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Candidate surname	Other names
Centre Number	Candidate Number
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Pearson Edexcel International GCSE (9–1)

Tuesday 13 June 2023

Morning (Time: 1 hour 15 minutes)	Paper reference	4CH1/2CR
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Chemistry

UNIT: 4CH1

PAPER: 2CR

<p style="font-weight: bold;">You must have:</p> Calculator, ruler	Total Marks
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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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(ii) Which statement is correct about the position of phosphorus, P, in the Periodic Table?

(1)

- A Group 2 and Period 5
- B Group 3 and Period 5
- C Group 5 and Period 2
- D Group 5 and Period 3

(iii) Explain which of the four elements in the diagram is least reactive.

(2)

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(Total for Question 1 = 6 marks)

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- 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

- (a) Complete the table by giving the missing information.

(2)

- (b) Describe a test to show that a colourless liquid is an alkene.

(2)

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

aluminium	calcium	gold	magnesium	silver	zinc
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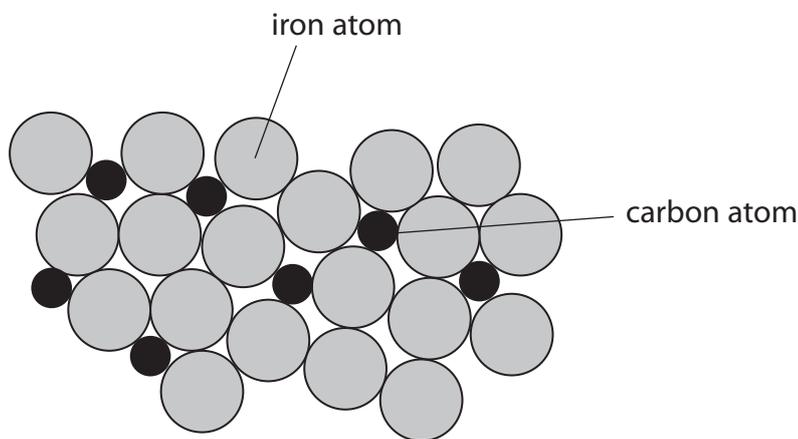
Use words from the box to answer these questions.

(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)

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(ii) Explain why an alloy is less malleable than a pure metal.

(2)

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(Total for Question 3 = 6 marks)

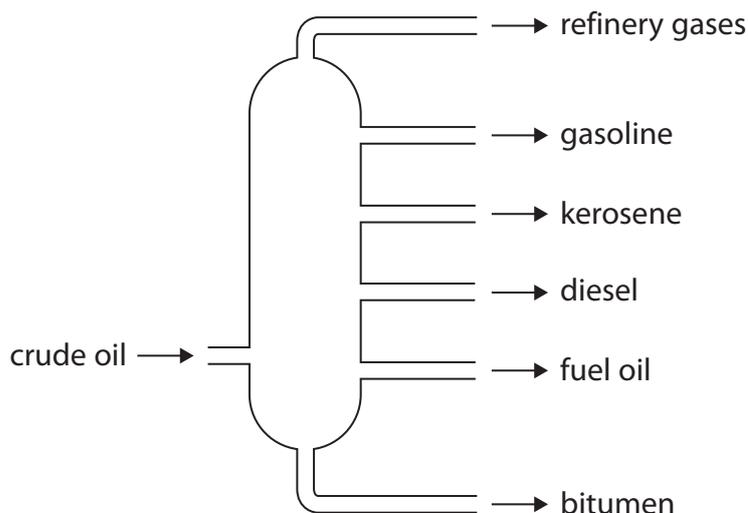
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4 (a) The diagram shows a fractionating column used to separate crude oil into fractions.



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

(2)

refinery gases

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bitumen

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(ii) Give a reason why refinery gases rise to the top of the column.

(1)

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(iii) State what must happen to the crude oil before it is pumped into the column.

(1)

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- (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.



Explain why there is a high demand for both of the products.

