



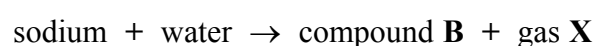
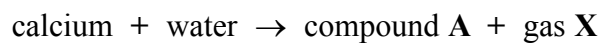


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**SECTION A**

1. Calcium and sodium are both reactive metals.  
 A small piece of each metal is added to separate troughs of water.  
 The metals react with water as shown in these equations:



- (a) (i) State one observation that would be the same during both reactions.

.....  
 .....  
 (1)

- (ii) State one observation that could be made during the reaction between sodium and water, but not during the reaction between calcium and water.

.....  
 .....  
 (1)

- (b) (i) What is the **name** of compound A?

.....  
 (1)

- (ii) What is the **formula** of compound B?

.....  
 (1)

- (c) Identify gas X and describe a test, and the result, for this gas.

Identity of X .....

Test .....

.....  
 (2)





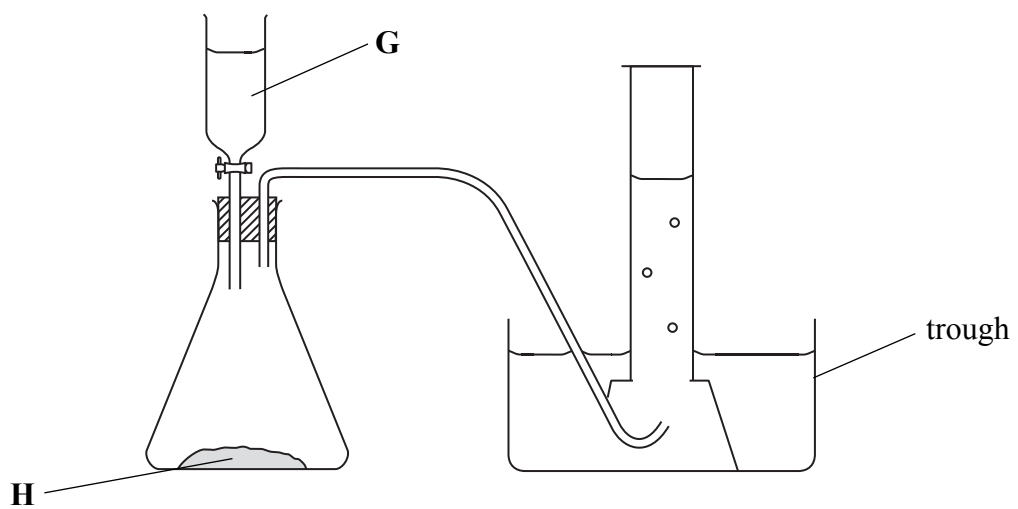
<p>(d) (i) State the colour of universal indicator in a solution of compound <b>B</b>. Which ion causes universal indicator to turn this colour?</p> <p>Colour of universal indicator .....</p> <p>Ion .....</p> <p style="text-align: right;"><b>(2)</b></p> <p>(ii) What colour does compound <b>B</b> give in a flame test?</p> <p>.....</p> <p style="text-align: right;"><b>(1)</b></p> <p style="text-align: right;"><b>(Total 9 marks)</b></p>	Leave blank
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N 3 6 7 5 5 A 0 5 2 8



2. The diagram shows apparatus for preparing oxygen gas in the laboratory using a colourless solution **G** and a black powder **H**.



(a) Name the substances **G** and **H**.

**G** .....

**H** .....

(2)

(b) The diagram shows oxygen gas being collected over water. Suggest one other way to collect the gas.

.....  
.....

(1)

(c) Substance **H** is unchanged at the end of the reaction. What is the role of **H** in the reaction?

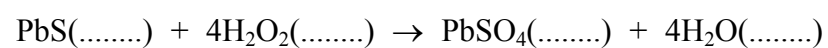
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(1)



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- (d) Solution **G** is used in the restoration of old paintings. It makes them lighter by converting black lead(II) sulphide in the paints into white lead(II) sulphate. The chemical equation for this reaction is



- (i) Complete the equation by writing a state symbol after each formula. (2)

- (ii) The reaction is a redox reaction because both reduction and oxidation occur. Identify the substance that is oxidised in the reaction, giving a reason for your choice.

Substance oxidised .....

Reason .....

