Please check the examination details belo	ow before entering your candidate information
Candidate surname	Other names
Pearson Edexcel Inter	
Tuesday 13 June 202	23
Morning (Time: 1 hour 15 minutes)	Paper reference 4CH1/2CR
Chemistry UNIT: 4CH1 PAPER: 2CR	
You must have: Calculator, ruler	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 ▶







# The Periodic Table of the Elements

0 4 He helium 2	20 <b>Ne</b> neon 10	40 <b>Ar</b> argon 18	84 <b>Kr</b> krypton 36	131 <b>Xe</b> xenon 54	[222] <b>Rn</b> radon 86	. full y
7	19 <b>F</b> fluorine 9	35.5 <b>CI</b> chlorine 17	80 <b>Br</b> bromine 35	127 	[210] <b>At</b> astatine 85	Elements with atomic numbers 112–116 have been reported but not full y authenticated
9	16 <b>O</b> oxygen 8	32 <b>S</b> sulfur 16	79 <b>Se</b> selenium 34	128 <b>Te</b> tellurium 52	[209] <b>Po</b> polonium 84	ave been rep 1
5	14 <b>N</b> nitrogen 7	31 <b>P</b> phosphorus 15	75 <b>As</b> arsenic 33	122 <b>Sb</b> antimony 51	209 <b>Bi</b> bismuth 83	s 112–116 ha authenticated
4	12 <b>C</b> carbon 6	28 <b>Si</b> silicon 14	73 <b>Ge</b> gemanium 32	119 <b>Sn</b> tin 50	207 <b>Pb</b> lead 82	omic number
ဇ	11 <b>B</b> boron 5	27 <b>Al</b> aluminium 13	70 <b>Ga</b> gallium 31	115 In indium 49	204 <b>TI</b> thallium 81	nents with atc
			65 <b>Zn</b> zinc 30	112 <b>Cd</b> cadmium 48	201 <b>Hg</b> mercury 80	Elem
			63.5 <b>Cu</b> copper 29	108 <b>Ag</b> silver 47	197 <b>Au</b> gold 79	[272] <b>Rg</b> roentgenium 111
			59 nickel 28	106 <b>Pd</b> palladium 46	195 <b>Pt</b> platinum 78	[271] <b>Ds</b> darmstadtium 110
			59 <b>Co</b> cobalt 27	103 <b>Rh</b> rhodium 45	192 <b>Ir</b> iridium 77	[268] <b>Mt</b> meitnerium 109
T Hydrogen			56 Fe iron 26	101 <b>Ru</b> ruthenium 44	190 <b>Os</b> osmium 76	[277] <b>Hs</b> hassium 108
			55 Mn manganese 25	[98] <b>Tc</b> technetium 43	186 <b>Re</b> rhenium 75	[264] <b>Bh</b> bohrium 107
	mass <b>bol</b> number		52 <b>Cr</b> chromium 24	96 <b>Mo</b> molybdenum 42	184 <b>W</b> tungsten 74	[266] Sg seaborgium 106
Key	relative atomic mass atomic symbol name atomic (proton) number		51 <b>V</b> vanadium 23	93 <b>Nb</b> niobium 41	181 <b>Ta</b> tantalum 73	[262] <b>Db</b> dubnium 105
	relati <b>ate</b> atomic		48 <b>Ti</b> titanium 22	91 <b>Zr</b> zirconium 40	178 <b>Hf</b> hafnium 72	[261] <b>Rf</b> rutherfordium 104
			45 Sc scandium 21	89 <b>≺</b> yttrium 39	139 <b>La*</b> lanthanum 57	[227] <b>Ac*</b> actinium 89
2	9 <b>Be</b> beryllium 4	24 <b>Mg</b> magnesium 12	40 <b>Ca</b> calcium 20	88 <b>Sr</b> strontium 38	137 <b>Ba</b> barium 56	[226] <b>Ra</b> radium 88
<b>←</b>	7 <b>Li</b> lithium 3	23 <b>Na</b> sodium 11	39 potassium 19	85 <b>Rb</b> rubidium 37	133 <b>Cs</b> caesium 55	[223] <b>Fr</b> francium 87

<sup>\*</sup> 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  $\boxtimes$ . If you change your mind about an answer, put a line through the box  $\boxtimes$  and then mark your new answer with a cross  $\boxtimes$ .

