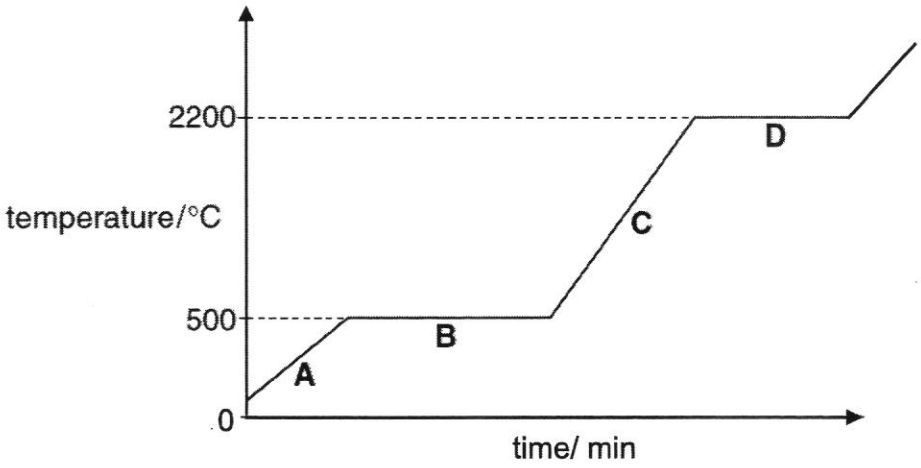
Section A [15 marks]

Answer **all** questions.

1 The graph below shows the changes in temperature when a substance is heated.

Which part of the graph shows the melting of the substance?



2 The description about gas **X** and solid **Y** are shown.

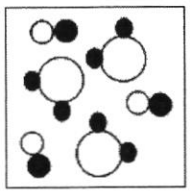
gas **X**	solid **Y**
A colourless gas which cannot be decomposed into simpler substances.	A green solid that can be separated into a white solid and a green liquid after adding water and filtering.

Which row correctly classifies **X** and **Y**?

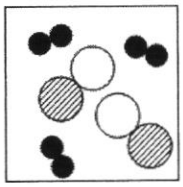
	X	**Y**
A	compound	compound
B	compound	mixture
C	element	compound
D	element	mixture

3 Which diagram represents a mixture of an element and a compound?

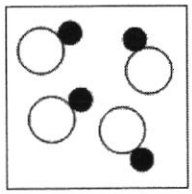
A



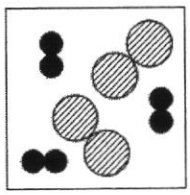
B



C



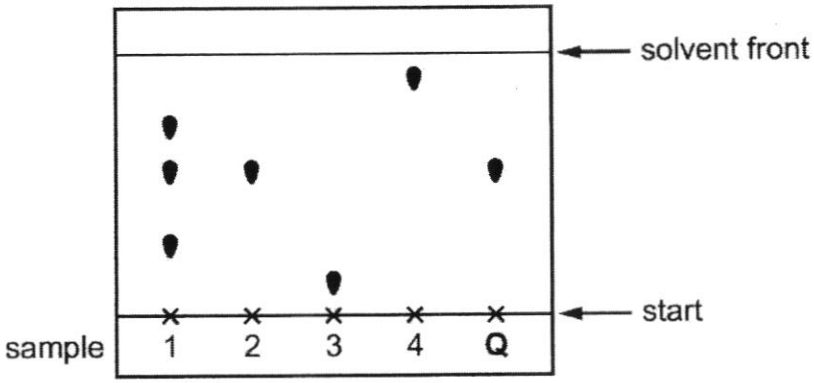
D



4 A chromatography experiment is carried out on four samples.

It is known that one of these samples is pure compound **Q**. A separate sample of pure compound **Q** is also spotted onto the chromatography paper. The paper is placed in a solvent.

The diagram shows the chromatogram obtained.



Which statement is correct?

A Sample 2 has travelled the furthest and sample 3 is pure compound **Q**.

B Sample 3 has travelled the furthest and sample 2 is pure compound **Q**.

C Sample 4 has travelled the furthest and sample 1 is pure compound **Q**.

D Sample 4 has travelled the furthest and sample 2 is pure compound **Q**.

