

**Paper Reference(s)     4CH1/2CR**

**Pearson Edexcel International GCSE (9–1)**

**Chemistry**

**Unit: 4CH1**

**Paper: 2CR**

**Wednesday 12 June 2019 – Morning**

**Time: 1 hour 15 minutes plus your additional  
time allowance**

**INSTRUCTIONS TO CANDIDATES**

**Write your centre number, candidate number,  
surname, other names and your signature in  
the boxes below. Check that you have the  
correct question paper.**

<b>Centre No.</b>								
<b>Candidate No.</b>								
<b>Surname</b>								
<b>Other names</b>								
<b>Signature</b>								
<b>Paper Reference</b>	<b>4</b>	<b>C</b>	<b>H</b>	<b>1</b>	<b>/</b>	<b>2</b>	<b>C</b>	<b>R</b>



- Use **BLACK** ink or ball-point pen.
- 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.
- 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 ☐.

## **MATERIALS REQUIRED FOR EXAMINATION**

### **Calculator**

## **ITEMS INCLUDED WITH QUESTION PAPERS**

### **Periodic Table**

## **INFORMATION FOR CANDIDATES**

- 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.

**(Instructions continue on next page)**

**(Turn over)**

## **ADVICE TO CANDIDATES**

- **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.**

**Answer ALL questions.**

**1 This question is about gases in the atmosphere.**

**(a) The box gives the names of some gases in the atmosphere.**

<b>argon</b>	<b>carbon dioxide</b>	
<b>helium</b>	<b>nitrogen</b>	<b>oxygen</b>

**Use gases from the box to answer the questions.**

**Each gas may be used once, more than once or not at all.**

**(i) Identify the two noble gases.  
(1 mark)**

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**(Question continues on next page)**

**(Turn over)**

**(ii) Identify the gas that is a compound. (1 mark)**

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**(iii) Identify the most abundant gas in the atmosphere. (1 mark)**

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**(iv) Identify the greenhouse gas. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

**(b) Describe the test for oxygen.  
(1 mark)**

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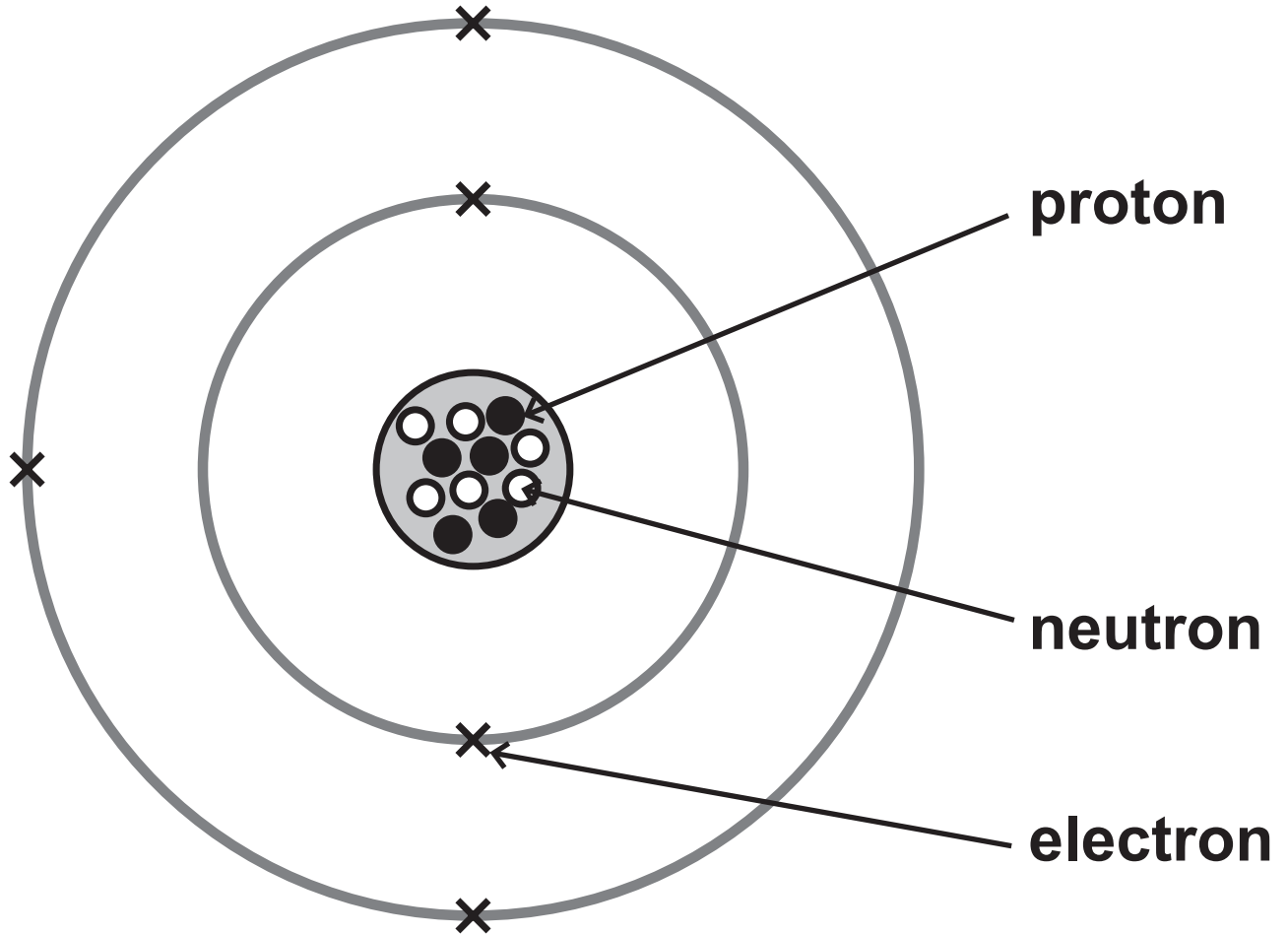
**(TOTAL FOR QUESTION 1 = 5 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