(3)

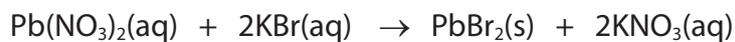
(Total for Question 4 = 9 marks)



5 This question is about the insoluble salt, lead(II) bromide.

Lead(II) bromide can be made by a precipitation reaction.

This is the equation for the reaction.



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

(4)

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- (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_2 , $M_r = 367$]

(2)

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- (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^3 of potassium bromide solution to a beaker

Step 2 measure the electrical conductivity of the solution

Step 3 add 10 cm^3 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^3 of lead(II) nitrate solution has been added.

The table shows the student's results.

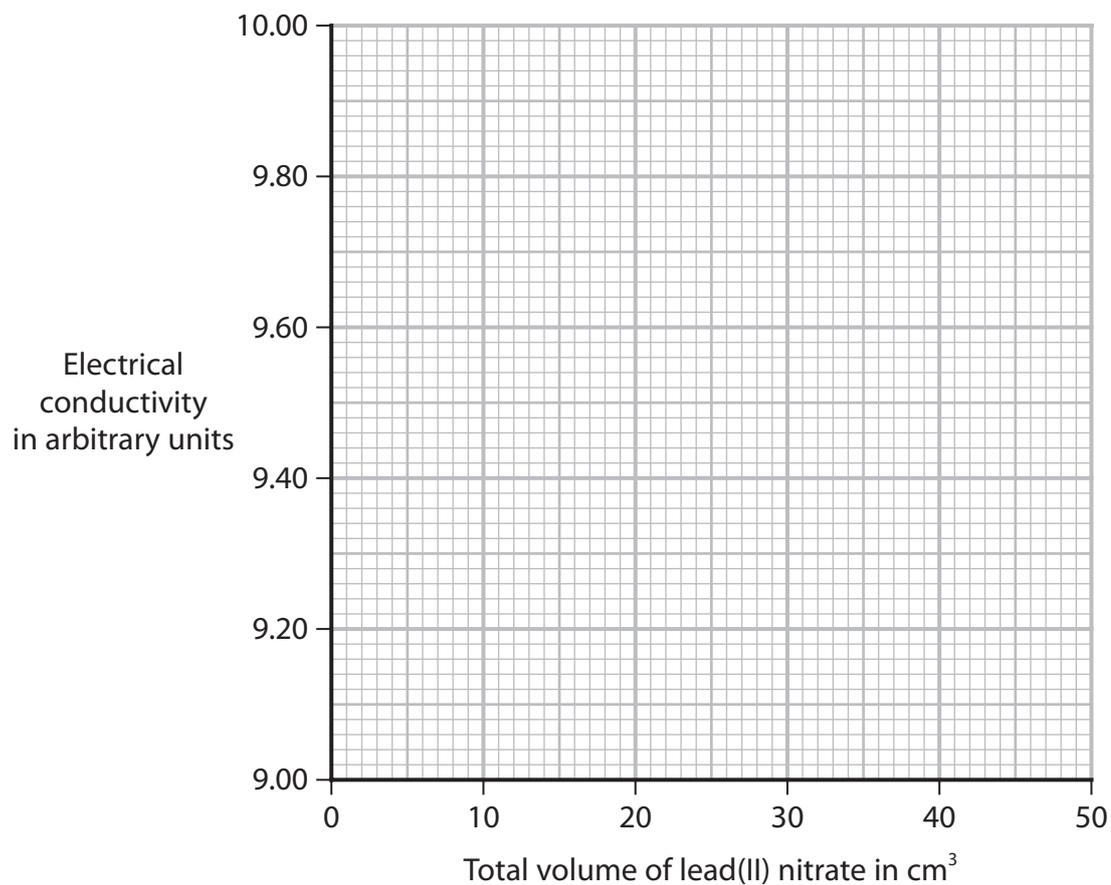
Total volume of lead(II) nitrate solution added in cm^3	Electrical conductivity in arbitrary units
0	10.00
10	9.80
20	9.77
30	9.40
40	9.20
50	9.00

- (i) Plot the student's results on the grid. (1)
- (ii) Draw a line of best fit, ignoring the anomalous result. (1)

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(iii) Explain the shape of the graph.