5 Which row correctly shows the relative charges of the electron, neutron and proton?

	electron	neutron	proton
A	-1	0	+1
B	-1	+1	0
C	+1	0	-1
D	+1	-1	0

6 An atom of element **Z** is represented by $^{31}_{15}Z$.

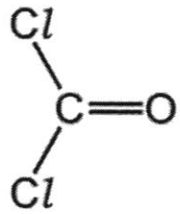
Which statement about an atom of **Z** is correct?

A It forms an ion with a charge of 1-.
B It has 3 electron shells.
C It has 5 protons in the outer shell.
D It has 31 neutrons.

7 What is the formula of the compound formed between the ions X^{3+} and Y^{2-}?

A XY **B** XY_2
C X_2Y_3 **D** X_3Y_2

8 The diagram shows the structure of the molecule carbonyl dichloride.



How many bonding pairs of electrons are there in the molecule?

A 2 **B** 4
C 6 **D** 8

9 8.8 g of gas **X** occupies 4800 cm^3 at room temperature and pressure.

What is the relative molecular mass of **X**?

A 10.5 **B** 18
C 44 **D** 54.5

10 40 cm^3 of carbon monoxide are reacted with 40 cm^3 of oxygen.

The equation for the reaction is shown.

$$2CO\ (g) + O_2\ (g) \longrightarrow 2CO_2\ (g)$$

All volumes are measured at room temperature and pressure.

What are the volumes of the gases remaining at the end of the reaction?

	volume of carbon monoxide / cm^3	volume of oxygen / cm^3	volume of carbon dioxide / cm^3
A	0	0	40
B	0	0	80
C	0	20	40
D	20	0	80

11 Which substance is commonly used to neutralise acidic soil?

A aqueous ammonia
B calcium hydroxide
C copper(II) oxide
D potassium nitrate

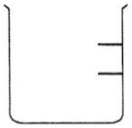
12 Which oxide reacts with both acids and alkalis?

A aluminium oxide
B carbon monoxide
C magnesium oxide
D sulfur dioxide

13 Which piece of apparatus can be used to accurately measure 16.8 cm^3 of a solution?

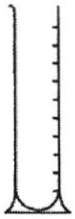
A

B



C

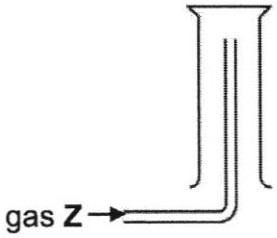
D



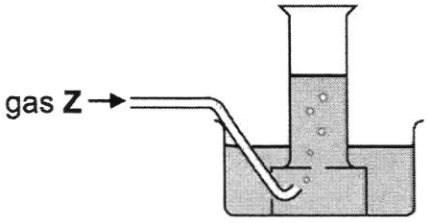
14 Gas **Z** is less dense than air and insoluble in water.

Which method **cannot** be used to collect the gas?

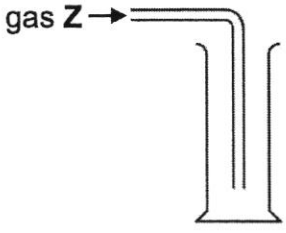
A



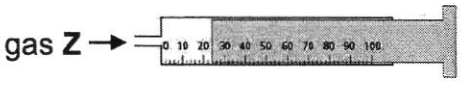
B



C



D



15 Which salt can be prepared by titration?

A ammonium carbonate
B barium sulfate
C copper(II) nitrate
D magnesium chloride

Section B [25 marks]

Answer **all** the questions in the spaces provided.

1 The melting and boiling points of four substances, **W**, **X**, **Y** and **Z** are given below.

substance	melting point / °C	boiling point / °C
W	-102	-35
X	-30	70
Y	45	202
Z	153	365

(a) Which substance has **no** fixed volume at room temperature?

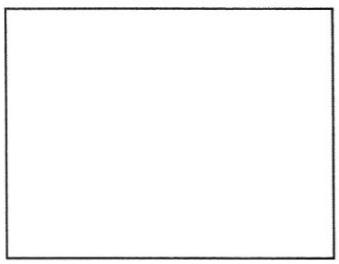
_____ [1]

(b) Describe the movement of the particles in substance **Y** at 100 °C.

