Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE

Monday 18 November 2024

Morning (Time: 1 hour 15 minutes)

Paper reference **4CH1/2C**

Chemistry

UNIT: 4CH1
PAPER: 2C

You must have:
Calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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 9 4 8 A 0 1 2 4

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						1 **H** hydrogen 1					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 Lanthanides (atomic numbers 58-71) and the Actinides(atomic numbers 90-103) have been omitted.***

Cu and Cl 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 The table shows the composition of five species that are either atoms or ions.

Species	Number of protons	Number of neutrons	Number of electrons
A	1	0	1
B	3	3	3
C	3	4	3
D	9	10	10
E	13	14	13

(a) Use the table to answer these questions.

You may use each letter once, more than once, or not at all.

(i) Give the letter of the species that is a negative ion.

(1)

.....

(ii) Give the letter of the species that has a full outer shell of electrons.

(1)

.....

(iii) Give the letter of the species that has an atomic number equal to its mass number.

(1)

.....

(b) Explain why species B and C are atoms of the same element with identical chemical properties.

(2)

(c) A proton has a mass of 1.6726×10^{-24} g.

A neutron has a mass of 1.6740×10^{-24} g.

Calculate the mass, in grams, of the nucleus of an atom of species C.

(2)

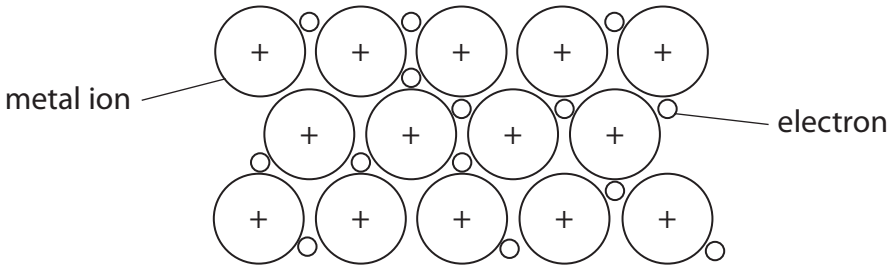
mass = ... g

(Total for Question 1 = 7 marks)

2 This question is about metals and metal compounds.

(a) All metals are malleable and good conductors of electricity.

The diagram shows the structure of a metal.



(i) Explain why metals are malleable.

(2)

(ii) Explain why metals are good conductors of electricity.

(2)

(b) Two methods of obtaining a metal from a compound are electrolysis and extraction using carbon.

Explain, without giving practical details, which method is most suitable for extracting iron from iron(III) oxide.

(2)

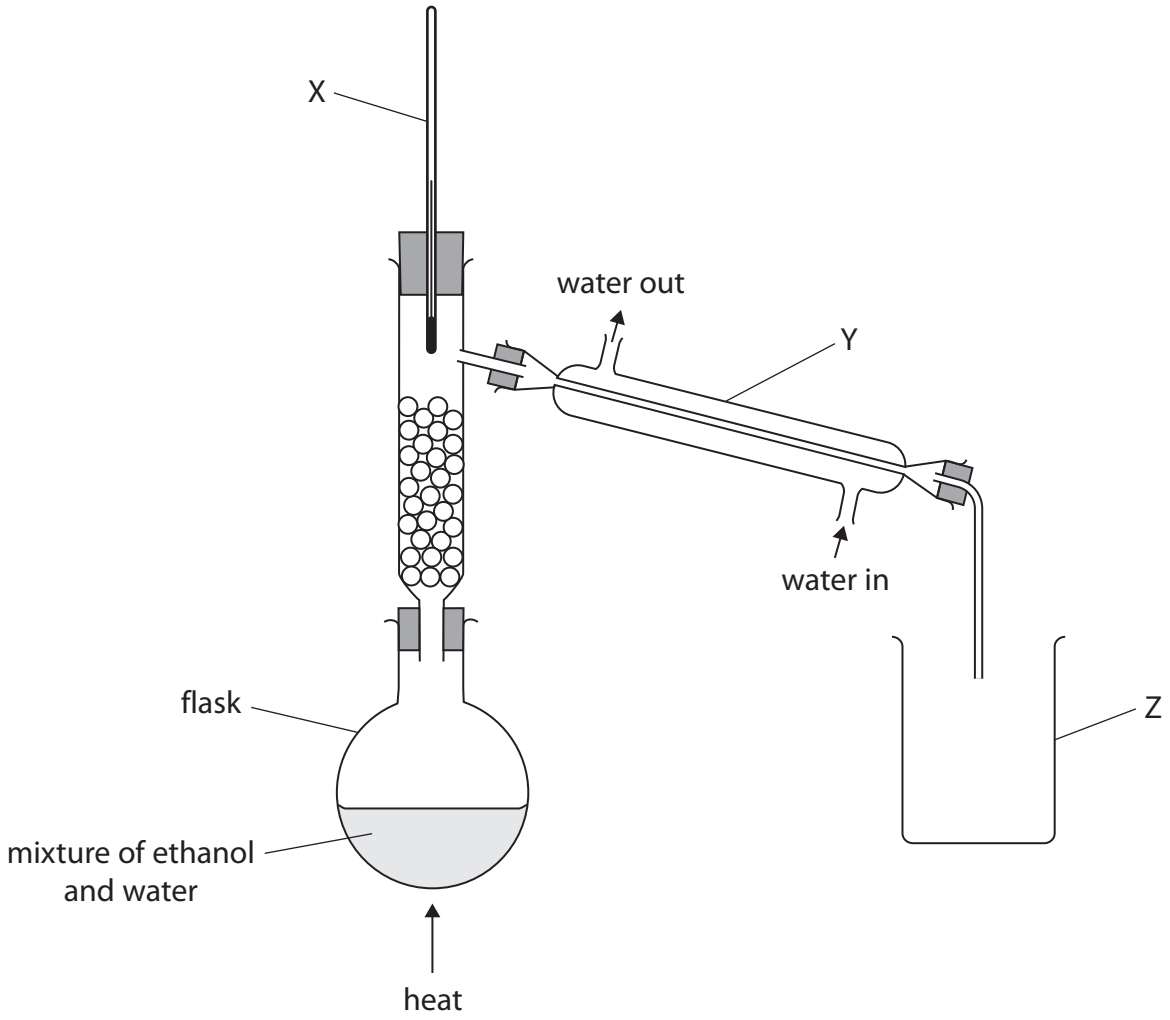
(c) A student has a solution of iron(II) sulfate and a solution of iron(III) sulfate.

