Assume that the molar volume at rtp of carbon dioxide is 24 dm^3]

(3)

volume = ... cm^3

(Total for Question 6 = 11 marks)

7 Ammonia is manufactured on a large scale and is used to make fertilisers such as ammonium nitrate (NH_4NO_3).

(a) The first stage in the manufacture of ammonium nitrate is to react ammonia gas with oxygen gas.

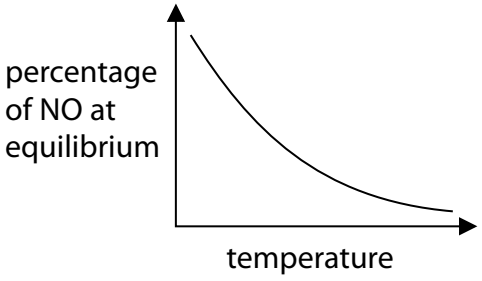
$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -907\,kJ/mol$$

The reaction is carried out at a pressure of about 10 atm and at a temperature of 800 °C, in the presence of a catalyst.

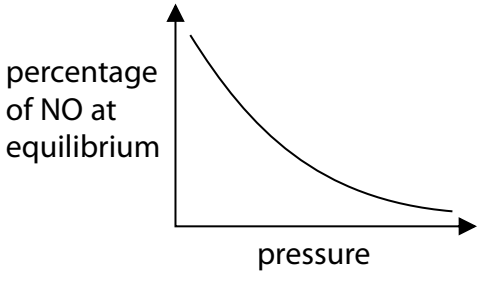
If the mixture is left for long enough in a sealed container, the reaction reaches a position of dynamic equilibrium.

Graph A shows how the percentage of nitrogen monoxide (NO) in the equilibrium mixture varies with temperature at constant pressure.

Graph B shows how the percentage of nitrogen monoxide (NO) in the equilibrium mixture varies with pressure at constant temperature.



graph A



graph B

(i) Explain why the percentage of NO at equilibrium decreases in each case.

(4)

Graph A .....

.....

.....

.....

Graph B .....

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(ii) Explain why the use of a catalyst has no effect on the position of equilibrium in a reversible reaction.

(2)

.....

.....

.....

.....

(b) The second stage in the manufacture of ammonium nitrate is to convert the nitrogen monoxide into nitric acid. The nitric acid is then reacted with concentrated aqueous ammonia as shown in this equation.

$$HNO_3(aq) + NH_3(aq) \rightarrow NH_4NO_3(aq)$$

(i) State, in terms of proton transfer, why this reaction is classified as an acid-base reaction.

(1)

.....

.....

(ii) Calculate the volume of 14.8 mol / dm^3 aqueous ammonia that is required to exactly neutralise 150 dm^3 of a solution of nitric acid of concentration 15.8 mol / dm^3.

(2)

volume of aqueous ammonia = ... dm^3

(Total for Question 7 = 9 marks)

8 Polymers can be classified as addition polymers or condensation polymers.

(a) An addition polymer can be formed from the monomer $CH_2{=}CHCl$

(i) Name this monomer.

(1)

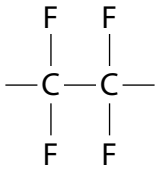
.....

(ii) Name the addition polymer formed from this monomer.

(1)

.....

(b) The diagram shows the repeat unit of a different addition polymer.

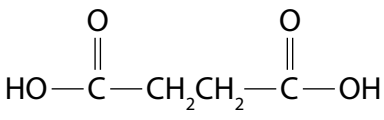


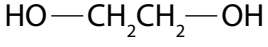
Draw the displayed formula of the monomer used to make this polymer.

(1)

(c) Polyesters are condensation polymers.

The structures of two monomers that are used to make a polyester are:





(i) Draw the structure of the repeat unit of the polyester formed from these two monomers.

(2)

(ii) Identify the small molecule formed when these two monomers form the polyester.

(1)

.....

(Total for Question 8 = 6 marks)

9 Grapes contain glucose that can be fermented to make ethanol.

(a) The grapes are collected and crushed to produce an aqueous solution containing glucose. Yeast is added to the solution and the mixture is left to ferment at a temperature of about 30 °C in the absence of air.

(i) State why yeast is added.

(2)

.....

.....

.....

.....

(ii) Explain why another organic compound may also be formed if fermentation is carried out in the presence of air.

(2)

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(iii) Explain why 30 °C is considered to be an optimum temperature for this reaction.

(2)

.....

.....

.....

.....

(b) Ethanol can also be manufactured by reacting ethene with steam.

(i) Write the chemical equation for this reaction.

(1)

.....

(ii) Name the type of reaction that occurs.

(1)

.....

(iii) State **two** conditions used for this reaction in industry.

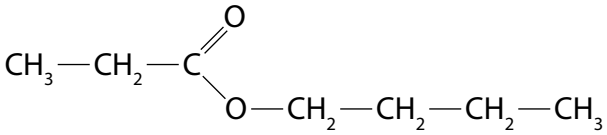
(2)

1 .....

2 .....

(c) Grapes also contain esters.

The formula of an ester is shown.



Deduce the name of the carboxylic acid and the alcohol that can react together to make this ester.

(2)

carboxylic acid .....

alcohol .....

(Total for Question 9 = 12 marks)

TOTAL FOR PAPER = 70 MARKS