_____

_____ [1]

(c) Draw the arrangement of particles in substance **X** at -50 °C.



[1]

2 Fig. 2.1 shows the apparatus that is used to separate a mixture of hexane (boiling point: 70 °C), heptane (boiling point: 98 °C) and octane (boiling point: 126 °C).

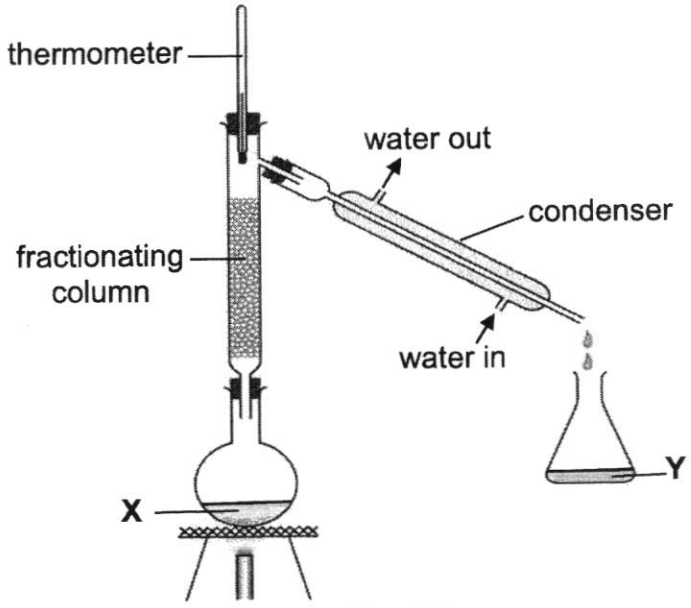


Fig. 2.1

(a) Name the physical property that allows hexane, heptane and octane to be separated.

_____ [1]

(b) State the purpose of the water in the condenser.

_____ [1]

(c) Describe the **change** in the arrangement of the particles in the condenser.

_____

_____

_____ [1]

(d) At 72 °C, two samples are taken, one at point **X** and another at point **Y**. Each sample is heated and its boiling point is measured.

Explain why the sample from **X** boils over a range of temperature whereas the sample from **Y** boils at a single temperature.

_____

_____ [1]

3 The table shows the nuclei of five different atoms, **P**, **Q**, **R**, **S** and **T**.

letter (**not** chemical symbol)	**P**	**Q**	**R**	**S**	**T**
particles in each nucleus	2 protons 2 neutrons	3 protons 4 neutrons	4 protons 5 neutrons	4 protons 6 neutrons	9 protons 10 neutrons

(a) Which letter(s) from **P**, **Q**, **R**, **S** or **T** best represent(s)

(i) the nucleus of an atom with a mass number of four,

_____ [1]

(ii) **two** nuclei from different isotopes of the same element?

_____and _____ [1]

(b) **Q** reacts with **T** to form a compound.

(i) Draw a 'dot and cross' diagram for the compound formed. Only the outer shell electrons need to be shown.

[2]

(ii) Using the symbols, '**Q**' and '**T**', state the chemical formula of the compound formed.

_____ [1]

10

4 A solution of potassium hydroxide, KOH, has a concentration of 28 g/dm^3.

(a) Calculate the concentration of the potassium hydroxide solution in mol/dm^3.

[Relative atomic masses: A_r: H, 1; O, 16; K, 39]

concentration =_____ mol/dm^3 [1]

(b) The **unbalanced** equation for the reaction between potassium hydroxide and ammonium sulfate is shown.

$$\square\ KOH + \square\ (NH_4)_2SO_4 \longrightarrow \square\ K_2SO_4 + \square\ NH_3 + \square\ H_2O$$

(i) Balance the equation. [1]

(ii) Calculate the mass of ammonium sulfate which reacts with 250 cm^3 of 28 g/dm^3 of potassium hydroxide.

mass =_____ g [3]