- 2 The diagram represents an atom of boron.



(Question continues on next page)

(Turn over)

**(a) Use information from the diagram to complete the table.**

**The first row has been done for you.  
(5 marks)**

<b>atomic number</b>	<b>5</b>
<b>mass number</b>	
<b>number of neutrons</b>	
<b>group in the Periodic Table that contains boron</b>	
<b>period in the Periodic Table that contains boron</b>	
<b>electronic configuration of an atom of boron</b>	

**(Question continues on next page)**

**(Turn over)**



**(b) Boron has two isotopes, boron-10 and boron-11.**

**A sample of boron contains 18.7% of boron-10 and 81.3% of boron-11.**

**Calculate the relative atomic mass of this sample of boron. (2 marks)**

**relative atomic mass = \_\_\_\_\_**

**(TOTAL FOR QUESTION 2 = 7 MARKS)**

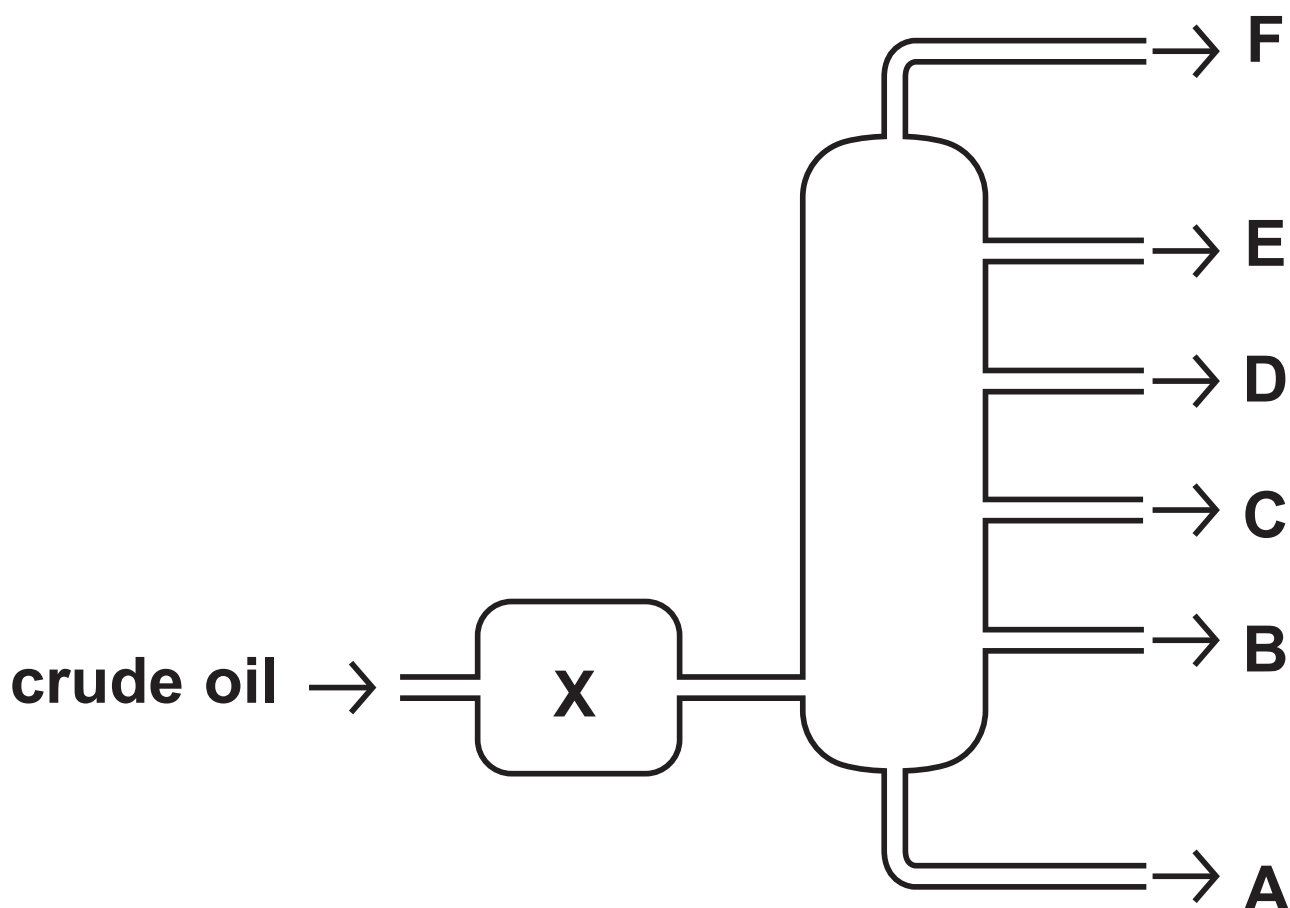
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**(Questions continue on next page)**

**(Turn over)**

**3 Crude oil is an important source of organic compounds.**

**(a) The diagram shows crude oil being separated into different fractions.**



**(i) Name the process used to separate crude oil into different fractions. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

**(ii) State what happens to the crude oil at X. (1 mark)**

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**(iii) Describe the differences between fraction B and fraction E.**

**In your answer, refer to**

- **size of the molecules**
- **boiling point**
- **colour**
- **viscosity**

**(4 marks)**

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**(Continue your answer on next page)**

