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)

Sample assessment material for first teaching 2024

Time: 1 hour 40 minutes

Paper reference **4WCH1/1C**

Chemistry (Modular)
UNIT 1

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.*

Information

- The total mark for this unit is 90.
- 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 ▶

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S 8 1 5 4 5 A 0 1 2 8

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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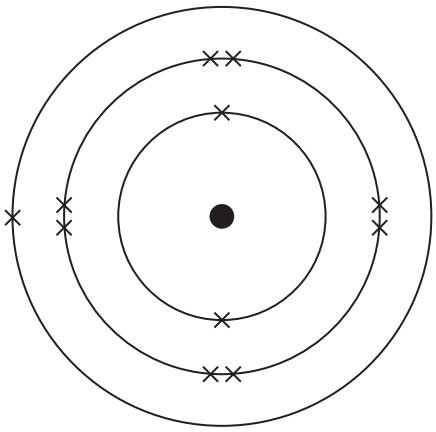
Answer ALL questions.

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 The diagram shows the electronic configuration of an atom of an element.



(a) Name the part of the atom that contains the protons and neutrons.

(1)

.....

(b) Give the number of protons in this atom.

(1)

.....

(c) Give the number of the group that contains this element.

(1)

.....

(d) Give the number of the period that contains this element.

(1)

.....

(Total for Question 1 = 4 marks)

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2 The diagram shows the positions of some elements in part of the Periodic Table.

Na												Al			S	Cl	
K																	Xe
												In					

(a) (i) Give the symbol of a metal from the diagram.

(1)

.....

(ii) Give the symbol of an element from the diagram that forms an acidic oxide.

(1)

.....

(b) Give a similarity in the electron configurations of Al and In.

(1)

.....

.....

(c) Explain which element in the diagram is unreactive.

(2)

.....

.....

.....

.....

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(d) One of the isotopes of Cl can be shown as ^{35}Cl

Determine the number of each sub-atomic particle in this isotope.

(3)

number of protons

.....

number of neutrons

.....

number of electrons

.....

(Total for Question 2 = 8 marks)

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3 This question is about changes of state and separation of mixtures.

(a) The box shows some changes of state.

boiling	condensation	evaporation
freezing	melting	sublimation

The table lists some physical changes.

Complete the table using words from the box to show the change of state for each physical change.

(4)

Physical change	Change of state
water to ice	
steam to water	
solid wax to liquid wax	
iodine crystals to iodine vapour	

(b) A student plans to obtain salt solution from a mixture of salt and sand.

The student adds pure water to the mixture to dissolve the salt.

State two things the student could do to make the salt dissolve quickly.

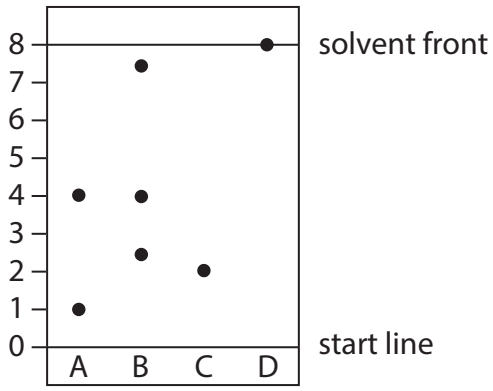
(2)

1 .....

2 .....

(c) Some mixtures can be separated using paper chromatography.

The diagram shows a chromatogram of the food dyes in four different food colourings, A, B, C and D.



(i) Give the letter of the food colouring that contains three different food dyes.

(1)

.....

(ii) Give the letters of the two food colourings that contain the same dye.

(1)

.....

(iii) Using the scale on the diagram, determine the R_f value of the dye in food colouring C.

(2)

R_f = ...

(iv) Give a reason why the dye in food colouring D moves the furthest from the start line.

(1)

.....

.....