11

5 Fig. 5.1 shows the properties and reactions of colourless solution **P**.

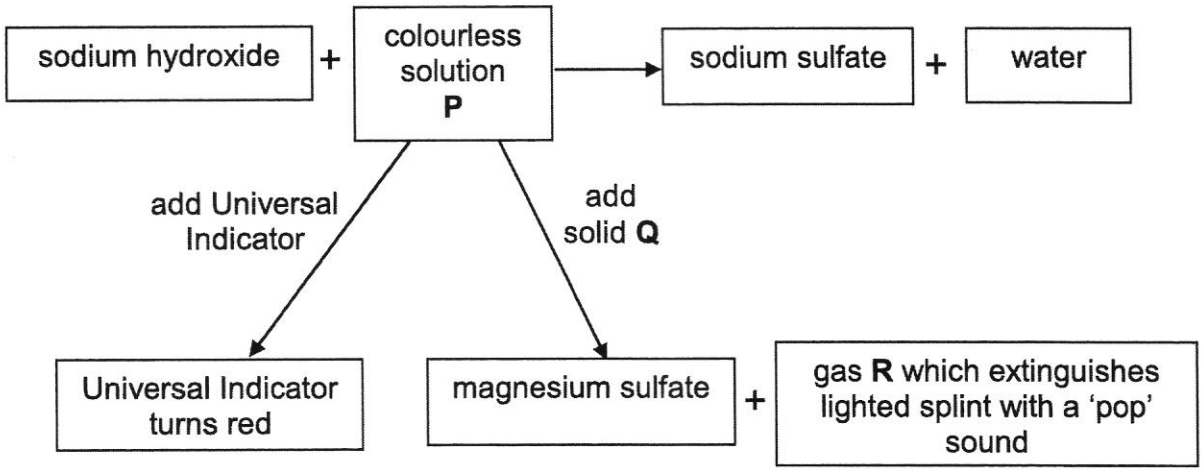


Fig. 5.1

(a) Name

(i) **P**, _____ [1]

(ii) **Q**, _____ [1]

(iii) **R**. _____ [1]

(b) Write an ionic equation for the reaction between sodium hydroxide and **P**. State symbols are **not** required.

_____ [1]

6 The solubility of some salts in water is shown.

soluble	insoluble
lead(II) nitrate potassium chloride potassium sulfate silver nitrate	lead(II) chloride silver carbonate

(a) Which **two** of these salts when dissolved in water can be mixed to form a precipitate of silver chloride?

_____ and _____ [1]

(b) Describe how a pure and dry sample of silver chloride can be prepared from the mixture resulting from **(a)**.

_____

_____

_____

_____

_____

[3]

Section C [20 marks]

Answer any **two** questions from this section.
Write your answers in the spaces provided on the question paper.

7 Sodium oxide and carbon dioxide are both compounds.

(a) When mixed with water, one of these compounds produces an acidic solution and the other produces an alkaline solution.

Describe how you would distinguish between an acidic solution and an alkaline solution.

_____

_____

_____

_____

[2]

(b) **(i)** Draw 'dot and cross' diagrams for sodium oxide and carbon dioxide.

Only the outer shell electrons need to be shown.

[Proton numbers: C, 6; O, 8; Na, 11]

sodium oxide

carbon dioxide

[4]

14

(ii) Explain, in terms of structure and bonding, why sodium oxide is a solid and carbon dioxide is a gas at room temperature and pressure.

[2]

(iii) Sodium oxide has different electrical conductivities in solid and molten states. Use the structure in **(b)(i)** to explain this difference.

[2]

8 Antacids are taken to relieve heartburn or indigestion caused by excess hydrochloric acid in the stomach. The active ingredient in antacids is calcium carbonate, $CaCO_3$.

(a) Name the ion that causes acidity.

_____ [1]

(b) Write a balanced chemical equation for the reaction between calcium carbonate and hydrochloric acid.

_____ [2]

(c) Describe a test to identify the gas produced in the reaction.

test _____

_____

observation _____

_____ [2]

(d) Calculate the relative formula mass of calcium carbonate.

[Relative atomic masses: A_r: C, 12; O, 16; Ca, 40]

relative formula mass = _____ [1]

(e) A man took 1.5 antacid tablets. Each antacid tablet contains 600 mg of calcium carbonate.

Calculate the number of moles of hydrochloric acid that would have reacted with 1.5 antacid tablets.

