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)

Tuesday 11 June 2024

Morning (Time: 1 hour 15 minutes)

Paper reference **4CH1/2C**

Chemistry

UNIT: 4CH1
PAPER: 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.*
- Show all the steps in any calculations and state the units.

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.
- 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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P 7 5 8 2 2 A 0 1 2 0

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 Use the Periodic Table to answer these questions.

(a) (i) Give the name of the element with atomic number 16

(1)

.....

(ii) Give the name of the element with relative atomic mass 9

(1)

.....

(iii) Give the name of the element in Group 3 and Period 2

(1)

.....

(iv) Give the electronic configuration of an atom of silicon.

(1)

.....

(b) Explain, in terms of electron configuration, why sodium is more reactive than lithium.

(3)

.....

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(Total for Question 1 = 7 marks)

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2 Structures made of iron can rust.

(a) (i) Name the two substances that cause iron to rust.

(2)

1 .....

2 .....

(ii) State a barrier method that prevents rusting.

(1)

.....

(b) Explain how sacrificial protection prevents the rusting of iron.

(2)

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(Total for Question 2 = 5 marks)

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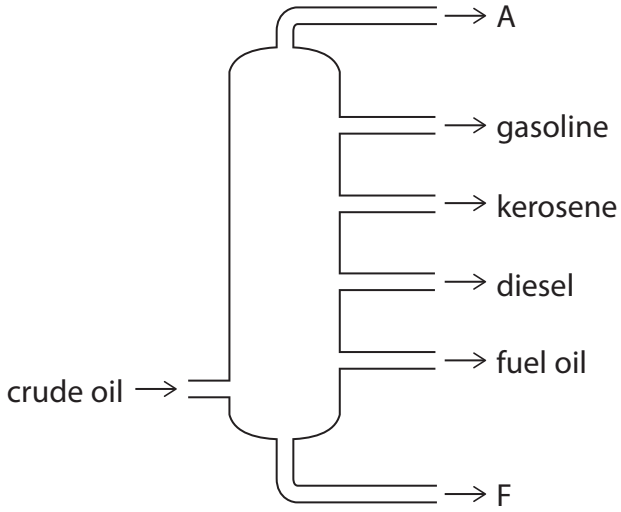
3 The diagram shows the separation of crude oil into fractions.



(a) Give the name of fraction A and the name of fraction F.

(2)

fraction A

.....

fraction F

.....

(b) One of the fractions is kerosene.

(i) Give one use of kerosene.

(1)

.....

(ii) Describe how kerosene can be obtained from crude oil.

(3)

.....

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(c) Catalytic cracking is a process used to break down fractions containing long-chain molecules.

(i) Give the name of the catalyst and the temperature used for catalytic cracking.

(2)

catalyst

temperature

(ii) Explain why catalytic cracking is useful.

(3)

(Total for Question 3 = 11 marks)

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4 The table shows the maximum mass of potassium nitrate (KNO_3) and the maximum mass of sodium nitrate ($NaNO_3$) that dissolves in 25 cm^3 of water at different temperatures.