1 (a) The table lists three subatomic particles.

Complete the table by giving the missing information.

(2)

Subatomic particle	Relative mass	Relative charge
proton		+1
neutron		
electron	0.0005	

(b) The diagram shows the position of some elements in the Periodic Table.

Ве								F	
							Р		
									Xe

Use the Periodic Table on page 2 to help you answer this question.

(i) How are elements arranged in the Periodic Table?

(1)

- A increasing atomic number
- B increasing melting point
- D increasing relative atomic mass



		statement is correct about the position of phosphorus, P, in the c Table?	(1)
$\times$	A	Group 2 and Period 5	(-)
×	В	Group 3 and Period 5	
$\times$	C	Group 5 and Period 2	
$\times$	D	Group 5 and Period 3	
(iii) Ex	plain	which of the four elements in the diagram is least reactive.	(2)
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(iii) Ex	plain	which of the four elements in the diagram is least reactive.	(2)

2 The table gives some information about the halogens, fluorine, chlorine, bromine and iodine.

Halogen	Physical state at room temperature	Colour	Colour of dilute aqueous solution of halogen
fluorine	gas		colourless
chlorine	gas	green	colourless
bromine		red-brown	orange
iodine	solid	grey	brown

	(~)	Complete th	o tablo b	, aivina	the missing	information
1	(a)	Complete the	e table b	y givino	i the missinc	i miormation

(2)

(b)	Describe a	test to	show	that a	colourless	liauid	l is an	alkene.
(0)	Describe a	icsi to	311044	triat a	Colourics	, iiqaia	i is aii	antene.

(2)


	(Total for Question 2 = 7 ma	rks)
	Explain the colour change that occars.	(3)
	Explain the colour change that occurs.	
	The student mixes the two solutions.	
(c)	A student is given an aqueous solution of chlorine and an aqueous solution of sodium iodide.	

**3** (a) The box gives the names of some metals.

aluminium	calcium	gold	magnesium	silver	zinc
aiuiiiiiiiiiiiii	Calcium	golu	magnesium	311161	ZITIC

Use words from the box to answer these questions.

(i) Identify the metal that burns with a bright white flame.

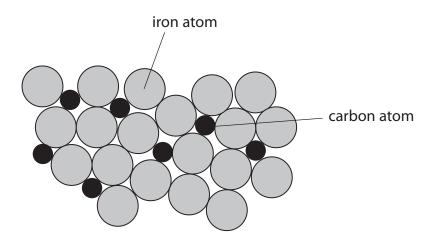
(1)

(ii) Explain which metal is most likely to be found in the Earth as an uncombined element.

(2)

(b) Steel is an alloy of iron and carbon.

The diagram shows how the particles are arranged in steel.



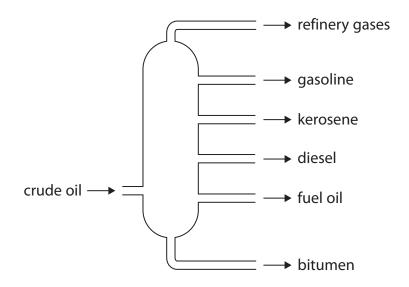
(i) State what is meant by the term **alloy**.

(1)



 										3 = 6 m		
											(2)	
(ii)	Expla	in why	an allo	y is less	malleak	ole tha	n a pur	e metal	•		(2)	

**4** (a) The diagram shows a fractionating column used to separate crude oil into fractions.



(i) Give one use for refinery gases and one use for bitumen.

