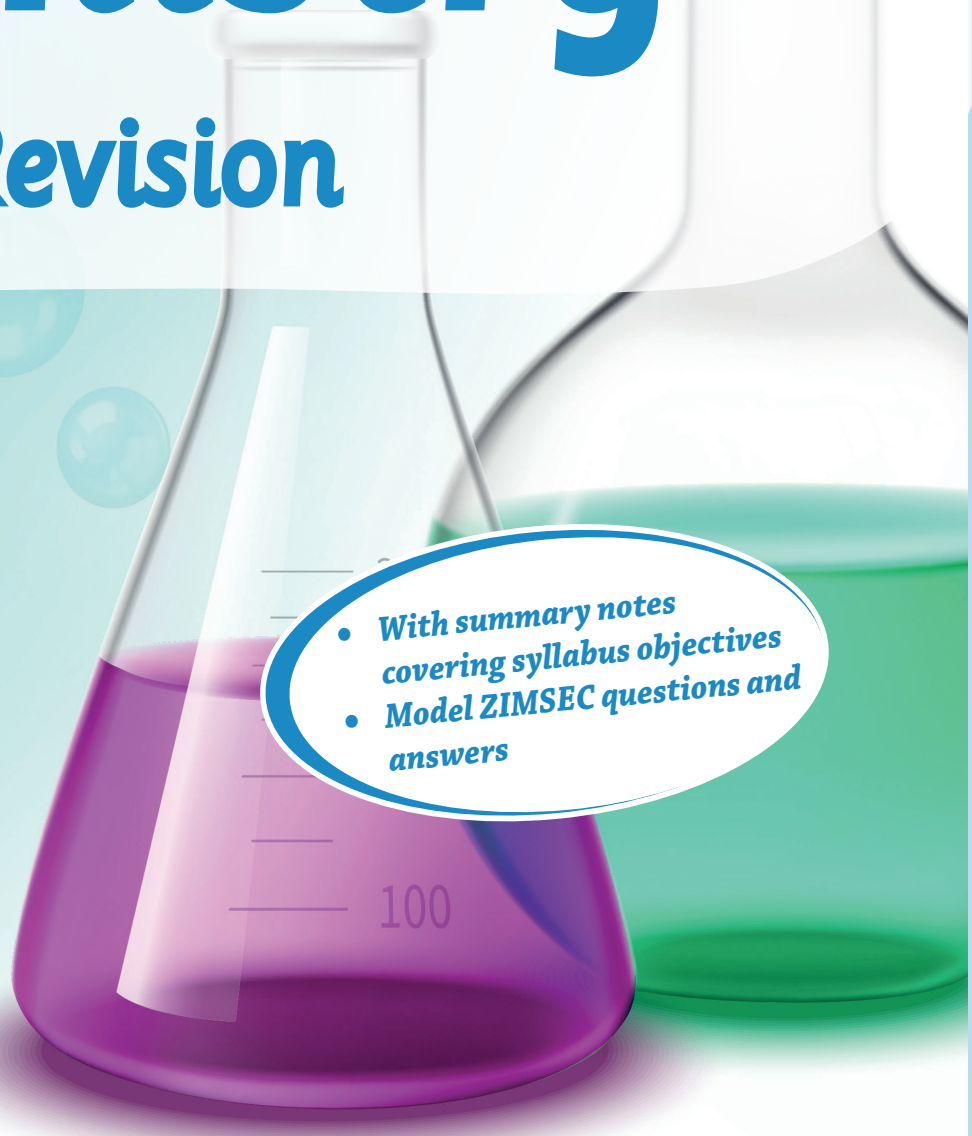
New Curriculum

A *Practical* Approach to

Chemistry

'O' Level Revision

- With summary notes covering syllabus objectives
- Model ZIMSEC questions and answers



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Contents

Introduction

To excel in your Chemistry examinations, you must cover all the topics in the Zimsec syllabus. This book offers you an opportunity to polish your knowledge in all Zimsec syllabus areas and acquire requisite skills to pass your examinations with flying colours. This book is organised into the following.

- Summary notes sections
- Zimsec specimen papers
- Marking guide for all papers

(a) Summary notes section

This sections gives summary notes for each topic as per the syllabus requirements. The content is organised as per syllabus requirements.

(b) Specimen Zimsec paper 1

Here, an insight into what Chemistry paper 1 looks like is given. It then highlights the common mistakes made by learners when answering examination questions. The paper is made up of carefully selected questions that meet the latest examination standards of the new curriculum.

