IGCSE Chemistry P4

650+ Qs with Mark Scheme

2016-2022

Compiled By:

Nouman Ahmad
A Level Chemistry Teacher at
Aitchison College, Lahore

Reviewed & Recommended with thanks By:

NIAZ AHMED AWAN
Senior A Level Chemistry at Lahore Grammar School
Visiting Faculty Member at:
Beaconhouse (Newlands & JT Campuses)
LGS, KIMS, The City School, SICAS, LACAS

Umar Zaman Khattak
HOD and Senior A Level Chemistry Teacher at
Garrison Academy for Cambridge Studies

Muhamad Ashfaq
LACAS, LGS, Lahore Lyceum

STUDENTS RESOURCE

Airport Road :
Shop 23-24,
Basement Faysal Bank,
Near Yasir Broast,
Airport Road, Lahore.
Mob: 0321-4567519
Tel: 042-35700707

DHA Ph-V:
Plaza No. 52-CCA, Ph-5
DHA Lahore Cantt.
Mob: 0321-4924519
Tel: 042-37180077

DHA Ph-I:
38-G, H Block Market,
Phase I, DHA Lahore.
Mob: 0321-4567952
Tel: 042-35691196

Johar Town :
Opp. Beaconhouse JTC
Adjacent Jamia Masjid PIA
Society Shadewal Chowk,
Johar Town Lahore.
Mob: 0313-4567519
Tel: 042-35227007

Bahria Town:
70 - Umer Block
Main Boulevard
Commercial Area
Bahria Town Lahore.
Mob: 0315-4567519
Tel: 042-35342995

studentsresource.net studentsresourc /students.resource /students.resource

Book Title: **IGCSE Chemistry Topical Paper 4 with Mark Scheme**

Compiled By: Nouman Ahmad **(0323-9149918)**
Aitchison College
Cambridge A Level Chemistry Teacher

Published by: **STUDENTS RESUORCE® Airport Road 0423-5700707**

Edition: **2023-25**

Price: 2200/-

Content

Topic 1	The Particulate Nature of Matter	4
Topic 2.1 & 2	Measurement & Purity & Experimental Techniques	17
Topic 3.1	Atomic Structure	31
Topic 3.2	Structure and Bonding	64
Topic 4.1	Formulae symbols and equation	114
Topic 4.2	The Mole Concept	136
Topic 5.1	Electricity and Chemistry	186
Topic 6.1 & 2	Energetics of a reaction and Bond Energy & Fuel	224
Topic 7.2	Rate of Reaction	245
Topic 7.3	Reversible Reactions	263
Topic 7.4	Redox	295
Topic 8.1& 2	Acids and Bases and Types of Oxide	303
Topic 8.3 & 4	Preparation of Salts and Ions & Gases	322
Topic 9.1/2 & 3	The Periodic Table	349
Topic 9.4 & 5	Transition Elements and Noble Gases	370
Topic 10.1/2 and **Topic 13**	Properties of Metals and Reactivity Series and Carbonates	379
Topic 10.3	Metal (Extraction Aluminum Iron and Zinc)	389
Topic 10.4	Uses of Metals & Alloys	417
Topic 11.1 & 2	Water and Air	420
Topic 11.3	Nitrogen and Fertilizers	433
Topic 11.4	Carbon Dioxide & Methane	442
Topic 12	Sulfuric Acid	446
Topic 14.2	Fuels (Crude Oil and Fractional Distillation)	455
Topic 14.3	Homologous Series	461
Topic 14.4	Alkane	471
Topic 14.5	Alkene	482
Topic 14.6	Alcohol	497
Topic 14.7	Carboxylic Acids	514
Topic 14.8	Esters & Polymers	518
Topic 15	Miscellaneous Questions	595