Describe a chemical test the student could use to identify which solution is iron(II) sulfate.

(2)

(Total for Question 2 = 8 marks)

3 A teacher uses this apparatus to separate a mixture of ethanol and water.



(a) Give the name of this method of separation.

(1)

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

(b) Name the pieces of apparatus labelled X, Y and Z.

(3)

X .....

Y .....

Z .....

(c) Give a physical test that the teacher could do to find out if the ethanol produced is pure.

(2)

.....

.....

.....

.....

(Total for Question 3 = 6 marks)

4 A teacher adds a small piece of lithium to water and collects the gas produced.

(a) (i) Give two observations when lithium is added to water.

(2)

1 .....

.....

2 .....

.....

(ii) The teacher adds a few drops of universal indicator to the solution at the end of the reaction.

Explain the final colour of the universal indicator.

(2)

.....

.....

.....

.....

(b) This is the equation for the reaction between lithium and water.

$$2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$$

The teacher collects 550 cm^3 of hydrogen at rtp.

Calculate the mass, in grams, of lithium that the teacher added to the water.

[one mole of gas at rtp has a volume of 24 000 cm^3]

[for lithium, $A_r = 7$]

[for carbon $A_r = 12$ for hydrogen, $A_r = 1$ for oxygen $A_r = 16$]

(3)

mass = ... g

(c) The teacher then adds a small piece of potassium to water.

(i) Give one observation seen with potassium that is **not** seen with lithium.

(1)

.....

.....

(ii) Explain why potassium is more reactive than lithium.

Refer to atomic structure in your answer.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question 4 = 11 marks)

5 A student does some titrations to find the volume of dilute nitric acid needed to exactly neutralise 25.0 cm^3 of sodium hydroxide solution.

This is the student's method.

Step 1 add 25.0 cm^3 of sodium hydroxide solution to a conical flask

Step 2 add three drops of methyl orange indicator

Step 3 fill a burette with the acid

Step 4 add acid from the burette until the indicator changes colour

Step 5 record the volume of acid added

(a) (i) Give the name of the apparatus that the student should use to measure the volume of sodium hydroxide solution in step 1.

(1)

.....

(ii) Give the colour change seen in step 4.

(1)

.....

(iii) Give a reason why the student does not use universal indicator in this titration.

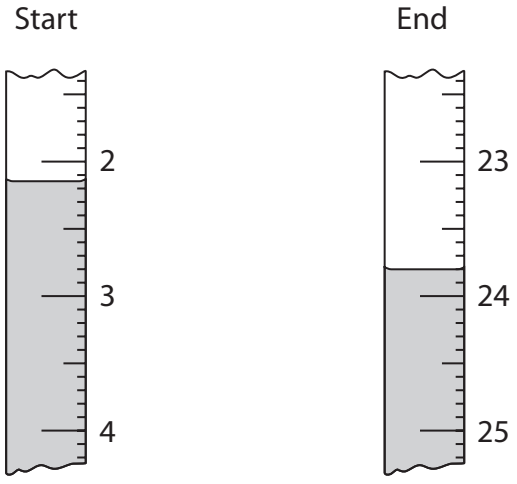
(1)

.....