(c) Specimen Zimsec paper 2

A typical Zimsec paper 2 is presented. In this paper, you are required to answer all questions in Section A and any four from Section B. The paper is made up of carefully selected paper 2 questions that meet the latest examination standards of the new curriculum.

(d) Specimen Zimsec paper 3

This section highlights the key areas that are examined in Chemistry Paper 3.

It further guides you how to present accurate answers in order to score maximum marks when answering practical questions.

Answering techniques

- Never skip any questions.
- Never leave any questions unanswered.
- Read and understand the demands of the questions.
- Write neatly and eligibly.
- Use a ruler, pencil and or black/ blue ink where necessary.
- Show all your working.

Common errors in Chemistry

- Do not waffle.
- Use proper chemistry language to explain where necessary.
- Do not spend too much time on a question. The time spent on a question must tally with the mark allocation.
- Answer the questions you know first such that while you at it, you will be unconsciously thinking of the questions you do not know.
- Cancel out neatly in pencil if you happen to make errors.
- Draw clear and annotated diagrams.
- Indicate your name, candidate number and centre number on every page of your answer script.

Malpractice

Examination malpractice has been on the increase amongst candidates in recent years. It includes circulating and using purported exam material before taking the exam, cheating, bringing material into the examination room, impersonation among other practices. These practices are a criminal offence and candidates who are caught will be penalised or disqualified. Candidates should be well prepared for the examination.

Study tips

Stage 1 : Planning

- Planning your revision is crucial if you are to take control of your learning and not get too stressed.
- This is not an easy task because to do it well, one has to plan in greater detail.
- Remember, 30 minutes sessions are the best and then take a short break.
- It is better to do one or two hours a night over a long period of time than cram it all in the last minute.

Date	Session 1 (30 minutes)	Session 2 (30 minutes)	Session 3 (30 minutes)
Monday 22/11/22	Mathematics	Science	English
Area	Number	Planets	Anthology
Method	Mind mapping	Cards	Notes
Aim	To understand	To list the…	To look for…

Stage 2: Creating an effective revision space

A clean, well equipped and ventilated study environment helps revision. It removes distractions and promotes an organised approach to studying. Include the following in your study space:

- Tidy and undisturbed place to work.
- Have a comfortable chair.
- Use a table which gives enough rooms. for books and writing materials.
- A bright lamp or light source.
- Pens, pencils, highlighters (optional), scrap paper and other equipment.

Stage 3: Active revision techniques

Simply reading a poor way of studying. Do the following to stay ahead.

- Summarise points on revision cards.
- Use mnemonics.
- Make mind maps or spider diagrams, stick them on the wall.
- Repeat lists or processes aloud over and over again.
- Tape notes and play them back
- Set yourself questions from your notes – go over wrong answers.
- Explain your work to a friend or parent
- When you feel ready, practice exam questions.

TOPIC 1 Measuring Instruments

Objectives

By the end of this topic, you should be able to:

- *identify suitable apparatus used in measurement of time, temperature, mass, volume and distance.*
- *use measuring apparatus correctly.*

Measuring instruments

A thermometer is used to measure temperature.

Fig. 1.1 Thermometer

A scale is used to measure mass.

Fig. 1.2 Scale

A stopwatch is used to measure time.

Fig. 1.3 Stop watch

A pipette is used to measure volume of the solution more accurately usually during titration.

Fig. 1.4 Pipette

A burette is used to measure volume of a liquid that is required to react completely with the solution in the conical flask during titration. It has an accuracy of 0,05cm^3.

Fig. 1.5 Burette

A gas syringe is used to collect and measure the volume of the gas produced during a chemical reaction.

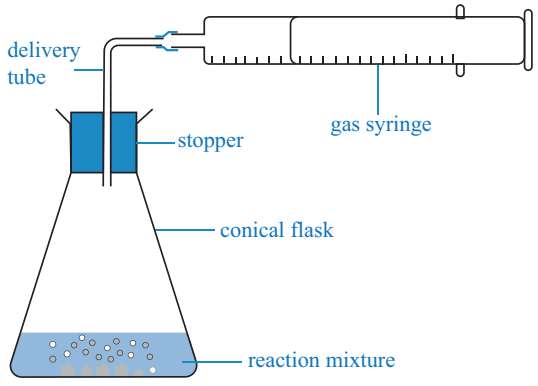


Fig. 1.6 Gas syringe

A meter rule is used to measure distance.