(2)

- (e) Some sulphur is burned in a gas jar of oxygen. The gas formed is sulphur dioxide. The sulphur dioxide is tested with damp blue litmus paper and with filter paper soaked in potassium dichromate(VI) solution.

- (i) Write a chemical equation for the reaction between sulphur and oxygen.

.....

(1)

- (ii) The damp litmus paper turns red when placed in the sulphur dioxide. What does this indicate about sulphur dioxide?

.....

(1)

- (iii) The potassium dichromate(VI) paper changes colour when placed in the sulphur dioxide.

State the colour change observed.

Starting colour .....

Final colour .....

(2)

Q2

(Total 12 marks)



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3. The reaction between magnesium and chlorine forms the ionic compound magnesium chloride,  $\text{MgCl}_2$ .

(a) By reference to electrons, describe how magnesium and chlorine atoms form magnesium chloride.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

(3)

(b) Oxidation occurs in this reaction.

Identify the substance that is oxidised in the reaction, giving a reason for your choice.

Substance oxidised .....

Reason.....

.....

(2)

(c) Explain why magnesium chloride has a high melting point.

.....  
.....  
.....  
.....  
.....

(3)

(Total 8 marks)

Q3





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4. Crude oil is a mixture of many different compounds.

(a) During industrial refining, crude oil is first separated into fractions.

(i) What is the name of the process used to obtain fractions from crude oil?

..... (1)

(ii) Describe how the fractions are obtained.

.....  
.....  
.....  
.....  
.....  
..... (4)

(b) Four of the fractions obtained from crude oil are:

- bitumen
- diesel
- gasoline
- kerosene

(i) Which of these four fractions is the most viscous?

..... (1)

(ii) Which of these four fractions is the most volatile?

..... (1)

(iii) Which of these four fractions is used in making roads?

..... (1)

(iv) Name two other fractions obtained from crude oil.

1 .....

2 .....

(2)



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(c) Octane is a hydrocarbon in the gasoline fraction.

Write the names of the substances in the word equation for the complete combustion of octane.

octane + ..... → ..... + ..... (3)

(d) Octane belongs to a homologous series called the alkanes. One characteristic of a homologous series is that each member of the series has the same general formula.

(i) What is the general formula of the alkanes?

..... (1)

(ii) State two other characteristics of a homologous series.

1 .....

.....

2 .....

..... (2)

(Total 16 marks)

Q4

**TOTAL FOR SECTION A: 45 MARKS**



**SECTION B**

5. (a) What is meant by the term **atomic number**?

.....  
 .....  
 (1)

(b) (i) What name is given to two atoms of the same element that contain different numbers of neutrons?

.....  
 (1)

(ii) Complete the table about two atoms of argon.

Number of protons in an atom	Number of electrons in an atom	Number of neutrons in an atom	Mass number
18	18	20	
			40

(4)

(iii) Explain why argon is chemically unreactive.

.....  
 .....  
 .....  
 (1)



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(c) (i) In a sample of copper, 69.1% of the atoms have a mass number of 63 and the remainder have a mass number of 65.  
Use this information to calculate the relative atomic mass of copper. Give your answer to 3 significant figures.

(3)

(ii) Explain why copper atoms with different numbers of neutrons have identical chemical properties.

.....

.....

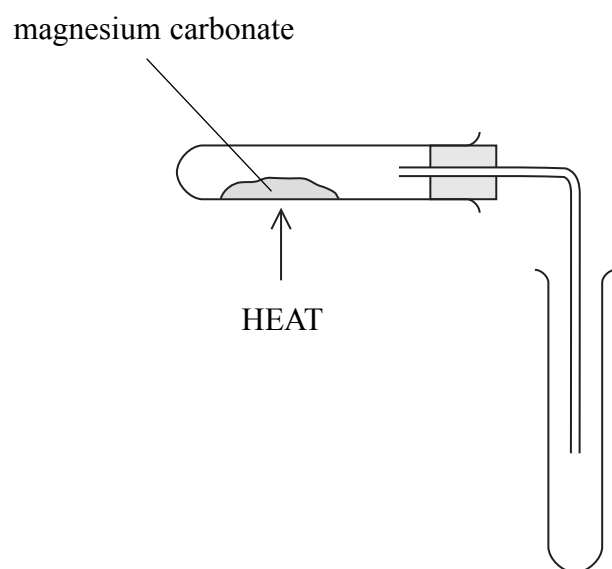
(1)

Q5

(Total 11 marks)



6. Magnesium carbonate undergoes thermal decomposition in a similar way to calcium carbonate.



(a) Write a chemical equation for the thermal decomposition of magnesium carbonate.