**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**

**(b) Crude oil often contains sulfur as an impurity.**

**Explain why this is a problem when using crude oil fractions as fuels.  
(2 marks)**

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**(TOTAL FOR QUESTION 3 = 8 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

**4 This question is about the halogens and their compounds.**

**(a) The table gives the colour and physical state at room temperature of the halogens.**

**Complete the table by predicting the colour of astatine and the physical state of fluorine at room temperature.  
(2 marks)**

<b>Halogen</b>	<b>Colour</b>	<b>Physical state at room temperature</b>
<b>fluorine</b>	<b>pale yellow</b>	
<b>chlorine</b>	<b>pale green</b>	<b>gas</b>
<b>bromine</b>	<b>red-brown</b>	<b>liquid</b>
<b>iodine</b>	<b>dark grey</b>	<b>solid</b>
<b>astatine</b>		<b>solid</b>

**(Question continues on next page)**

**(Turn over)**

**(b) Chlorine gas is bubbled into a colourless solution of potassium bromide.**

**Explain why the solution turns orange. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

**(c) Potassium bromide is an ionic compound.**

**Draw diagrams to show the outer electrons in a potassium ion and in a bromide ion.**

**Include the charges on the ions.  
(3 marks)**

potassium ion	bromide ion

**(Question continues on next page)**

**(Turn over)**



- (d) A student sets up a circuit to test the electrical conductivity of water, solid sodium chloride and aqueous sodium chloride.