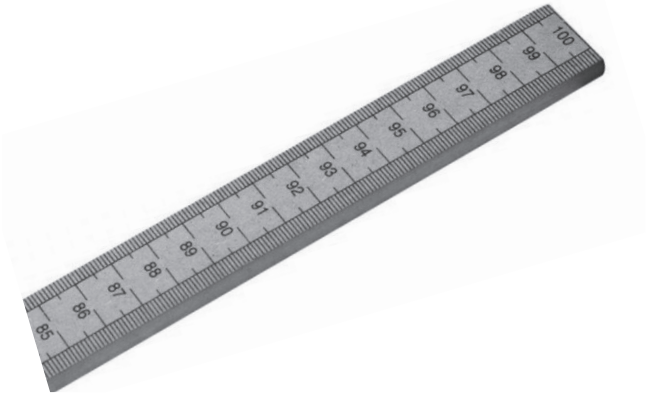


Fig. 1.7 Meter rule

TOPIC 2 Separation Techniques

Objectives

By the end of this topic, you should be able to:

- *carry out titration experiments.*
- *complete titration tables.*
- *calculate moles and concentration from titres.*
- *identify different methods of separating mixtures.*
- *suggest suitable separation techniques given the nature of the mixture.*
- *describe the principles of fractional and steam distillation.*
- *describe the concepts of paper and thin layer chromatography.*
- *carry out tests to identify ions.*
- *describe tests to identify gases.*

Filtration

It is used to separate insoluble substances from a liquid.

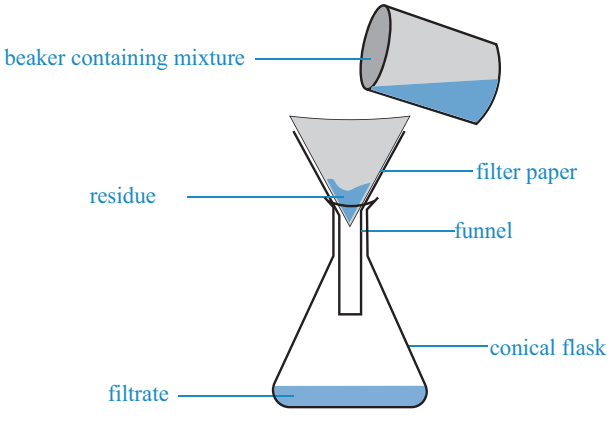


Fig. 2.1 Filtration

Simple distillation

Distillation is a method used to separate the solute and the solvent from the solution.
When the solution is heated, the solvent boils, the vapour of the solvent rises and gets into a condenser. In the condenser, condensation occurs leading to the solvent being obtained as a distillate. The solute remains in the heating flask.

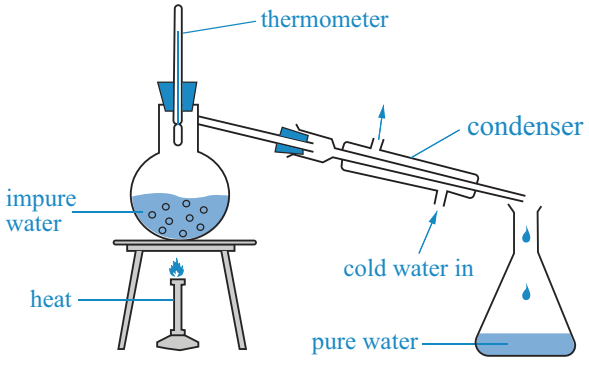


Fig. 2.2 Simple distillation

Fractional distillation

Fractional distillation is a separation technique used to separate liquids with different boiling points. The solution is heated, the liquid with the least lowest boiling point boils first. The vapour of the liquid with the least lowest boiling point rises and gets into a condenser where it will be changed back into liquid state.

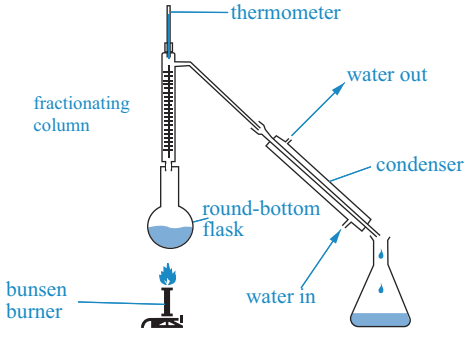


Fig. 2.3 Fractional distillation

As long as the temperature is maintained at the boiling point of a liquid with the lowest boiling point, that liquid is the only one that is obtained as the distillate. The fractionating column has glass beads to ensure complete separation.

Evaporation

Evaporation is used to obtain the solute from the solution. The solution is heated to remove all the water or solvent. The crystals of the solute remains.