(Total for Question 3 = 11 marks)

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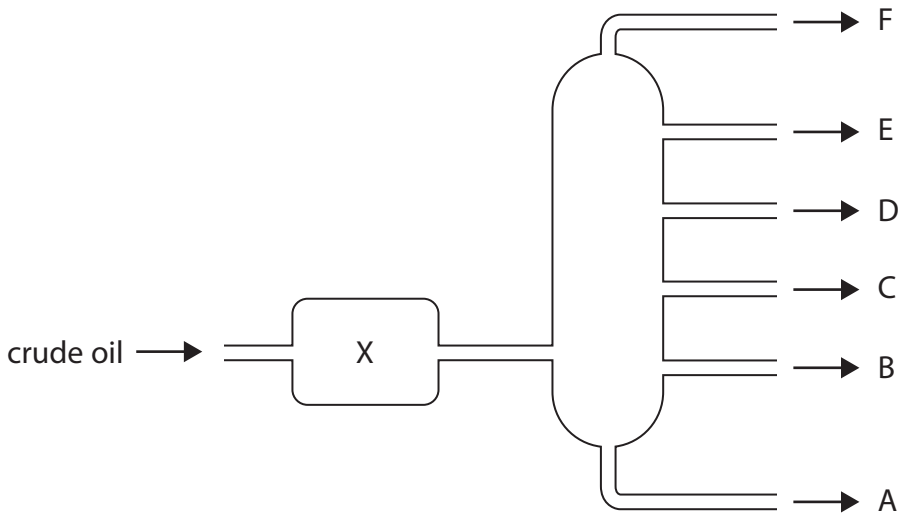
4 Crude oil is an important source of organic compounds.

(a) The diagram shows how crude oil can be separated into fractions by fractional distillation.



(i) State what happens to the crude oil when it is in X.

(1)

.....

(ii) Give the name of fraction E.

(1)

.....

(iii) Give a use for fraction A.

(1)

.....

(b) One of the compounds in fraction D is tridecane ($C_{13}H_{28}$) which can be cracked to form shorter-chain hydrocarbons.

(i) State the catalyst and temperature used in this cracking reaction.

(2)

catalyst

.....

.....

temperature

.....

.....

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(ii) The equation shows an example of a catalytic cracking reaction.

$$C_{13}H_{28} \rightarrow C_8H_{18} + C_2H_4 + C_3H_6$$

Give **two** reasons why this reaction is important.

(2)

1 .....

.....

2 .....

.....

(c) Sulfur is an impurity in crude oil.

Explain why this is a problem for the environment.

(3)

.....

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(Total for Question 4 = 10 marks)

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5 The reactions of metals with water and with dilute sulfuric acid can be used to determine the order of reactivity of the metals.

The table shows the reactions of four metals, W, X, Y and Z, with water and with dilute sulfuric acid.

Metal	Reaction with water	Reaction with dilute sulfuric acid
W	no reaction	no reaction
X	very slow reaction	reacts quickly
Y	no reaction	reacts slowly
Z	reacts quickly	reacts violently

(a) What is the order of reactivity of these metals?

(1)

Most reactive ⟶ least reactive

☒	**A**	W	X	Y	Z
☒	**B**	Z	X	Y	W
☒	**C**	W	Y	X	Z
☒	**D**	Z	Y	X	W

(b) (i) State which metal, W, X, Y or Z, could be copper.

(1)

.....

(ii) State which metal, W, X, Y, or Z, could be magnesium.

(1)

.....

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(c) A displacement reaction can also be used to decide the order of reactivity of two metals.

State two observations made when an excess of magnesium powder is added to an aqueous solution of copper(II) sulfate.

(2)

1 .....

.....

2 .....

.....

(Total for Question 5 = 5 marks)

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6 A salt can be made by reacting an acid with an insoluble base.

A student has a sample of copper(II) oxide.

The student uses this method.

Stage 1 pour 50 cm^3 of dilute sulfuric acid into a beaker

Stage 2 warm the acid using a Bunsen burner

Stage 3 add a small amount of copper(II) oxide to the warm acid and stir the mixture

Stage 4 add further amounts of copper(II) oxide until copper(II) oxide is in excess

Stage 5 filter the mixture

Stage 6 obtain crystals from the filtrate

(a) State why the acid is warmed in stage 2.