[1 g = 1000 mg]

number of moles = _____mol [2]

16

(f) Calculate the volume of gas produced when the man took 1.5 antacid tablets, at room temperature and pressure.

volume = _____ dm^3 [2]

9 Zinc nitrate can be prepared using nitric acid and a base.

(a) State **two** physical properties of all acids.

1. _____

2. _____

[2]

(b) Name a base that can be used to react with nitric acid to form zinc nitrate.

_____ [1]

(c) Describe how a pure and dry sample of zinc nitrate crystals can be prepared from nitric acid and the base named in **(b)**.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [5]

(d) Write a balanced chemical equation, with state symbols, for the reaction.

_____ [2]

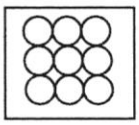
- END OF PAPER -

Marking Scheme

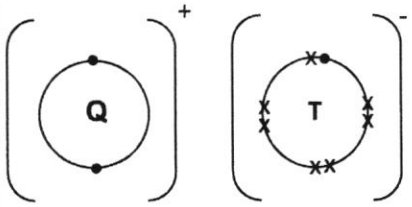
Section A [15 marks]

1	**B**	2	**D**	3	**B**	4	**D**	5	**A**
6	**B**	7	**C**	8	**B**	9	**C**	10	**C**
11	**B**	12	**A**	13	**A**	14	**C**	15	**A**

Section B [25 marks]

1	a	**W**	[1]
	b	The particles slide over one another.	[1]
	c		[1]
			Total: [3]

2	a	Different boiling points	[1]
	b	To <u>cool</u> the vapour and turn it to liquid Not: To condense the vapour only	[1]
	c	The arrangement of particles will change from <u>far apart in a random arrangement</u> to <u>closely packed in a disorderly arrangement</u>.	[1]
	d	The sample from **X** is a <u>mixture of heptane and octane</u> whereas the sample from **Y** is <u>pure hexane</u>, which is a compound/ pure substance. (Must **name** the substances; Not: **X** is impure but **Y** is pure/ **X** is a mixture and **Y** is a compound)	[1]
			Total: [4]

3	ai	**P**	[1]
	aii	**R** and **S**	[1]
	bi	 'Dot and cross' diagram of Q^+ <u>and</u> correct charge [1] 'Dot and cross' diagram of T^- <u>and</u> correct charge [1]	[2]

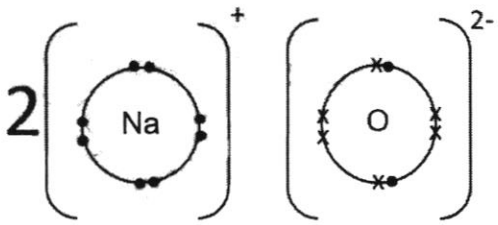
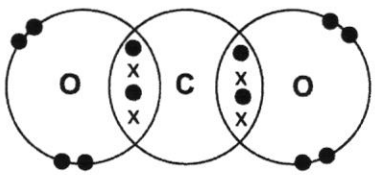
	bii	**QT**	[1]
			Total: [5]

4	a	$M_r = 39 + 16 + 1 = 56$ Concentration = 28 ÷ 56 = <u>0.5 mol/ dm^3</u> (1)	[1]
	bi	**2** KOH + **1** $(NH_4)_2SO_4$ → **1** K_2SO_4 + **2** NH_3 + **2** H_2O Not: 0	[1]
	bii	No. of moles of potassium hydroxide = 0.25 x 0.5 = 0.125 mol (1) $(NH_4)_2SO_4$: KOH Mole ratio 1 : 2 0.0625 mol : 0.125 mol (1) Mass of $(NH_4)_2SO_4$ = 0.0625 x (14(2) + 8 + 32 + 16(4)) = 0.0625 x 132 = <u>8.25 g</u> (1) Allow ecf for • wrong number of moles of KOH • wrong balancing of equation	[3]
			Total: [5]

5	ai	Sulfuric acid	[1]
	aii	Magnesium	[1]
	aiii	Hydrogen	[1]
	b	$H^+ + OH^- \rightarrow H_2O$	[1]
			Total: [4]