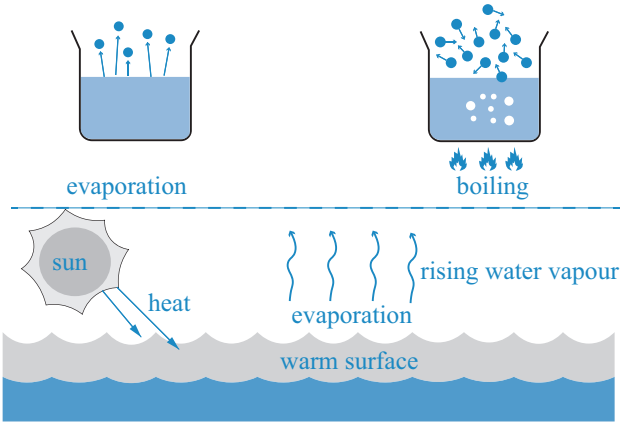


Fig. 2.4 Evaporation

Crystallisation

Crystallisation is a separation method used to obtain the solute from the solution. The solution is heated to saturation. The saturated solution is then cooled afterwards crystals then appear.

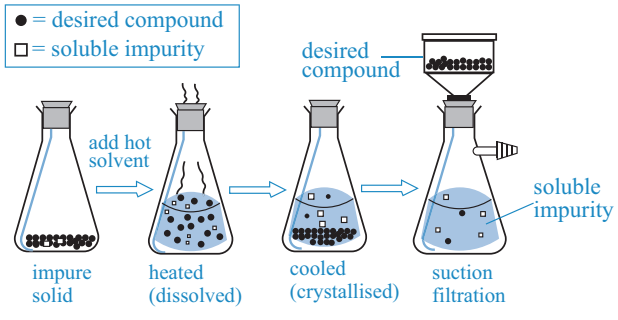


Fig. 2.5 Crystallisation

Paper chromatography

It is used to separate substances that have different solubility and adsorption, for instance, dyes in an ink.

Spots of substances to be separated are placed on a pencil line just above the edge of the paper. The paper is dipped in the solvent such that the pencil line is above the solvent. Ethanol is an example of a solvent.

The solvent moves by capillary action carrying up the analytes (substances to be separated). It is because the analytes have different solubility and adsorption. They move different distances up the paper and hence getting separated.

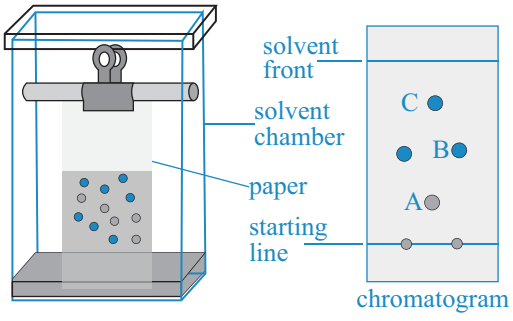


Fig. 2.6 Paper Chromatography

Thin Layer Chromatography (TLC)

Instead of a paper, a thin layer of powdered adsorbent is spread on the plate. Substances are separated depending on their varied solubility and adsorption rates.

Spots of substances to be separated are placed on a pencil line just above the edge of the paper which is then dipped in the solvent such that the pencil line is above the solvent. The solvent moves by capillary action carrying up the analytes (substances to be separated). The analytes move different distances up the paper hence get separated.

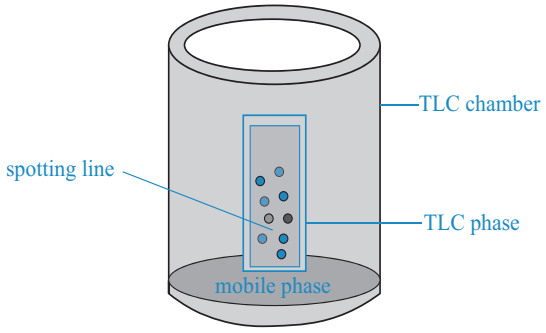


Fig. 2.7 Thin Layer Chromatography

$$R_f \text{ value} = \frac{\text{distance moved by the substance from the pencil line}}{\text{distance moved by the solvent}}$$

Substances with the same Rf values are considered to be the same.

Advantages of TLC

- It has more resolution than paper chromatography.
- It saves time as compared to traditional paper chromatography.
- It requires minimal equipment for carrying out the TLC procedure.
- A large number of samples that can be run at a single time along with a plate.
- It is a susceptible technique providing confidence in the accuracy of the results.
- It is also useful if a small sample volume is available and does not require huge samples.