The table shows the student's results.

Substance	Conducts electricity?
water	no
solid sodium chloride	no
aqueous sodium chloride	yes

Explain these results, with reference to the structure and bonding of the substances. (5 marks)

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(Continue your answer on next page)

(Turn over)

**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**

- (e) A concentrated aqueous solution of sodium chloride is electrolysed using graphite electrodes.**

**Chlorine is formed at the positive electrode (anode).**

- (i) Give an ionic half-equation for the formation of chlorine at the positive electrode. (1 mark)**

- 
- (ii) State why this ionic half-equation represents an oxidation reaction. (1 mark)**
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**(Question continues on next page)**

**(Turn over)**

**(iii) Which substance is formed at the negative electrode (cathode)?  
(1 mark)**

☐ **A    hydrogen**

☐ **B    oxygen**

☐ **C    sodium**

☐ **D    water**

**(TOTAL FOR QUESTION 4 = 15 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

**5 This question is about the reactions of carboxylic acids.**

**(a) Carboxylic acids react with solutions of metal carbonates.**

**(i) Complete the chemical equation for the reaction of ethanoic acid,  $\text{CH}_3\text{COOH}$ , with potassium carbonate solution. (2 marks)**



\_\_\_\_\_ + \_\_\_\_\_  
  
+ \_\_\_\_\_

**(ii) State what you would see in this reaction. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

**(b) The ester, ethyl ethanoate, can be prepared by reacting ethanol with ethanoic acid.**

**This is the method for the preparation.**

- **mix equal amounts of ethanoic acid and ethanol in a boiling tube**
- **add a few drops of concentrated sulfuric acid**
- **place the boiling tube in a hot water bath for several minutes**

**(i) State the role of concentrated sulfuric acid in this reaction.  
(1 mark)**

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**(Question continues on next page)**

**(Turn over)**

- (ii) Suggest why the mixture is heated in a water bath rather than directly with a Bunsen burner flame. (1 mark)**

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- (iii) State how you would know that ethyl ethanoate has formed. (1 mark)**

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- (c) Another ester, methyl propanoate, can be prepared by reacting methanol with propanoic acid.**

**(Question continues on next page)**

**(Turn over)**



**(i) Draw the displayed formulae of methanol, propanoic acid and the ester, methyl propanoate. (3 marks)**

<b>methanol</b>	<b>propanoic acid</b>
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**methyl propanoate**

**(Question continues on next page)**

**(Turn over)**

**(ii) Give the name of the other product of this reaction. (1 mark)**

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**(d) Give one use of esters. (1 mark)**

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**(TOTAL FOR QUESTION 5 = 11 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

**6 When a bottle of wine is left open for several days, some of the ethanol in the wine turns to ethanoic acid,  $\text{CH}_3\text{COOH}$**

**(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.**

**She uses this method.**

- **fill a burette with the white wine and record the reading**
- **add  $25.0\text{ cm}^3$  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**

**(Question continues on next page)**

**(Turn over)**

- (i) Name the piece of apparatus that would be most suitable for measuring the  $25.0\text{ cm}^3$  of sodium hydroxide solution. (1 mark)
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- (ii) Suggest why red wine would not be suitable to use for this investigation. (1 mark)
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(Question continues on next page)

(Turn over)

**(iii) State why she swirls the flask continuously. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

- (iv) State why she adds the wine drop by drop near the end point.  
(1 mark)**

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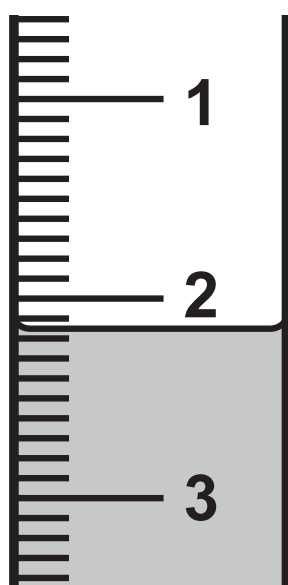
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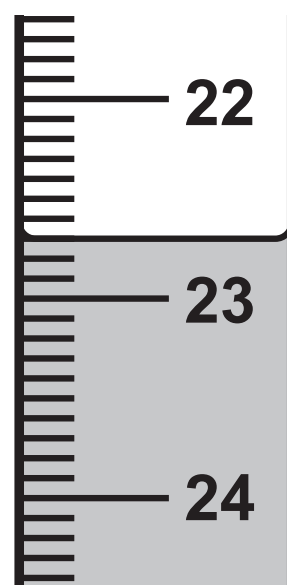
**(Question continues on next page)**