6	a	silver nitrate and potassium chloride	[1]
	b	Filter the mixture to obtain silver chloride as the residue. (1) Wash the residue with distilled water. (1) Dry the residue between sheets of filter paper. (1)	[3]
			Total: [4]

Section C [20 marks]

7	a	Use red litmus. If the red litmus paper remains red, then the solution is acidic. If the red litmus paper turns blue, then the solution is alkaline. OR Use blue litmus. If the blue litmus paper turns red, then the solution is acidic. If the blue litmus paper remains blue, then the solution is alkaline. OR Add a few drops of Universal Indicator. If the Universal Indicator turns red/ orange / yellow, then the solution is acidic. If the Universal Indicator turns violet/blue, then the solution is alkaline. (1) for method, (1) for both results	[2]
	bi	 'Dot and cross' diagram of Na^+ and correct charge + ratio (1) 'Dot and cross' diagram of O^{2-} and correct charge (1)  	[4]

		Correct number of shared electrons (1), correct number of valence electrons (1)	
	bii	Sodium oxide consists of <u>strong electrostatic forces of attraction / strong ionic bonds between oppositely charged ions</u> . A <u>large amount of energy</u> is required to overcome the forces of attraction / break the bonds. On the other hand, carbon dioxide consists of <u>weak intermolecular forces of attraction</u>. <u>Little amount of energy</u> is required to overcome the forces of attraction. Description of forces of attraction for both (1) Amount of energy required to overcome forces of attraction for both (1)	[2]
	biii	Sodium oxide cannot conduct electricity in the solid state but it can conduct electricity in the molten state. (1) In the solid state, the <u>ions</u> in sodium oxide are held in fixed positions/ not free to move whereas in the molten state, the <u>ions</u> are free to move about to help conduct electricity. (1)	[2]
			Total: [10]

8	a	Hydrogen ion	[1]
	b	$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$ (1) for correct formulae, (1) for correct balancing	[2]
	c	Test: Pass / bubble the gas through limewater. (1) Observation: A white precipitate is obtained in limewater. (1)	[2]
	d	$M_r = 40 + 12 + 16(3) = 100$	[1]
	e	Mass of $CaCO_3$ in 1.5 antacid tablets = 0.6 x 1.5 = 0.9 g No. of moles of $CaCO_3$ = 0.9 ÷ 100 = 0.009 mol (1) $CaCO_3$: HCl Mole ratio 1 : 2 0.009 mol : <u>0.018 mol</u> (1) Allow ecf for • wrong M_r / number of moles of $CaCO_3$ • wrong balancing of equation	[2]
	f	$CaCO_3$: CO_2	[2]

		Mole ratio 1 : 1 0.009 mol : 0.009 mol (1) Vol of CO_2 = 0.009 x 24 = <u>0.216 dm^3</u> (1) Allow ecf for: • wrong M_r / number of moles of $CaCO_3$ • wrong balancing of equation	
			Total: [10]

9	a	• Sour taste • Good electrical conductor • Turns moist blue litmus red Any 2 answers, (1) each	[2]
	b	Zinc oxide / zinc hydroxide	[1]
	c	Add <u>excess zinc oxide/ zinc hydroxide</u> to <u>nitric acid</u> until no more zinc oxide/ zinc hydroxide dissolves. (1) <u>Filter</u> the mixture (1) to obtain the excess zinc oxide/ zinc hydroxide as the residue and zinc nitrate solution as the filtrate. (Pour the filtrate into an evaporating dish.) <u>Heat the filtrate to evaporate most of the water</u> and obtain a <u>saturated solution</u>. (1) Allow the solution to <u>cool</u> to obtain zinc nitrate crystals. (1) <u>Filter</u> to obtain the crystals and <u>dry</u> the crystals between sheets of filter paper. (1)	[5]
	d	$ZnO\ (s) + 2HNO_3\ (aq) \rightarrow Zn(NO_3)_2\ (aq) + H_2O\ (l)$ OR $Zn(OH)_2\ (s) + 2HNO_3\ (aq) \rightarrow Zn(NO_3)_2\ (aq) + 2H_2O\ (l)$ (1) for correct balanced equation, (1) for state symbols	[2]
			Total: [10]