(2)

refinery gases

bitumen

- (ii) Give a reason why refinery gases rise to the top of the column.
- (1)
- (iii) State what must happen to the crude oil before it is pumped into the column.
- (1)

(b)	There is a low demand for some of the hydrocarbons obtained from crude oil.	
	Catalytic cracking can be used to convert low-demand hydrocarbons into more useful products.	
	(i) Give the conditions needed for cracking.	(2)
	(ii) The cracking of tetradecane is shown in the equation.	
	$C_{14}H_{30} \rightarrow 2C_3H_6 + C_8H_{18}$	
	Explain why there is a high demand for both of the products.	(3)
	(Total for Question $4 = 9$ m	arks)

5	This question	is about the	insoluble salt,	lead(II) k	oromide.
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Lead(II) bromide can be made by a precipitation reaction.

This is the equation for the reaction.

$$Pb(NO_3)_2(aq) + 2KBr(aq) \rightarrow PbBr_2(s) + 2KNO_3(aq)$$

(a) Describe how solutions of lead nitrate and potassium bromide can be used to make a pure, dry sample of lead(II) bromide.

(4)


(b) A solution containing 0.150 mol of lead(II) nitrate is reacted with an excess of potassium bromide solution.

A mass of 49.6 g of pure, dry lead(II) bromide is produced.

Show, by calculation, that the percentage yield of lead(II) bromide is 90.1%.

[for PbBr<sub>2</sub>,  $M_r = 367$ ]

(2)

(c) A student investigates the change in electrical conductivity as dilute lead(II) nitrate solution is added to dilute potassium bromide solution.

This is the student's method.

- **Step 1** add 50 cm<sup>3</sup> of potassium bromide solution to a beaker
- **Step 2** measure the electrical conductivity of the solution
- Step 3 add 10 cm<sup>3</sup> of lead(II) nitrate solution to the beaker
- **Step 4** stir the mixture
- **Step 5** measure the electrical conductivity of the mixture

Repeat steps 3, 4 and 5 until a total of 50 cm<sup>3</sup> of lead(II) nitrate solution has been added.

The table shows the student's results.

Total volume of lead(II) nitrate solution added in cm <sup>3</sup>	Electrical conductivity in arbitrary units
0	10.00
10	9.80
20	9.77
30	9.40
40	9.20
50	9.00

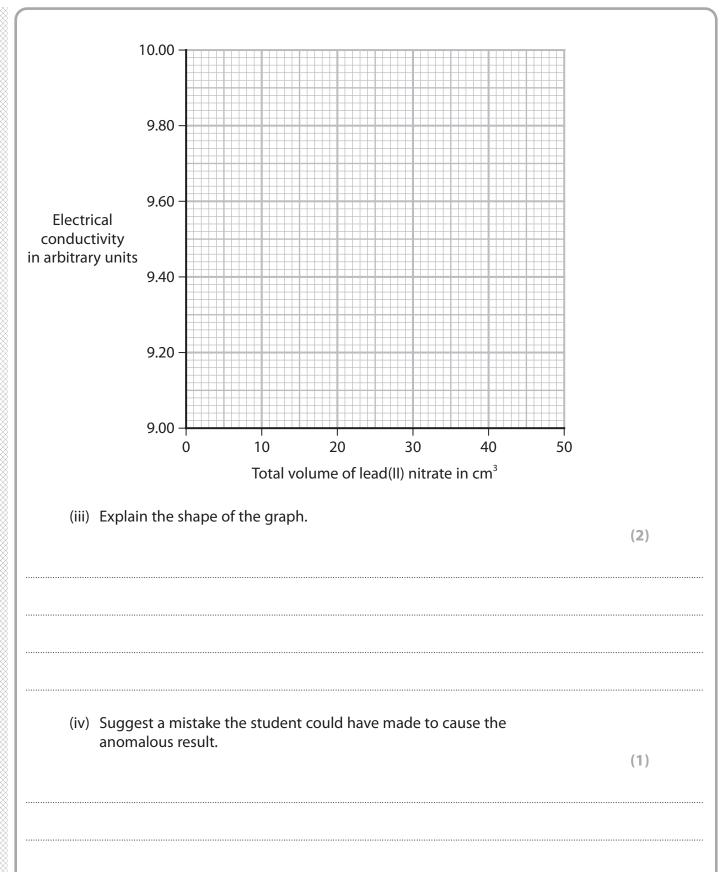
(i) Plot the student's results on the grid.