Disadvantages of TLC

- The requirement of pre-known R_f values presents another challenging disadvantage associated with thin-layer chromatography.
- Some of the TLC plates do not have long stationary phases. In such cases, it poses the limitation of the length of separation for the mixture. The greater the length of the plate, the finer would be the separation of the mixture into individual components.
- TLC operates within the confines of an open system, it is susceptible to being affected by environmental factors such as temperature and humidity.
- More than one compound or different separations can be done in a single run only as long the mobile phase is the same for all the separations being carried out. Otherwise, different runs on separate plates would be necessary in case of separations demanding separate mobile phases.
- TLC applies to only nonvolatile compounds, thus limiting its use.

Steam distillation

Steam distillation is used to obtain organic compounds that decompose if distilled at their boiling point. This separating technique enables the solution of the organic compounds to boil at lower boiling point thereby preventing the decomposition of the organic compound.

Dry steam is introduced into the mixture. The increase in vapour pressure results in the decrease of the boiling point of the solution.

Steam distillation is used to extract substances with pleasant smell from flowers that will be used to make perfumes.

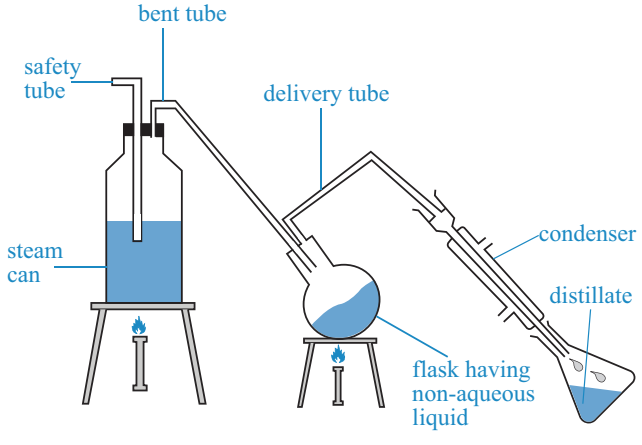


Fig. 2.8 Steam distillation

Sublimation

This method is used to obtain a solid that sublimes from a solid mixture. Examples of solids that sublime include iodine and naphthalene (found in mothballs).

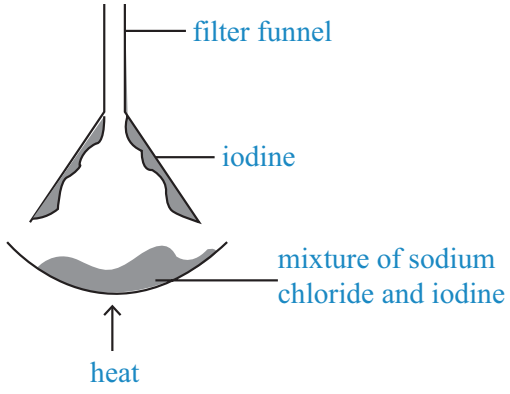


Fig. 2.9 Sublimation

Measuring volume

Volumes of solutions have to be frequently measured in chemistry experiments. The following are apparatus for measuring volume.

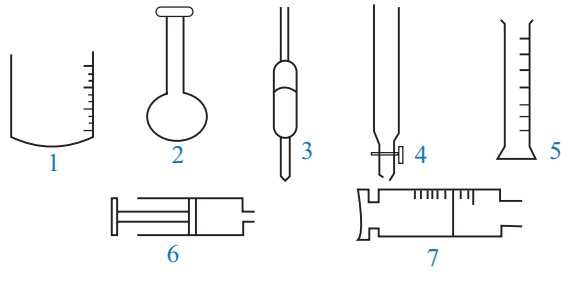


Fig. 2.10 Instruments for measuring volume

1. Beaker

It is used to measure volumes of liquids approximately according to the graduated marks on the apparatus.

2. Volumetric flask

It is used to accurately measure fixed volumes of liquids when solutions of flask particular concentrations need to be prepared.

3. Pipette

It is used to accurately measure volumes of liquids when a fixed volume of solution is needed for an experiment.

4. Burette

To accurately measure (nearest $0,1cm^3$) volumes of liquids which are used up in an experiment.

5. Measuring cylinder

To measure volumes of liquids with some accuracy (nearest $0,1cm^3$) according to the graduated marks on the apparatus.

6. Syringe

To measure small volumes of liquids with some accuracy according to the graduated marks on the apparatus.

7. Gas syringe

To accurately measure volumes of gases produced in experiments according to the graduated marks on the apparatus.

Collecting gases produced

1. Displacement of water

It is used to collect gases which are not very soluble in water, such as oxygen and hydrogen.