..... (2)

(b) Magnesium carbonate can be made as a precipitate by reacting together solutions of two soluble salts.

(i) Name two suitable soluble salts.

.....  
..... (2)

(ii) Write a chemical equation for the reaction.

.....  
..... (2)



(iii) Describe how you would obtain a pure, dry, sample of the magnesium carbonate formed in this reaction.

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.....  
.....  
.....  
.....  
.....

(3)

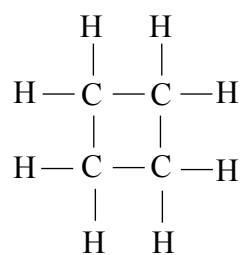
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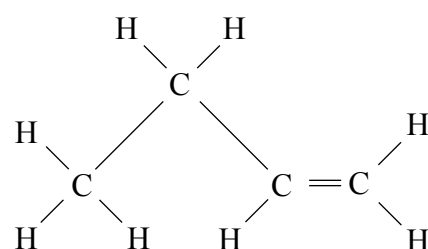
Q6



7. **A** and **B** are two hydrocarbons with the molecular formula  $C_4H_8$ .  
Their structures are:



**A**



**B**

- (a) Describe a chemical test to distinguish between hydrocarbons **A** and **B**.  
Give the result you would expect for each hydrocarbon.

Test .....

Result with **A** .....

Result with **B** .....

**(3)**

- (b) To which homologous series does **B** belong?

.....

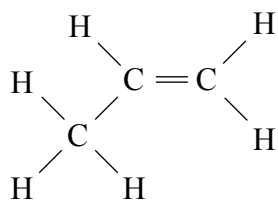
**(1)**





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(c) Hydrocarbon **C** belongs to the same homologous series as **B**. It has the structure:



**C**

**C** forms an addition polymer. Draw the repeat unit of this polymer.

(2)

(d) Give the name of the addition polymer formed by **C**.

.....

(1)

Q7

(Total 7 marks)



8. The table gives some information about two metals and their compounds.

Substance	Colour of solid	Solubility in water	Colour of solution
copper	brown	insoluble	not applicable
copper(II) sulphate	blue	soluble	blue
zinc	grey	insoluble	not applicable
zinc sulphate	white	soluble	colourless

(a) When zinc is added to copper(II) sulphate solution a displacement reaction takes place.

(i) Write a chemical equation for the displacement reaction.

.....  
 ..... (2)

(ii) What does this reaction suggest about the reactivity of copper compared to zinc?

.....  
 ..... (1)

(iii) Use the information in the table to describe what you would expect to see during the reaction.

.....  
 .....  
 .....  
 ..... (2)



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(b) Iron rusts when exposed to air and water.

Ships are often prevented from rusting by attaching zinc blocks to their hulls.

(i) Give the name of this method of preventing rusting.

.....  
(1)

(ii) Explain how the zinc blocks prevent rusting.

.....  
.....  
.....  
(2)

(iii) Suggest why attaching copper blocks to the hulls of ships would not prevent them from rusting.

.....  
.....  
(1)

(Total 9 marks)

Q8



9. Phosphorus(V) chloride,  $\text{PCl}_5$ , reacts with water to form hydrogen chloride gas and phosphoric acid,  $\text{H}_3\text{PO}_4$ .

(a) Write the chemical equation for this reaction.

.....  
.....

(2)

(b) State and explain the colour change seen when hydrogen chloride gas is bubbled into water containing universal indicator.

.....  
.....  
.....  
.....

(3)

(c) (i) A hydrogen chloride molecule contains a covalent bond.

Draw a dot and cross diagram to show the electrons in this molecule.  
Show only the outer electrons of each atom.

(2)

(ii) How does the covalent bond hold the hydrogen and chlorine atoms together?

.....  
.....  
.....

(2)



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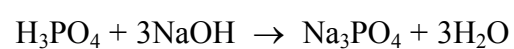
(d) Hydrogen chloride is a gas at room temperature.

Explain why hydrogen chloride has a low boiling point.

.....  
.....  
.....