Topic 1 The Particulate Nature of Matter

1 The particulate nature of matter

1.1 The particulate nature of matter

Core	Supplement
• State the distinguishing properties of solids, liquids and gases	
• Describe the structure of solids, liquids and gases in terms of particle separation, arrangement and types of motion	
• Describe changes of state in terms of melting, boiling, evaporation, freezing, condensation and sublimation	• Explain changes of state in terms of the kinetic theory
• Describe qualitatively the pressure and temperature of a gas in terms of the motion of its particles	
• Show an understanding of the random motion of particles in a suspension (sometimes known as Brownian motion) as evidence for the kinetic particle (atoms, molecules or ions) model of matter	• Describe and explain Brownian motion in terms of random molecular bombardment • State evidence for Brownian motion
• Describe and explain diffusion	• Describe and explain dependence of rate of diffusion on molecular mass

0620/42/O/N/21/Q1)

1 This question is about states of matter.

(a) Complete the table, using ticks (✓) and crosses (✗), to describe the properties of gases, liquids and solids.

state of matter	particles are touching	particles have random movement	particles are regularly arranged
gas			
liquid			
solid			

[3]

(b) Substances can change state.

(i) Boiling and evaporation are two ways in which a liquid changes into a gas.

Describe **two** differences between boiling and evaporation.

1 .....

2 .....

[2]

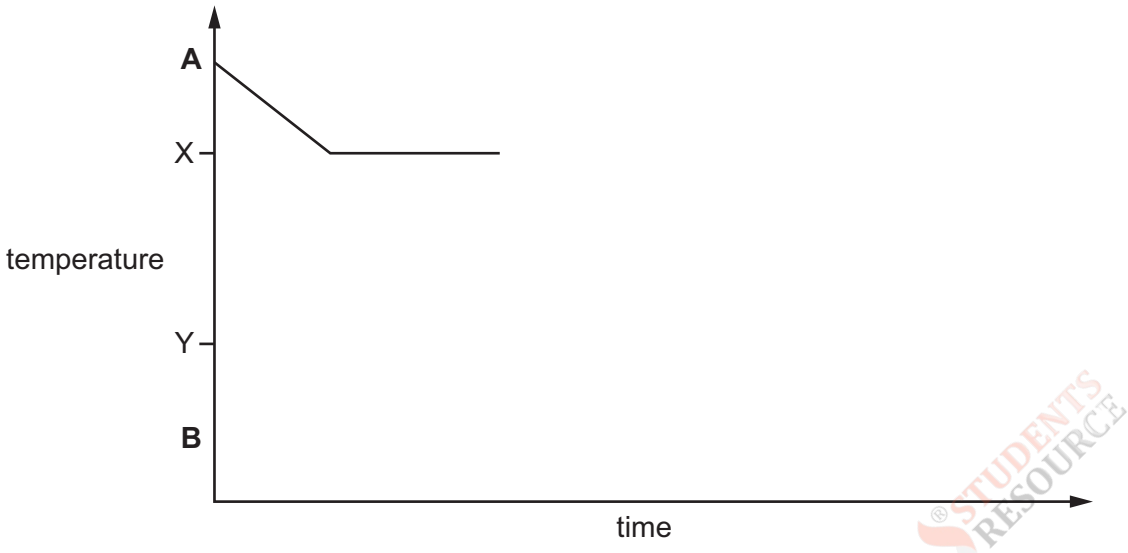
(ii) Name the change of state when:

- a gas becomes a liquid .....
- a solid becomes a gas. .....

[2]

(c) A substance boils at temperature X and melts at temperature Y.

Complete the graph to show the change in temperature over time as the substance cools from temperature **A** to temperature **B**.



[2]

(d) A solution is a mixture of a solute and a solvent.

(i) Name the process when a solid substance mixes with a solvent to form a solution.

..... [1]

(ii) Name the type of reaction when two solutions react to form an insoluble substance.

..... [1]

0620/42/F/M/21/Q2(a,b,c)

2 The elements shown are gases at room temperature and pressure.

hydrogen
nitrogen
oxygen
chlorine

(a) State which **one** of these gases is green.

..... [1]

(b) The gases shown exist as diatomic molecules.

State the name of **another** element which has diatomic molecules and is a gas at room temperature and pressure.

..... [1]

(c) When separate samples of each of these gases are placed in a container they will diffuse.

(i) Describe why these gases diffuse.

..... [1]

(ii) State which of these four gases has the highest rate of diffusion.

Explain your answer.

gas .....

explanation .....

.....
[2]

---

3 0620/41/O/N/20/Q3(d)

(d) Ammonia gas is prepared at the front of a laboratory.