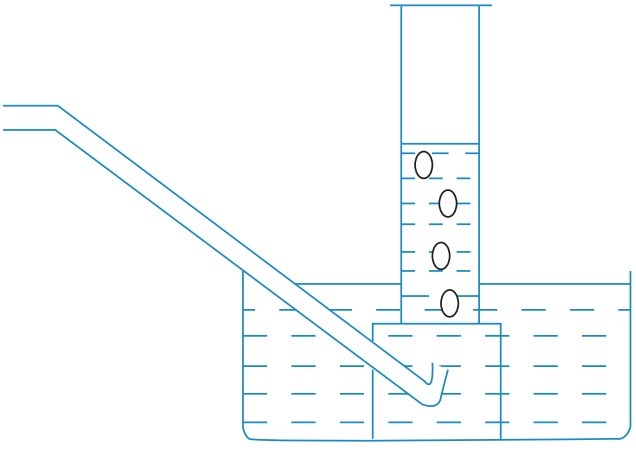


Fig. 2.11 Displacement of water

2. Downward delivery

It is used to collect gases which are denser than air, such as carbon dioxide, hydrogen chloride and chlorine.

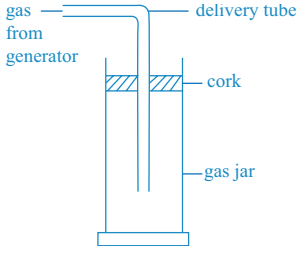


Fig. 2.12 Downward delivery

3. Upward delivery

It is used to collect gases which are less dense than air, such as ammonia and hydrogen.

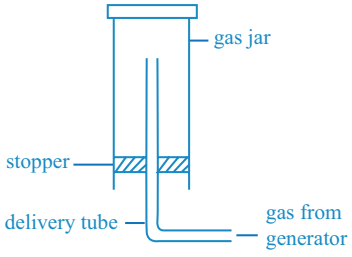


Fig. 2.13 Upward delivery

Drying of gases

When gases produced need to be obtained dry, the moisture content has to be removed using appropriate drying agents.

1. Fused calcium chloride

This is anhydrous calcium chloride which removes moisture from gases. This can be used to dry gas which do not react with calcium chloride.

2. Concentrated sulphuric acid

This is a common drying agent but it cannot be used to dry gases which are basic.

3. Quick lime/Calcium oxide

This is a drying agent used to dry basic gases such as ammonia.

Table 2.1 Test for gases

Gas	Test	Observation
Oxygen, O_2	Place a glowing splint into the test tube.	The glowing splint relights.
Hydrogen, H_2	Place a lighted splint at the mouth of the test tube.	The lighted splint extinguishes with a "pop" sound.
Carbon dioxide, CO_2	Bubble the gas into lime water.	A white precipitate of calcium carbonate forms.
Sulphur dioxide, SO_2	Place a paper soaked with acidified potassium manganate (VII) at the mouth of the test-tube.	The paper turns from purple to colourless.
Chlorine, Cl_2	Place a damp blue litmus paper at the mouth of the test tube.	The blue litmus paper turns red and is finally bleached white.
Ammonia, NH_3	Place a damp litmus paper at the mouth of the test tube	The red litmus paper turns blue.

Table 2.2 Test for cations

Cation	Reaction with $NaOH_{(aq)}$	Reaction with $NH_{3(aq)}$
Aluminium ion, Al^{3+}	A white precipitate forms. The precipitate dissolves in excess NaOH to give a colourless solution.	A white precipitate forms. The precipitate is insoluble in excess NH_3.
Calcium ion, Ca^{2+}	A white precipitate forms. The precipitate is insoluble in excess NaOH.	No visible change.
Copper (II) ion, Cu^{2+}	A light blue precipitate forms. The precipitate is insoluble in excess NaOH.	A light blue precipitate forms. The precipitate dissolves in excess NH_3 to give a deep blue solution.
Iron (II) ion, Fe^{2+}	A dirty green precipitate forms. The precipitate is insoluble in excess NaOH.	A dirty green precipitate forms. The precipitate is insoluble in excess NH_3.
Iron (III) ion, Fe^{3+}	A reddish brown precipitate forms. The precipitate is insoluble in excess NaOH.	A reddish brown precipitate forms. The precipitate is insoluble in excess NH_3.
Lead (II) ion, Pb^{2+}	A white precipitate forms. The precipitate dissolves in excess NaOH to give a colourless solution.	A white precipitate forms. The precipitate is insoluble in excess NH_3.
Zinc ion, Zn^{2+}	A white precipitate forms. The precipitate dissolves in excess NaOH to give a colourless solution.	A white precipitate forms. The precipitate dissolves in excess NH_3 to give a colourless solution.
Ammonium ion, NH_4^+	No precipitate forms. Ammonia gas is produced on warning.	No visible change.