**(Turn over)**

(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  $0.05 \text{ cm}^3$ . (3 marks)

burette reading at end	
burette reading at start	
volume of wine added in $\text{cm}^3$	

(Question continues on next page)

(Turn over)

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

**The table shows her results for these four titrations.**

<b>titration number</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>volume of wine added in cm<sup>3</sup></b>	<b>20·40</b>	<b>20·10</b>	<b>20·35</b>	<b>20·45</b>
<b>concordant results</b>				

**Concordant results are those within 0·20 cm<sup>3</sup> of each other.**

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

**(Question continues on next page)**

**(Turn over)**



- (ii) Use your ticked results to calculate the mean (average) volume of wine added. (2 marks)**

**mean volume  
of wine added = \_\_\_\_\_ cm<sup>3</sup>**

**(Question continues on next page)**

**(Turn over)**

- (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**



**The mean volume of wine added is  $19.50 \text{ cm}^3$ .**

**(Question continues on next page)**

- (i) The concentration of the sodium hydroxide solution is  $0.0500 \text{ mol/dm}^3$ .

Calculate the amount, in moles, of NaOH in  $25.0 \text{ cm}^3$  of sodium hydroxide solution.  
(2 marks)

amount of NaOH = \_\_\_\_\_ mol

(Question continues on next page)

(Turn over)

- (ii) Deduce the amount, in moles, of  $\text{CH}_3\text{COOH}$  in  $19.50\text{ cm}^3$  of the wine. (1 mark)

amount of  $\text{CH}_3\text{COOH}$  = \_\_\_\_\_ mol

(Question continues on next page)

(Turn over)

- (iii) Calculate the concentration, in  $\text{mol/dm}^3$ , of  $\text{CH}_3\text{COOH}$  in the wine.  
(2 marks)

concentration  
of  $\text{CH}_3\text{COOH}$  = \_\_\_\_\_  $\text{mol/dm}^3$

**(TOTAL FOR QUESTION 6 = 15 MARKS)**

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(Questions continue on next page)

(Turn over)

- 7 Hydrogen gas can be produced by reacting a mixture of methane and steam in the presence of a nickel catalyst.**

**The reaction conditions are a temperature of 700 °C and a pressure of 5 atmospheres.**

**The equation for the reaction is**



$$\Delta H = +206 \text{ kJ/mol}$$

- (a) What does the symbol  $\rightleftharpoons$  represent?**  
**(1 mark)**
- 

**(Question continues on next page)**

**(Turn over)**

- (b) (i) The mixture of methane and steam is heated to a temperature greater than  $700^{\circ}\text{C}$  but the pressure is kept at 5 atmospheres.**

**Predict the effect of this change on the yield of hydrogen at equilibrium, giving a reason for your answer. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

- (ii) The mixture of methane and steam is kept at the same temperature of  $700^{\circ}\text{C}$  but the pressure is increased to more than 5 atmospheres.

**Predict the effect of this change on the yield of hydrogen at equilibrium, giving a reason for your answer. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**



- (c) Calculate the volume, in  $\text{dm}^3$ , of hydrogen gas at rtp that is produced when 10 tonnes of methane gas completely react with steam.**

**[molar volume of hydrogen at rtp is  $24 \text{ dm}^3$ ]**

**Give your answer in standard form.  
(4 marks)**

**(Continue your answer on next page)**

**(Turn over)**

volume of hydrogen = \_\_\_\_\_ dm<sup>3</sup>

**(TOTAL FOR QUESTION 7 = 9 MARKS)**

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**TOTAL FOR PAPER = 70 MARKS**  
**END**