The pungent smell of ammonia spreads throughout the laboratory slowly.

(i) Name the process that occurs when ammonia gas spreads throughout the laboratory.

..... [1]

(ii) Explain, using ideas about particles, why ammonia gas spreads throughout the laboratory.

.....

.....

..... [2]

(iii) Explain why carbon dioxide gas, CO_2, will spread throughout the laboratory at a slower rate than ammonia gas, NH_3.

.....

..... [1]

---

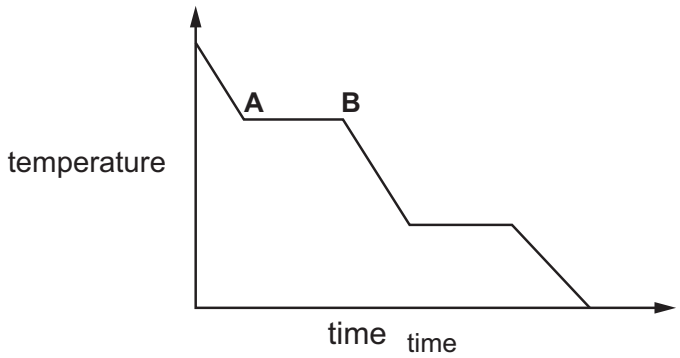
4 0620/43/M/J/20/Q5

(a) Complete the table about solids, liquids and gases.

	particle separation	particle arrangement	type of motion
solid		regular	vibrate only
liquid	touching		random
gas	apart	random	

[3]

(b) The graph shows the change in temperature as a sample of a gas is cooled.



Name the change of state taking place between **A** and **B**.

..... [1]

(c) A bottle of liquid perfume is left open at the front of a room.

After some time, the perfume is smelt at the back of the room.

Name the **two** physical processes taking place.

1 .....

2 ..... [2]

---

5 0620/42/O/N/17/Q1

(a) Dust particles in the air move around in a random way.

(i) What term describes the random movement of the dust particles?

..... [1]

(ii) Identify the particles in the air which cause the random movement of the dust particles.

..... [2]

(iii) Explain why the dust particles move in this way.

.....

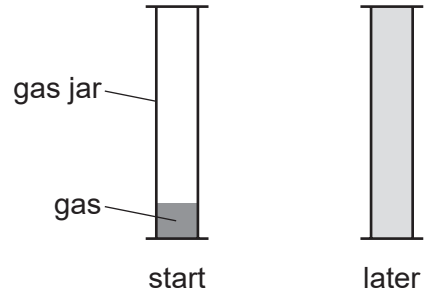
.....

..... [2]

(b) When chlorine gas, Cl_2, is put into a gas jar, it spreads out to fill the gas jar.

When bromine gas, Br_2, is put into a gas jar, it also spreads out to fill the gas jar.

The process takes longer for bromine gas than for chlorine gas.



(i) What term describes the way that the gas particles spread out?

..... [1]

(ii) Use **data** from the Periodic Table to explain why bromine gas takes longer to fill a gas jar than chlorine gas.

.....

.....

..... [2]

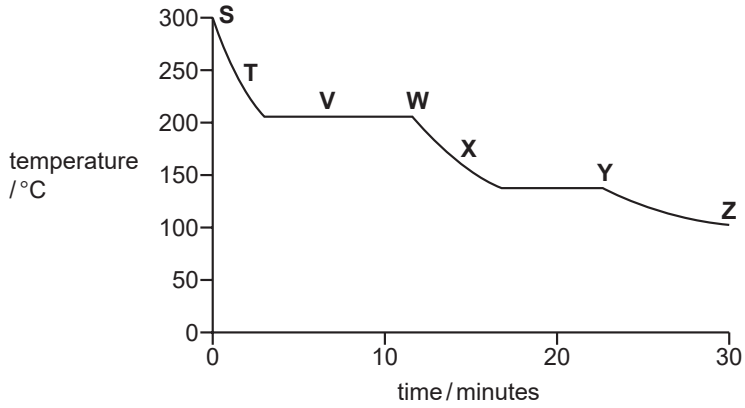
(iii) Explain why increasing the temperature increases the rate at which the gas particles spread out.