Table 2.3 Test for anions

Anions	Test	Observation
Nitrate ion, NO_3^-	Add aqueous sodium hydroxide and a small piece of aluminium foil and warm the mixture.	Ammonia gas is released, the gas turns damp red litmus blue.
Carbonate ion, CO_3^{2-}	Add dilute hydrochloric acid.	Carbon dioxide is released, the gas forms a white precipitate when bubbled into lime water.

Anions	Test	Observation
Chloride ion, Cl^-	Add dilute nitric acid, followed by aqueous silver nitrate.	A white precipitate of silver chloride is produced.
Iodide ion, I^-	Add dilute nitric acid, followed by aqueous lead (II) nitrate.	A yellow precipitate of lead (II) iodide is produced.
Sulphate ion, SO_4^{2-}	Add dilute nitric acid, followed by aqueous barium nitrate.	A white precipitate of barium sulphate is produced.

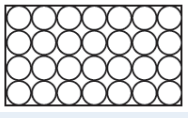
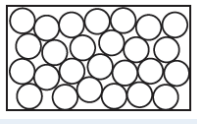
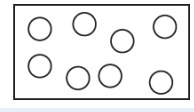
TOPIC 3 Matter

Objectives

By the end of this topic, you should be able to:

- *state the three states of matter.*
- *explain the states of matter using the kinetic theory.*
- *explain the inter-conversion of states in terms of energy and arrangement of particles.*
- *describe and explain diffusion.*
- *interpret heating and cooling curves.*
- *describe the effects of impurities on boiling and melting points.*

Table 3.1 States of matter descriptions

Property	Solid	Liquid	Gas
Structure			
Packing of particles	Tightly packed in an orderly manner.	Packed closely together, but not as tightly as in solids. No regular movement.	Spaced far apart from each other.
Movement of particles	Can only vibrate about fixed positions.	Particles slide past each other. Particles can move around.	Particles move freely at high speeds.
Shape	Fixed shape	No fixed shape. Takes on the shape of the container it is in.	No fixed shape. Takes on the shape of the container it is in.
Volume	Fixed volume. Not easily compressed.	Fixed volume. Not easily compressed.	No fixed volume. Easily compressed.

States of matter

The three states of matter are solid, liquid and gas.

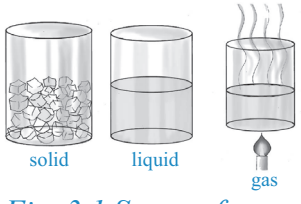


Fig. 3.1 States of matter

Kinetic theory

The kinetic theory of matter states that matter is made up of small particles that are always in constant motion. However, the amount of kinetic energy depends on the state of matter.

Solid particles possess the least kinetic energy while liquid particles have more kinetic energy and gaseous particles possess the most kinetic energy.

TOPIC 12 Periodic Table

Objectives

By the end of this topic, you should be able to:

- *describe the change from metallic to non-metallic character across a period.*
- *explain the relationship between number of electron shells and the period.*
- *describe the relationship between group number and number of valence electrons.*
- *describe the reactions of magnesium, calcium and barium with oxygen and water.*
- *describe the trends in the physical and chemical properties of group (vii) elements.*
- *describe the properties of transition elements.*
- *explain the industrial and biological significance of transition elements.*

The periodic table

This is a method of grouping elements according to their properties. The periodic table was first designed by the Russian scientist Dmitri Mendeleev. Elements are arranged in order of increasing atomic numbers in the periodic table. They are organised into horizontal rows known as periods and vertical columns known as groups.

Group																	
I	II										III	IV	V	VI	VII	0	
							1 H Hydrogen 1									4 He Helium 2	
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18	
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a X b — a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

TOPIC 17 Polymers

Objectives

By the end of this topic, you should be able to:

- *describe the formation of polythene.*
- *describe the formation of nylon and terylene.*
- *draw the structure to represent synthetic polymers.*
- *identify repeat units for polymers.*
- *deduce the structure of the monomer from a given polymer and vice versa.*
- *describe the uses of synthetic polymers.*
- *name the type of linkages in each of the polymers starch and protein.*
- *draw structures to represent natural polymers.*
- *deduce the structure of the monomer from a given polymer and vice-versa.*
- *describe the hydrolysis of natural polymer.*