(1)

(ii) Draw a line of best fit, ignoring the anomalous result.

(1)





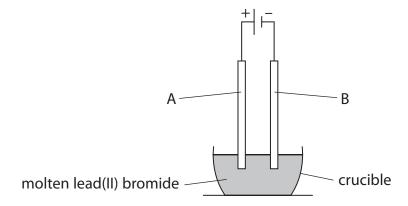


(v) Further 10 cm³ volumes of lead(II) nitrate are added to the beaker so the lead(II) nitrate is in excess.

Predict what will happen to the conductivity of the mixture when the lead(II) nitrate is in excess.

(1)

(d) The diagram shows the electrolysis of molten lead(II) bromide, PbBr<sub>2</sub>



This is the ionic half-equation for the formation of bromine at electrode A.

$$2Br^{-} \rightarrow Br_{2} + 2e^{-}$$

Give a reason why this half-equation shows oxidation.

(1)

(Total for Question 5 = 13 marks)

6	(a) Describe the forces of attraction in metallic bonding.	(2)
	<ul><li>(b) When a small piece of potassium is added to water, bubbles of hydrogen gas are observed.</li><li>(i) Give the test for hydrogen gas.</li></ul>	(1)
1	(ii) Give two other observations that would be made.	(2)
2	(c) Explain why lithium is less reactive than potassium.  Refer to atomic structure in your answer.	(3)



(d) This is the equation for the reaction between sodium and water.

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

A mass of 0.750 g of sodium is reacted with an excess of water.

Calculate the volume of hydrogen gas produced, in cm<sup>3</sup>, at room temperature.

[molar volume of hydrogen at rtp =  $24\,000\,\text{cm}^3$ ]

[for Na,  $A_r = 23$ ]

Give your answer to three significant figures.

(4)

volume of hydrogen = .....cm<sup>3</sup>



(e) This is the equation for the reaction between sodium hydroxide and sulfuric acid.

$$2NaOH \ + \ H_2SO_4 \ \rightarrow \ Na_2SO_4 \ + \ 2H_2O$$

A volume of 25.0 cm<sup>3</sup> of sodium hydroxide solution is completely neutralised by 16.3 cm<sup>3</sup> of 0.0500 mol/dm<sup>3</sup> sulfuric acid.

Calculate the concentration of the sodium hydroxide solution in mol/dm<sup>3</sup>.

(3)

concentration = ..... mol/dm<sup>3</sup>

(Total for Question 6 = 15 marks)

Methanol is made by the reaction between hydrogen and carbon monoxide.

This is the equation for the reaction.

$$2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$$
  $\Delta H = -119 \text{ kJ/mol}$ 

$$\Delta H = -119 \, \text{kJ/mol}$$

A mixture of hydrogen and carbon monoxide is left until dynamic equilibrium is reached.

(a) (i) Give two characteristics of a reaction at dynamic equilibrium.

(2)


(ii) Give a reason why adding a catalyst does **not** affect the yield of methanol.





 (iii)	The temperature of the reaction mixture is decreased at constant pressure.  Explain the effect of this change on the yield of methanol.	(2)
 (iv)	The pressure of the reaction mixture is increased at constant temperature.  Explain the effect of this change on the yield of methanol.	(2)

(b) This equation shows the displayed formulae for the reactants and product.

The table gives the bond energies for the bonds in the reactants and product.

Bond	Bond energy in kJ/mol
Н—Н	436
C≡O	1072
С—Н	414
C—O	358
О—Н	463

(i) Show that the molar enthalpy change,  $\Delta H$ , for the reaction is  $-119 \, \text{kJ/mol}$ .

(3)

(ii) Explain why this reaction is exothermic.

(2)

(c) The diagram shows the displayed formula of an ester that is made from methanol and a carboxylic acid.

(i) Draw a circle around the functional group of the ester.

(1)

(ii) Give the displayed formula of the carboxylic acid used to make this ester.

(1)

(Total for Question 7 = 14 marks)

**TOTAL FOR PAPER = 70 MARKS** 

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