(2)

(e) The reaction between dilute phosphoric acid and sodium hydroxide solution is represented by the equation



A sample of sodium hydroxide solution was titrated against dilute phosphoric acid. It was found that 25.0 cm<sup>3</sup> of sodium hydroxide solution was neutralised by 12.30 cm<sup>3</sup> of phosphoric acid of concentration 0.150 mol dm<sup>-3</sup>.

(i) Calculate the amount, in moles, of phosphoric acid used in the titration.

(2)

(ii) Calculate the amount, in moles, of sodium hydroxide that would react with this amount of phosphoric acid.

(1)

(iii) Calculate the concentration, in mol dm<sup>-3</sup>, of the sodium hydroxide solution.

(2)

Q9

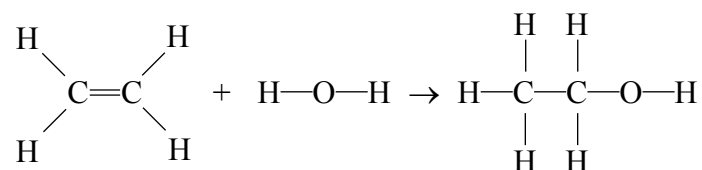
(Total 16 marks)

21

Turn over



10. One industrial process for making ethanol involves reacting ethene with steam.



(a) Identify the catalyst and one other condition used for this reaction.

.....

.....

.....

(2)

(b) The table shows the values of some average bond dissociation energies.

Bond	C—C	C=C	C—H	C—O	O—H
Dissociation energy (kJ/mol)	348	612	412	360	463

Use these values to calculate:

(i) The energy required, in kJ/mol, to break the bonds in the reactants.

(1)

(ii) The energy given out, in kJ/mol, when the bonds in the product are formed.

(1)

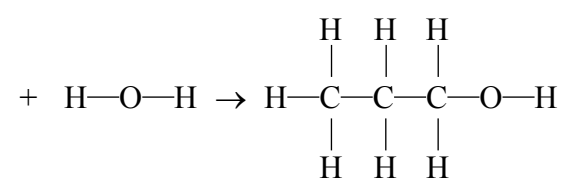


(iii) The enthalpy change, in kJ/mol, for this reaction.

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(1)

(c) Other alkenes react with steam in a similar way to ethene.  
Complete the following equation by drawing the structure of the missing reactant.



(1)

Q10

(Total 6 marks)



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11. (a) Copper(II) carbonate reacts with dilute hydrochloric acid.  
The equation for the reaction is



An excess of copper(II) carbonate was added to a solution containing 0.200 mol of hydrochloric acid.

- (i) Calculate the amount, in moles, of copper(II) carbonate that will react with 0.200 mol of hydrochloric acid.

(1)

- (ii) Calculate the mass, in grams, of this amount of copper(II) carbonate.

(2)

- (iii) Calculate the volume of carbon dioxide gas at room temperature and atmospheric pressure that will be formed in this reaction.  
(The volume of 1 mol of any gas at room temperature and atmospheric pressure is 24 dm<sup>3</sup>).

(2)

- (b) Describe what is seen when excess ammonia solution is added gradually to copper(II) chloride solution. Give the formula of the complex ion formed.

.....  
.....  
.....  
.....

(3)

Q11

(Total 8 marks)





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**12.** Chlorine is manufactured industrially by the electrolysis of concentrated sodium chloride solution in a diaphragm cell.  
Hydrogen is formed at the negative electrode (cathode).  
Chlorine is formed at the positive electrode (anode).

(a) Both electrodes are made from metal.  
Describe the structure of a metal and explain why metals are able to conduct electricity.

.....  
.....  
.....  
.....  
.....

**(3)**

(b) (i) The negative electrode is made of steel (iron).

Suggest why steel is not suitable for making the positive electrode.

.....  
.....

**(1)**

(ii) Identify the metal from which the positive electrode is made.

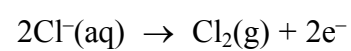
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**(1)**



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(c) The equation for the reaction at the positive electrode is



A diaphragm cell was operated using a current of 100 000 A.

(i) Calculate the charge, in coulombs, passing in 2 minutes.

(2)

(ii) Calculate the amount, in moles, of chlorine molecules produced in 2 minutes.  
(One faraday is 96 000 coulombs).

(2)

Q12

(Total 9 marks)

**TOTAL FOR SECTION B: 75 MARKS**

**TOTAL FOR PAPER: 120 MARKS**

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