(1)

.....

.....

(b) State how the student would know that the copper(II) oxide is in excess in stage 4.

(1)

.....

.....

(c) State why the mixture is filtered in stage 5.

(1)

.....

.....

(d) State the colour of the filtrate obtained in stage 5.

(1)

.....

.....

(e) Describe how the student could obtain a pure, dry sample of hydrated copper(II) sulfate crystals from the filtrate in stage 6.

(5)

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(f) The overall equation for the formation of hydrated copper(II) sulfate crystals from copper(II) oxide is

$$CuO(s) + H_2SO_4(aq) + 4H_2O(l) \rightarrow CuSO_4.5H_2O(s)$$

(i) In an experiment, a student completely reacts 9.54 g copper(II) oxide.

Show that the maximum possible mass of $CuSO_4.5H_2O$ crystals that can be obtained is about 30 g.

[M_r of CuO = 79.5 M_r of $CuSO_4.5H_2O$ = 249.5]

Give your answer to an appropriate number of significant figures.

(3)

mass = ... g

(ii) In this experiment, the actual yield of $CuSO_4.5H_2O$ crystals is 23.92 g.

Calculate the percentage yield of $CuSO_4.5H_2O$

(2)

percentage yield = ... %

(Total for Question 6 = 14 marks)

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7 Titanium is an important metal in industry. Titanium metal is extracted from its ore.

The first stage in this extraction is the conversion of titanium dioxide to titanium(IV) chloride.

(a) This is the equation for the reaction.

$$TiO_2 + 2Cl_2 + C \rightarrow TiCl_4 + CO_2$$

Calculate the volume, in dm^3, of chlorine gas at rtp needed to react completely with 20 tonnes of titanium dioxide.

Give your answer in standard form.

[1 tonne = 10^6 g M_r of TiO_2 = 80]

[molar volume of chlorine gas at rtp = 24 dm^3]

(4)

volume of chlorine gas = ... dm^3

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(b) Aeroplanes are made of an alloy containing aluminium and titanium.

Explain why the alloy is stronger than pure titanium metal.

You may include diagrams in your answer.

(3)

(Total for Question 7 = 7 marks)

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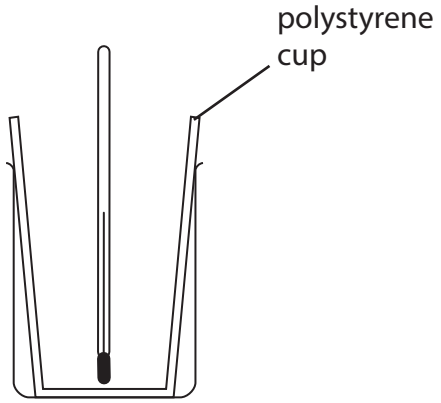
8 A student uses this apparatus to investigate the temperature change that occurs when ammonium nitrate is dissolved in water.



The student uses this method.

- put 100 cm^3 of water into the polystyrene cup and measure the initial temperature of the water
- add 8.00 g of ammonium nitrate and stir
- record the lowest temperature reached by the solution

The table shows her results.

Initial temperature of water in °C	20.0
Lowest temperature of solution in °C	14.2

(a) Use the results of the experiment to explain what type of reaction is taking place when ammonium nitrate is added to water.

(2)

.....

.....

.....

.....

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(b) Show that the heat energy change, Q, is about 2400 J.

[mass of 1.00 cm^3 of solution = 1.00 g]

[for the solution, c = 4.18 J/g/°C]

(3)

Q = ... J

(c) Use your answer to part (b) to calculate the enthalpy change, ΔH, in kilojoules per mole of ammonium nitrate.

[M_r of ammonium nitrate = 80.0]

Include a sign in your answer.