.....

..... [1]

6 **0620/41/O/N/17/Q2**

The graph shows how the temperature of a substance changes as it is cooled over a period of 30 minutes. The substance is a gas at the start.



Each letter on the graph may be used once, more than once or not at all.

(a) Which letter, **S**, **T**, **V**, **W**, **X**, **Y** or **Z**, shows when

(i) the particles in the substance have the most kinetic energy,

..... [1]

(ii) the particles in the substance are furthest apart,

..... [1]

(iii) the substance exists as both a gas and a liquid?

..... [1]

(b) Use the graph to estimate the freezing point of the substance.

..... °C [1]

(c) Name the change of state directly from a solid to a gas.

..... [1]

(d) When smoke is viewed through a microscope, the smoke particles in the air appear to jump around.

(i) What term describes this movement of the smoke particles?

..... [1]

(ii) Explain why the smoke particles move in this way.

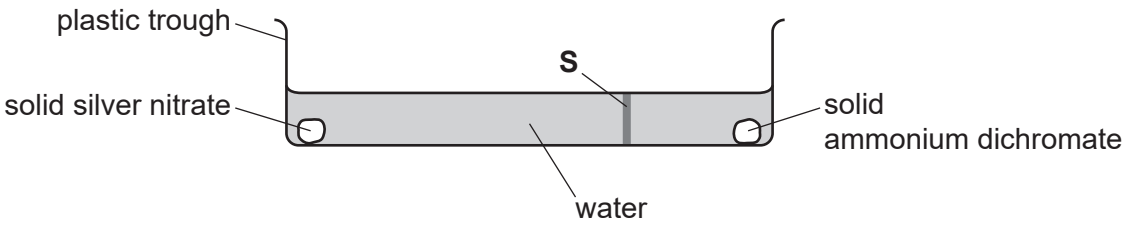
.....

.....

..... [2]

7 **0620/42/F/M/17/Q2**

The apparatus shown was set up.



After five minutes, a red solid appeared along the line marked **S** on the diagram.

(i) Explain why a red solid appeared along the line marked **S**.

.....

.....

.....

..... [3]

(ii) The experiment was repeated at a higher temperature.

What effect, if any, would this have on the time taken for the red solid to appear? Explain your answer.

.....

..... [2]

8 **0620/42/O/N/16/Q1**

Particles behave differently when in different physical states.

(a) Solids have a fixed volume and a definite shape.
Gases have no fixed volume and take the shape of the container.

Describe the volume and shape of liquids.

.....

..... [1]

(b) Complete the table to show the separation, arrangement and movement of particles in each physical state.

state	separation of particles	arrangement of particles	movement of particles
solid			
liquid	touching one another	randomly arranged	move over one another
gas			

[6]

(c) Name the following changes of state.

(i) Ice turning into water.

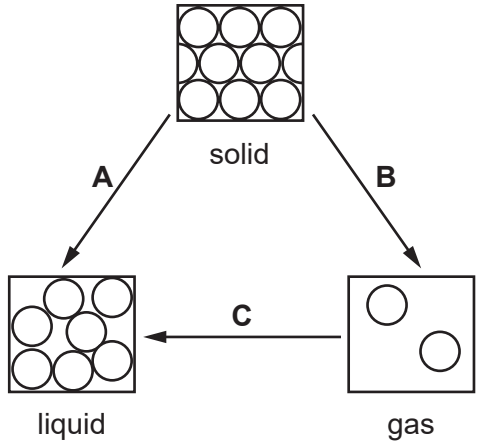
..... [1]

(ii) Solid carbon dioxide turning directly into gaseous carbon dioxide at room temperature.

..... [1]

9 **0620/41/O/N/16/Q2**

Matter can exist as solid, liquid or gas. The arrows show some changes of state.



(a) Name the changes of state represented on the diagram.

(i) **A** ..... [1]

(ii) **B** ..... [1]

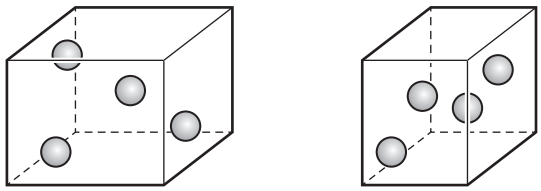
(iii) **C** ..... [1]

(b) Explain why energy has to be supplied to turn a liquid into a gas.