(2)

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(iv) Suggest a mistake the student could have made to cause the anomalous result.

(1)

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- (v) Further 10 cm^3 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.

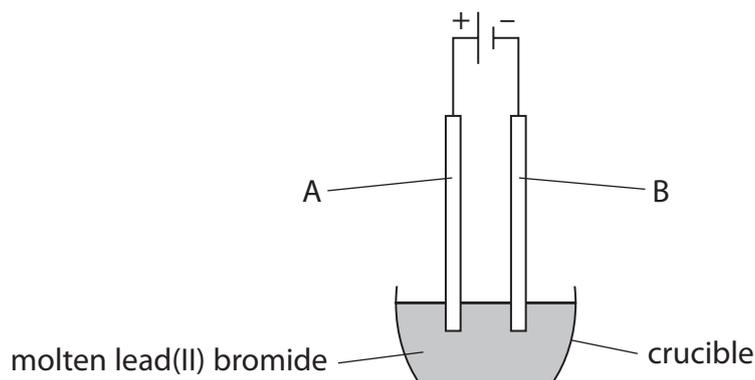
(1)

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- (d) The diagram shows the electrolysis of molten lead(II) bromide, PbBr_2



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



Give a reason why this half-equation shows oxidation.

(1)

(Total for Question 5 = 13 marks)



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6 (a) Describe the forces of attraction in metallic bonding.

(2)

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(b) When a small piece of potassium is added to water, bubbles of hydrogen gas are observed.

(i) Give the test for hydrogen gas.

(1)

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(ii) Give two other observations that would be made.

(2)

1

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(c) Explain why lithium is less reactive than potassium.

Refer to atomic structure in your answer.

(3)

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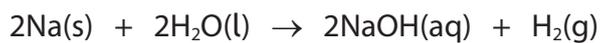
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(d) This is the equation for the reaction between sodium and water.



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

Calculate the volume of hydrogen gas produced, in cm^3 , at room temperature.

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

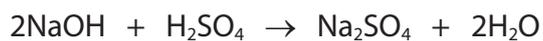
[for Na, $A_r = 23$]

Give your answer to three significant figures.

(4)

volume of hydrogen = cm^3

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



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

Calculate the concentration of the sodium hydroxide solution in mol/dm^3 .

(3)

concentration = mol/dm^3

(Total for Question 6 = 15 marks)

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

This is the equation for the reaction.



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)

1

2

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

(1)

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(iii) The temperature of the reaction mixture is decreased at constant pressure.

Explain the effect of this change on the yield of methanol.

(2)

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(iv) The pressure of the reaction mixture is increased at constant temperature.

Explain the effect of this change on the yield of methanol.

(2)

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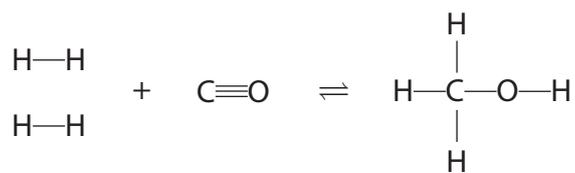
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(b) This equation shows the displayed formulae for the reactants and product.



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

Bond	Bond energy in kJ/mol
H—H	436
C≡O	1072
C—H	414
C—O	358
O—H	463

(i) Show that the molar enthalpy change, ΔH , for the reaction is -119 kJ/mol .

(3)

(ii) Explain why this reaction is exothermic.

(2)

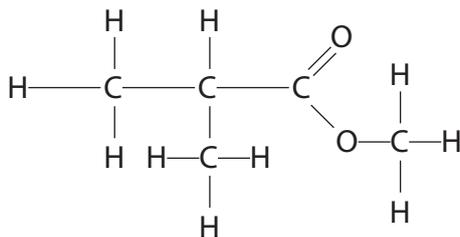
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- (c) The diagram shows the displayed formula of an ester that is made from methanol and a carboxylic acid.



- (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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