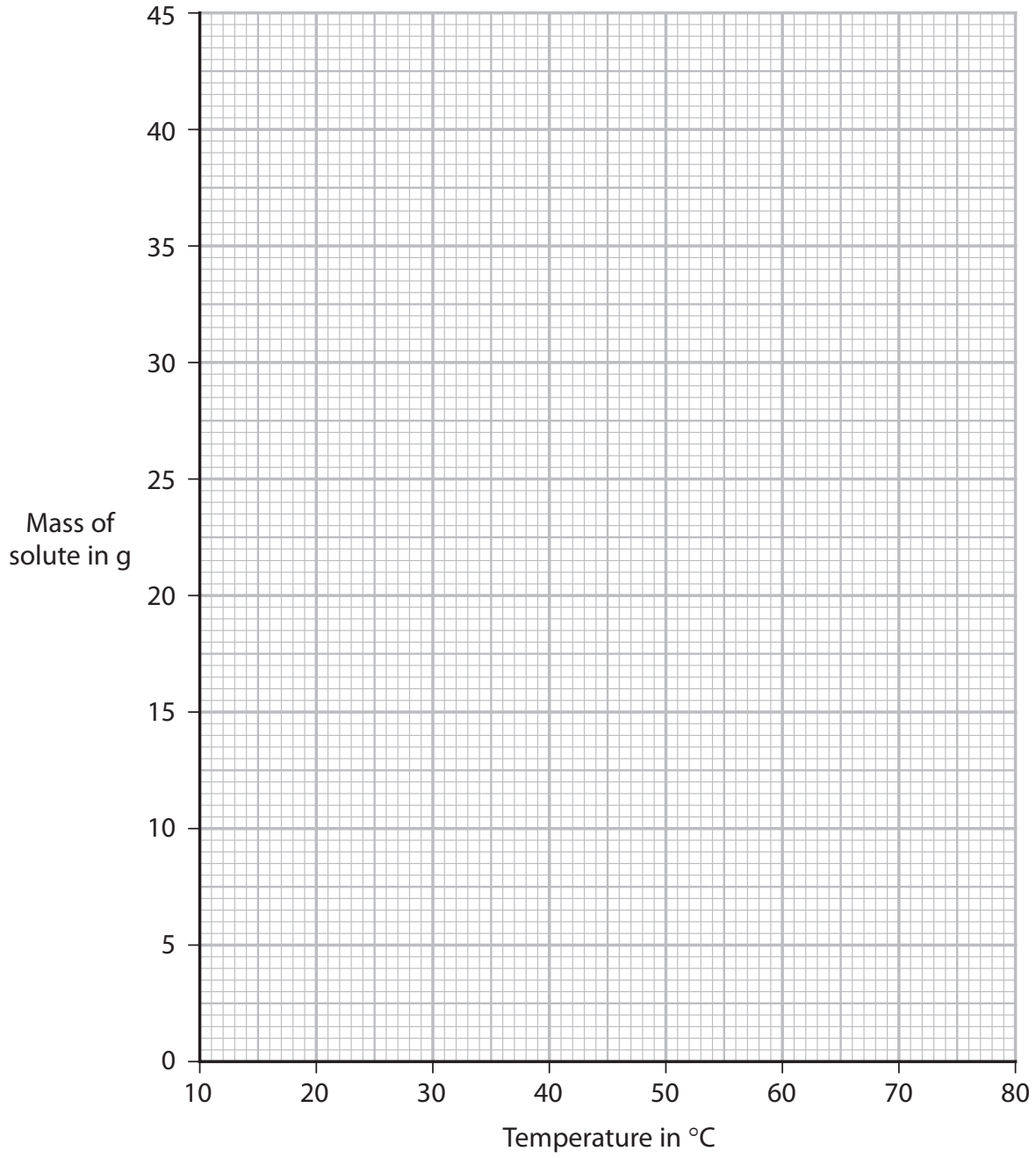
Temperature in °C	10	25	40	60	75
Mass of potassium nitrate in g	5	10	16	28	39
Mass of sodium nitrate in g	21	23	26	31	35

(a) (i) Plot the data for potassium nitrate and for sodium nitrate on the grid.

(2)

(ii) Draw and label a curve of best fit for KNO_3 and for $NaNO_3$

(2)



(b) The graph shows the temperature at which the maximum mass dissolved is the same for each solute.

Determine this temperature.

(1)

temperature = ... °C

(c) Use your graph to calculate the solubility, in g per 100 g of water, of sodium nitrate at 30 °C.

[1.0 cm^3 of water has a mass of 1.0 g]

(2)

solubility of sodium nitrate in g per 100 g of water = ...

(d) 25 cm^3 of a saturated solution of potassium nitrate is cooled from 50 °C to 20 °C.

Use your graph to determine the mass, in grams, of potassium nitrate that crystallises.

Show your working on the graph.

(3)

mass = ... g

(Total for Question 4 = 10 marks)

5 Methanol, CH_3OH, is the first member of the homologous series of alcohols.

(a) Give two characteristics of a homologous series.

(2)

1 .....

.....

2 .....

.....

(b) Methanol is heated with potassium dichromate(VI) and one other reagent.

The methanol is oxidised to methanoic acid, HCOOH

(i) Give the formula of the other reagent.

(1)

.....

(ii) Give the colour change that occurs during the reaction.

(2)

from ..... to .....

(iii) Draw the displayed formula for methanol and for methanoic acid in the boxes.

(2)

methanol	methanoic acid

(c) Methanol reacts with methanoic acid to form an ester.

Complete the equation for this reaction.

(1)

$CH_3OH + HCOOH \rightarrow$ ..... + ...