.....

..... [1]

(c) The diagrams represent the same number of particles of a gas in two containers, **D** and **E**, which have different volumes. The two containers are at the same temperature.



In which container will the pressure be higher? Explain your answer.

.....

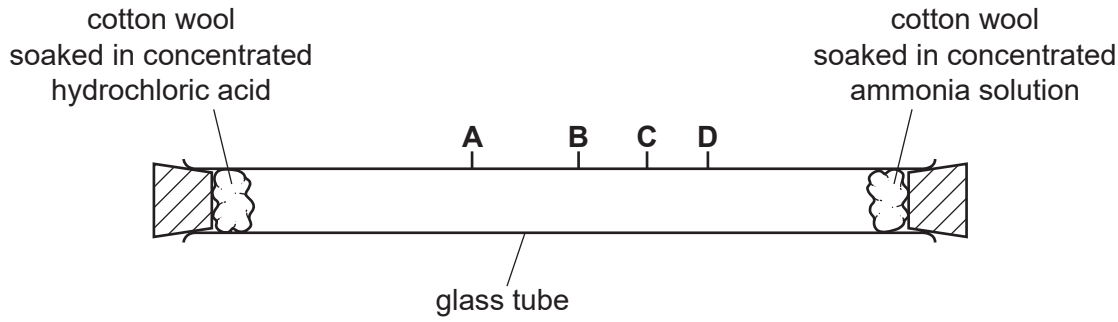
.....

..... [1]

10 **0620/43/M/J/16/Q6**

Concentrated ammonia solution gives off ammonia gas. Concentrated hydrochloric acid gives off hydrogen chloride gas. Ammonia, NH_3, and hydrogen chloride, HCl, are both colourless gases. Ammonia reacts with hydrogen chloride to make the white solid ammonium chloride.

Apparatus is set up as shown.



After ten minutes a white solid forms in the tube where the gases meet.

(i) Write the chemical equation for the reaction of ammonia with hydrogen chloride.

..... [1]

(ii) Name the process by which the ammonia and hydrogen chloride gases move in the tube.

..... [1]

(iii) At which point, **A**, **B**, **C** or **D**, does the white solid form? Explain why the white solid forms at that point.

the solid forms at .....

explanation .....

.....

[3]

(iv) The experiment was repeated at a higher temperature.

Predict how the results of the experiment would be different. Explain your answer.

.....

.....

..... [3]

1 (a) 1 mark for each correct row **3**

State	touching	random movement	regularly arranged
Gas		✔	
Liquid	✔	✔	
Solid	✔		✔

(b)(i) boiling happens at a specific temperature (1)
boiling has bubbles (1) **2**

(b)(ii) condensation (1)
sublimation (1) **2**

(c) one horizontal line level with Y (1)
two separate decreases before and after horizontal line (1) **2**

(d)(i) dissolving **1**

(d)(ii) precipitation **1**

---

2 (a) chlorine **1**

(b) fluorine **1**

(c)(i) random motion of **molecules / particles** **1**

(c)(ii) hydrogen **2**

lowest (relative) molecular mass

(d)(i) 78 **1**

---

3 **(i)** diffusion **1**

(ii) particles move from an area of high to low concentration **2**

particles move randomly

(iii) CO_2 **molecules** are heavier (than NH_3) **1**

---

4 (a)

	particle separation	particle arrangement	type of motion
solid	touching		
liquid		random	
gas			random

3

(b) condensing **1**

(c) evaporation
diffusion **2**

---

5 **(a) (i)** Brownian (motion) **1**

(ii) molecules **1**

nitrogen / N_2 / N **OR** oxygen / O_2 / O **1**

(iii) nitrogen **OR** oxygen (particles) collide with / bombard / hit the dust (particles) **1**

(the bombarding particles) move **randomly** **1**

(b) (i) diffusion **1**

(ii) Br_2 has an M_r of 160 **AND** Cl_2 has an M_r of 71 / bromine has an A_r of 80 **AND** chlorine has an A_r of 35.5 **1**