(4)

ΔH = ... kJ / mol

(Total for Question 8 = 9 marks)

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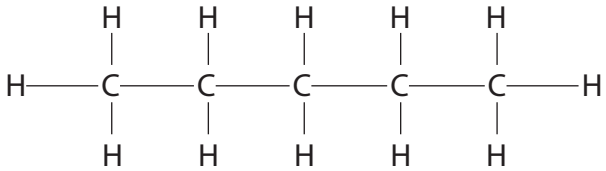
9 (a) There are three isomers with the molecular formula C_5H_{12}

One of these isomers is pentane.

The displayed formula for pentane is



(i) State what is meant by the term **isomers**.

(2)

.....

.....

.....

.....

(ii) Draw the displayed formula for another isomer of C_5H_{12}

(2)

(b) Pentane reacts with bromine in the presence of ultraviolet radiation.

(i) Complete the equation for this reaction.

(2)

$C_5H_{12} + Br_2 \rightarrow$ ..... + ...

(ii) Give the name of this type of reaction.

(1)

.....

(Total for Question 9 = 7 marks)

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10 When a bottle of wine is left open for several days, some of the ethanol in the wine turns to ethanoic acid, CH_3COOH

(a) A scientist uses a titration method to investigate how much ethanoic acid is formed if a bottle of white wine is left open for one week.

The scientist uses this method.

- fill a burette with the white wine and record the reading
- add 25.0 cm^3 of sodium hydroxide solution to a conical flask
- add a few drops of phenolphthalein indicator to the flask
- swirl the flask continuously while adding wine from the burette
- add the wine drop by drop near the end point
- record the reading at the end point

(i) Name the piece of apparatus that would be most suitable for measuring the 25.0 cm^3 of sodium hydroxide solution.

(1)

.....

.....

(ii) Suggest why red wine would not be suitable to use for this investigation.

(1)

.....

.....

.....

(iii) State why the scientist swirls the flask continuously.

(1)

.....

.....

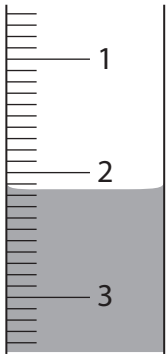
(iv) State why the scientist adds the wine drop by drop near the end point.

(1)

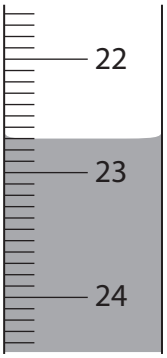
.....

.....

(b) The diagram shows the burette readings at the start and end of one of the titrations.



start



end

Use the readings to complete the table.

Give your values to the nearest 0.05 cm^3.

(3)

Burette reading at end	
Burette reading at start	
Volume of wine added in cm^3	

(c) The scientist repeats the titration four more times.

The table shows the results for these four titrations.

Titration number	1	2	3	4
Volume Volume of wine added in cm^3	20.40	20.10	20.35	20.45
Concordant results dant results				

Concordant results are those within 0.20 cm^3 of each other.

(i) Add ticks (✓) to the table to show the concordant results.

(1)

(ii) Use your ticked results to calculate the mean (average) volume of wine added.

(2)

mean volume of wine added = ... cm^3

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(d) Another scientist repeats the titration with a different bottle of white wine that has been left open for a week.

The equation for the reaction that occurs in this titration is

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

The mean volume of wine added is 19.50 cm^3.

(i) The concentration of the sodium hydroxide solution is 0.0500 mol / dm^3.

Calculate the amount, in moles, of NaOH in 25.0 cm^3 of sodium hydroxide solution.

(2)

amount of NaOH = ... mol

(ii) Deduce the amount, in moles, of CH_3COOH in 19.50 cm^3 of the wine.

(1)

amount of CH_3COOH = ... mol

(iii) Calculate the concentration, in mol / dm^3, of CH_3COOH in wine.

(2)

concentration of CH_3COOH = ... mol/dm^3

(Total for Question 10 = 15 marks)

TOTAL FOR UNIT = 90 MARKS