(d) The structural formula of an ester is $CH_3COOCH_2CH_2CH_2CH_3$

(i) What is the name of this ester?

(1)

☒ **A** butyl ethanoate

☒ **B** butyl methanoate

☒ **C** ethyl butanoate

☒ **D** methyl butanoate

(ii) Deduce the molecular formula of this ester.

(1)

.....

(Total for Question 5 = 10 marks)

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6 A scientist reacts lead(II) nitrate solution with sodium bromide solution.

This is the equation for the reaction.

$$Pb(NO_3)_2(aq) + 2NaBr(aq) \rightarrow PbBr_2(s) + 2NaNO_3(aq)$$

(a) Describe how the scientist could obtain a pure dry sample of lead(II) bromide ($PbBr_2$) from the reaction mixture.

(3)

(b) The scientist reacts an excess of lead(II) nitrate solution with 25 cm^3 of sodium bromide solution of concentration 2.0 mol/dm^3.

(i) Show that the amount of sodium bromide used is 0.050 mol.

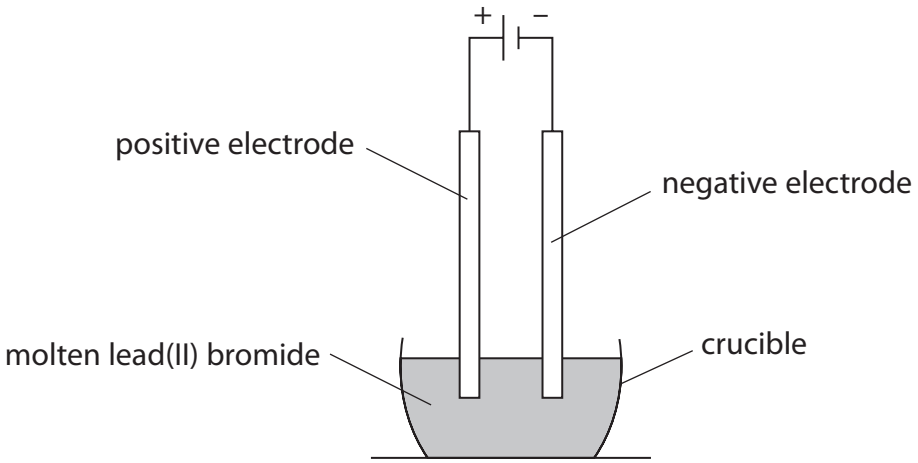
(1)

(ii) Show that the maximum theoretical mass of lead(II) bromide is approximately 9 g.

[for $PbBr_2$ $M_r = 367$]

(2)

(c) The scientist electrolyses molten lead(II) bromide using this apparatus.



(i) Explain why lead(II) bromide needs to be molten rather than solid for electrolysis to occur.

(3)

(ii) The electrolyte is at a temperature of 400 °C.

Explain a suitable material for the electrodes.

(2)

(iii) Give the half-equation that occurs at the negative electrode.

(1)

.....

(d) Bromine forms at the positive electrode.

This is the half-equation for the reaction at the positive electrode.

$$2Br^- \rightarrow Br_2 + 2e^-$$

(i) State what is observed at the positive electrode.

(1)

.....

.....

(ii) State why the half-equation represents an oxidation reaction.

(1)

.....

.....

(Total for Question 6 = 14 marks)

7 This question is about hydrogen chloride (HCl).

Hydrogen chloride is a covalent compound.

(a) State, in terms of electrostatic attraction, what is meant by a covalent bond.

(2)

(b) When hydrogen chloride gas is dissolved in an organic solvent, the hydrogen chloride remains a covalent molecule.

When hydrogen chloride gas is dissolved in water, ions are formed.

Explain what happens when dry blue litmus paper is dipped into separate samples of each solution.

(4)

(c) In the presence of ultraviolet radiation, hydrogen reacts with chlorine to form hydrogen chloride.

This is the equation for the reaction.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

The table shows the bond energies.

Bond	H—H	Cl—Cl	H—Cl
Bond energy in kJ/mol	436	242	431

(i) Calculate the enthalpy change (ΔH), in kJ/mol, for the reaction.

Include a sign in your answer.

(3)

ΔH = ... kJ/mol

(ii) Draw a reaction profile for the reaction.

Label the reactants, the products, ΔH and the activation energy (E_a).

(4)

energy

(Total for Question 7 = 13 marks)

TOTAL FOR PAPER = 70 MARKS

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