(heavier) bromine (molecules / particles) diffuses more slowly **1**

(iii) particles have more energy / move faster **1**

---

6 **(a) (i)** **S** **1**

(ii) **S** **1**

(iii) **V** **1**

(b) any value in the range 130–145 °C **1**

(c) s ublimation **1**

(d) (i) Brownian motion **1**

(ii) nitrogen / oxygen / carbon dioxide / air molecules hit / bombard the smoke particles **1**

(the bombarding particles) move randomly **1**

---

7 **(i)** **M1** dichromate ions / particles are heavier (than silver ions) **1**

M2 so dichromate ions diffuse / move more slowly **ORA** **1**

M3 (where they meet they react and) silver dichromate is made **1**

(ii) **M1** red solid forms in less than five minutes **or** red solid for ms faster / sooner **1**

M2 particles / ions move faster **1**

---

8 **(a)** fixed volume **AND** take the shape of the container **1**

(b) **6**

solid	touching	regular	vibrate
liquid			
gas	not touching	random	random

(c)(i) melting **1**

(ii) sublimation **1**

---

9 **(a)(i)** melt(ing) **1**

(ii) sublimation / sublime **1**

(iii) condensing / condensation **1**

(b) overcome / break the attractive forces **1**

(c) **E AND** particles hit the walls (of the container) more often **1**

---

10 **(i)** $NH_3 + HCl \rightarrow NH_4Cl$; **1**

(ii) diffusion; **1**

(iii) **3**

solid forms at: A;
explanation: ammonia molecules /
particles have a smaller mass; (and so) move / diffuse faster;

(iv) **3**

M1 solid forms in less time / faster / quicker;
M2 particles / molecules have more energy;
M3 (and so) move faster / diffuse faster;

Topic 2.1 Measurement

Topic 2.2 Purity & Experimental Techniques

2 Experimental techniques

2.1 Measurement

Core

- Name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes and measuring cylinders

2.2 Purity

2.2.1 Criteria of purity

Core

- Demonstrate knowledge and understanding of paper chromatography
- Interpret simple chromatograms
- Identify substances and assess their purity from melting point and boiling point information
- Understand the importance of purity in substances in everyday life, e.g. foodstuffs and drugs

Supplement

- Interpret simple chromatograms, including the use of R_f values
- Outline how chromatography techniques can be applied to colourless substances by exposing chromatograms to substances called locating agents. (Knowledge of *specific* locating agents is **not** required.)

2.2.2 Methods of purification

Core

- Describe and explain methods of purification by the use of a suitable solvent, filtration, crystallisation and distillation (including use of a fractionating column). (Refer to the fractional distillation of petroleum in section 14.2 and products of fermentation in section 14.6.)
- Suggest suitable purification techniques, given information about the substances involved

1 0620/41/M/J/21/Q5(b i)

Nitrates decompose when heated.

When hydrated zinc nitrate is heated, oxygen gas is given off.

Describe a test for oxygen.

test .....

observations .....

[2]

---

2 0620/43/O/N/20/Q4(d i)

When hydrated magnesium sulfate crystals, $MgSO_4 \cdot xH_2O$, are heated they give off water.

$$MgSO_4 \cdot xH_2O(s) \rightarrow MgSO_4(s) + xH_2O(g)$$

A student carries out an experiment to determine the value of x in $MgSO_4 \cdot xH_2O$.

Step 1 Hydrated magnesium sulfate crystals were weighed.

Step 2 Hydrated magnesium sulfate crystals were heated.

Step 3 The remaining solid was weighed.

Describe how the student can ensure that all the water is given off.

.....

.....

..... [2]

---

3 0620/43/M/J/20/Q4

(a) Filtration and chlorination are two stages in water treatment.

State the purpose of each stage.

filtration .....

.....

chlorination .....

.....

[2]

(b) A student uses anhydrous copper(II) sulfate to test for the presence of water.