.....

(b) The student completes a rough titration and four accurate titrations.

The diagram shows the burette readings from the rough titration.



The table shows the student's results.

	Rough titration	Titration 1	Titration 2	Titration 3	Titration 4
Burette reading at end in cm^3		21.80	22.85	21.75	24.10
Burette reading at start in cm^3		0.50	0.15	0.25	0.10
Volume added in cm^3		21.30	22.70	21.50	24.00

(i) Complete the table by adding the results from the rough titration.

Record the volumes to the nearest 0.05 cm^3

(2)

(ii) Concordant results are results within 0.20 cm^3 of each other.

Use the concordant results from the table to calculate the mean volume of acid added.

(3)

mean volume of acid = ... cm^3

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c) This is the equation for the reaction between dilute nitric acid and sodium hydroxide solution.

$$HNO_3(aq) + NaOH(aq) \rightarrow NaNO_3(aq) + H_2O(l)$$

After the titration, the student knows the volume of acid needed to neutralise 25.0 cm^3 of the sodium hydroxide solution.

Sodium nitrate decomposes at high temperatures.

Describe how the student could obtain pure, dry crystals of sodium nitrate from dilute nitric acid and sodium hydroxide solution.

(5)

(Total for Question 5 = 13 marks)

6 This question is about crude oil.

(a) Describe how crude oil is separated into fractions by fractional distillation.

(4)

(b) Some of the long-chain alkanes obtained from fractional distillation are cracked, producing shorter-chain alkanes and ethene.

(i) Give the conditions necessary for cracking to occur.

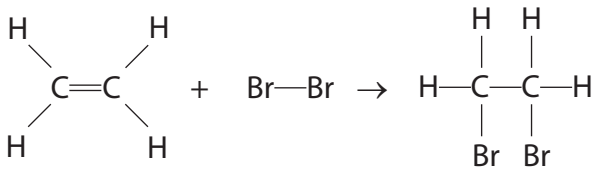
(2)

(ii) Explain why shorter-chain alkanes are more useful than longer-chain alkanes.

(2)

(iii) Ethene reacts with bromine.

The equation shows the displayed formulae of the reactants and product.



The table shows some bond energies.

Bond	Bond energy in kJ/mol
C═C	612
C—C	348
C—H	414
Br—Br	193
C—Br	276

Show that the molar enthalpy change, ΔH, for this reaction is about –100 kJ/mol.

(3)

ΔH = ... kJ/mol

(iv) Explain why the reaction between ethene and bromine is exothermic.

Refer to bond energies in your answer.

(2)

(Total for Question 6 = 13 marks)

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7 This question is about alcohols and carboxylic acids.

(a) These are the structural formulae of alcohol A and carboxylic acid B.

Alcohol A $CH_3CH_2CH_2OH$

Carboxylic acid B $CH_3(CH_2)_nCOOH$

(i) Name alcohol A.

(1)

.....

(ii) Draw the displayed formula of alcohol A.

(1)

(iii) Carboxylic acid B has a chain of carbon atoms with no branches.

The number of CH_2 units is represented by the letter n.

Calculate the value of n.

[for carboxylic acid B, M_r = 242]

(3)

n = ...

(iv) Alcohol A and carboxylic acid B react together to form an ester.

Give the other product of the reaction.

(1)

.....

(b) These are the structural formulae of dicarboxylic acid C and diol D.

Dicarboxylic acid C $HOOCCH_2CH_2COOH$

Diol D $HOCH_2CH_2OH$

(i) This is the equation for the reaction between dicarboxylic acid C and sodium hydroxide solution.

$$HOOCCH_2CH_2COOH + 2NaOH \rightarrow NaOOCH_2CH_2COONa + 2H_2O$$

25.0 cm^3 of 0.150 mol/dm^3 sodium hydroxide solution is completely neutralised by 17.5 cm^3 of a solution of dicarboxylic acid C.

Calculate the concentration, in mol/dm^3, of the solution of dicarboxylic acid C.

Give your answer to three significant figures.

(4)

concentration = ... mol/dm^3

(ii) Dicarboxylic acid C and diol D react to form a polyester.

Draw the displayed formula of the repeat unit of this polyester.

(2)

(Total for Question 7 = 12 marks)

TOTAL FOR PAPER = 70 MARKS

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