(i) What colour change is seen if water is present?

from ..... to ..... [2]

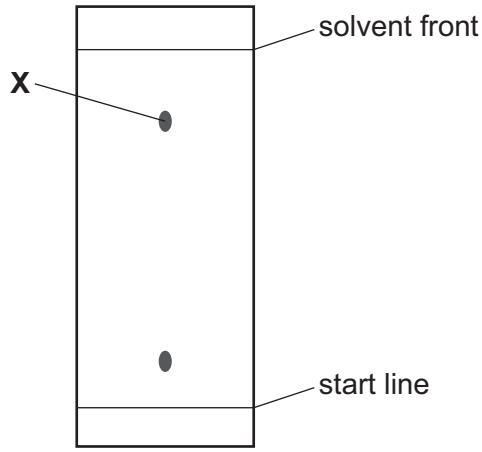
(ii) The purity of a sample of water can be assessed by measuring its boiling point.

How is the boiling point of water affected by impurities?

..... [1]

(c) Chromatography can be used to test the purity of substances.

The diagram shows the chromatogram of a coloured substance.



(i) How does this chromatogram show that this substance is **not** pure?

..... [1]

(ii) Draw a circle round the correct R_f value for the spot labelled **X**.

0.2 0.4 0.8 1.2 [1]

(iii) State how a colourless substance can be made visible on a chromatogram.

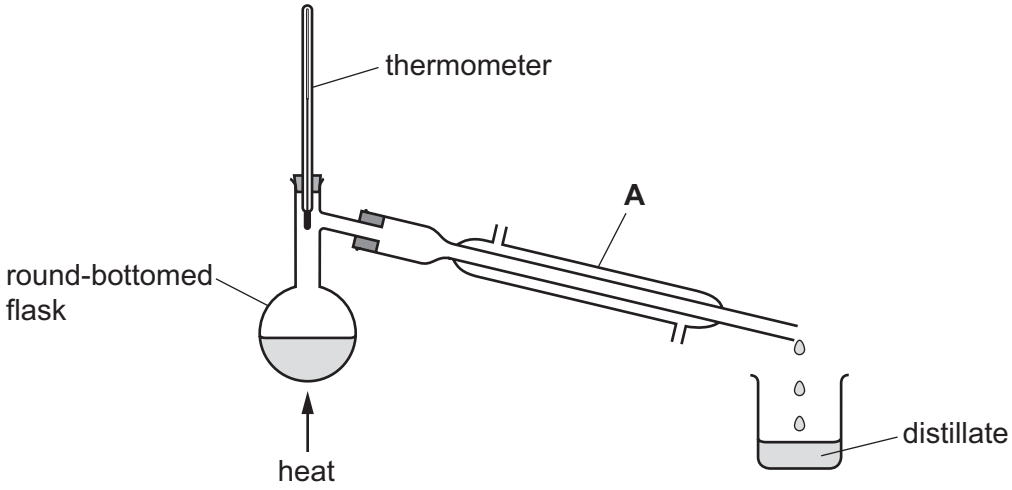
..... [1]

4 0620/41/M/J/20/Q5(c)

Alcohols can be partially oxidised to form aldehydes.

Aldehydes are a homologous series of organic compounds.

Partial oxidation is achieved by reacting an alcohol with the oxidising agent in distillation apparatus as shown.



(i) Name apparatus **A**.

..... [1]

(ii) On the diagram, use **one** arrow to show where water enters apparatus **A**

. [1]

5 0620/43/O/N/19/Q7(c)

Complex carbohydrates are natural condensation polymers. They can be broken down into colourless monomers which can then be separated and identified.

X is a complex carbohydrate.

Starting with a sample of **X**, describe how to produce, separate, detect and identify the monomers which make it up.

Your answer should include:

- the name of the process used to break down **X** into its monomers
- **two** types of substance that can be used to break down **X**
- the name of the process used to **separate** the monomers
- the method used to **detect** the monomers after they have been separated
- the method used to **identify** the monomers after they have been separated and detected.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

6 **0620/41/M/J/18/Q1**

Substances can be classified as elements, compounds or mixtures.

(a) What is meant by the term *compound*?

.....

.....

..... [2]

(b) Mixtures can be separated by physical processes.

A sequence of physical processes can be used to separate common salt (sodium chloride) from a mixture containing sand and common salt only.

Give the order and the correct scientific term for the physical processes used to separate the common salt from the mixture.

1 .....

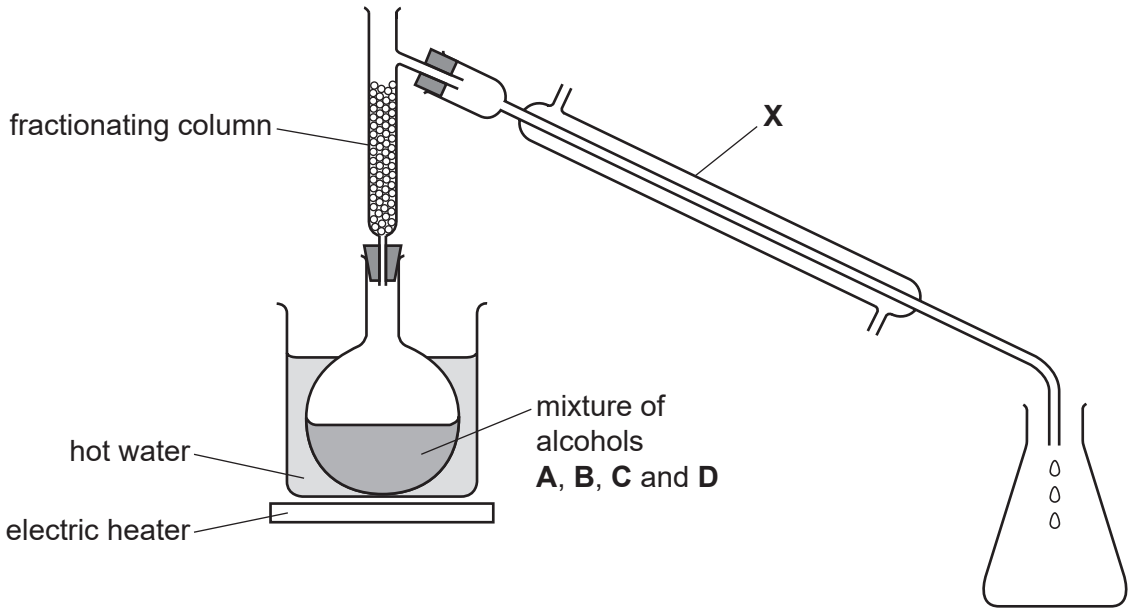
2 .....

3 ..... [4]

The boiling points of four different alcohols, **A**, **B**, **C** and **D**, are shown.

alcohol	**A**	**B**	**C**	**D**
boiling point / °C	56	78	122	160

(c) A student suggested that the apparatus shown could be used to separate the mixture of alcohols.



(i) Apparatus **X** needs to have cold water flowing through it.

- Draw an arrow on the diagram to show where the cold water enters apparatus **X**.
- Name apparatus **X**.

.....

[2]

(ii) Part of the fractionating column is missing. This means that the experiment will not work.

- Draw on the diagram the part of the fractionating column which is missing.
- Explain why the experiment will **not** work with this part of the fractionating column missing.

.....

.....

[2]

(iii) Suggest why a Bunsen burner is **not** used to heat the flask

..... [1]

(iv) A hot water bath cannot be used to separate alcohols **C** and **D**.

Explain why.

.....

.....

..... [2]

7 **0620/32/O/N/10/Q5(b)(ii)**

Carbon dioxide is acidic and methane is neutral.

Suggest another way of measuring the volume of methane in the sample.

.....

..... [2]

---

8 **0620/42/F/M/18/Q5ôŜù**

Chromatography can be used to identify simple sugars in a mixture.

A student analysed a mixture of simple sugars by chromatography. All the simple sugars in the mixture were colourless.

(i) What is the name given to the type of substance used to identify the positions of the simple sugars on the chromatogram?

..... [1]

(ii) The student calculated the R_f value of a spot on the chromatogram.

Complete the expression for the R_f value of the spot.

R_f =

[1]

(iii) How could a student identify a simple sugar from its R_f value?

.....

..... [1]

(iv) Sometimes not all the substances in a mixture can be identified from the chromatogram produced.

Explain why this may happen.

..... [1]