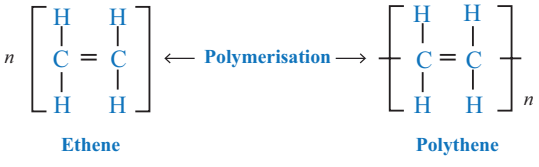
Polymers

- Polymers are large molecules made by joining together many smaller units called monomers.
- They are chemical compounds with molecules bonded together in long, repeating chains.
- Polymers can be man-made or synthetic.
- The joining together of monomers to form polymers is called polymerisation.
- Repeat unit: a repeat unit is the simplest part of a polymer which is repeated many times to form the polymer.
- Synthetic polymers are man-made polymers.
- They can be made by two types of polymerisation, addition polymerisation and condensation polymerisation.

Addition polymerisation

- Addition polymerisation is the linking together of unsaturated monomer units such as alkenes to form polymers.
- Each polymer is made of one kind of monomer molecule.
- Addition polymers are made from unsaturated monomers through an addition reaction.
- The double bond in the unsaturated monomer breaks and forms the monomer that then combines with other monomers to form a long chain.
- Examples of synthetic addition polymers include polyethene and polyvinylchloride (PVC).

Formation of polythene from ethene



- Each ethene monomer has a double bond. The unsaturated monomers join together by addition polymerisation to form the polymer ethene.

Uses of polythene:

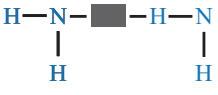
- plastic bags.
- wire insulation.
- plastic bottles.

Condensation polymerisation

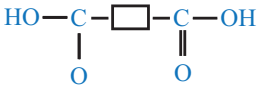
- Condensation polymerisation is the linking together of monomers with the elimination of a small molecule, usually water.
- Each polymer may contain two kinds of monomer molecules.
- Examples of synthetic condensation polymers are nylon and terylene.

Formation of nylon (polyamide)

- The monomers used are dicarboxylic acids and diamines.

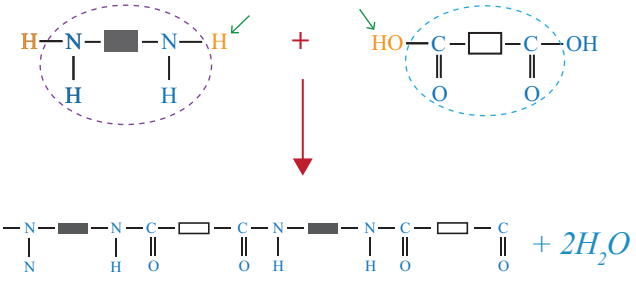


Diamine

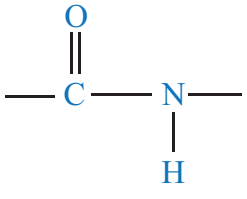


Dicarboxylic acid

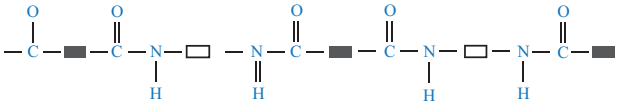
- The monomers are joined together by amide linkages to form a polyamide. A molecule of water is eliminated.



- The linkage between monomers in nylon is called an amide linkage.



- Amide linkage in nylon.
- The structure of nylon is represented as:



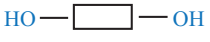
Uses of nylon

- fibres and threads.
- carpets.
- clothing.
- ropes.
- curtains.
- seat belts.

Formation of terylene (polyester)

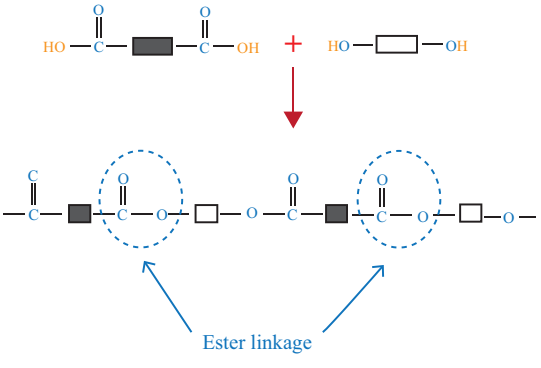
- Terylene is a polyester made by the reaction of a dicarboxylic acid with a diol by condensation polymerisation.

Dicarboxylic acid monomer



Diol monomer

- Water is eliminated as the monomers join to form the polymer.



- The linkage between the monomers in terylene is called an ester linkage.

SPECIMEN EXAMINATION 1

PAPER 1

TIME: 1 hour 45 minutes

Answer **all** questions.
No additional materials required.

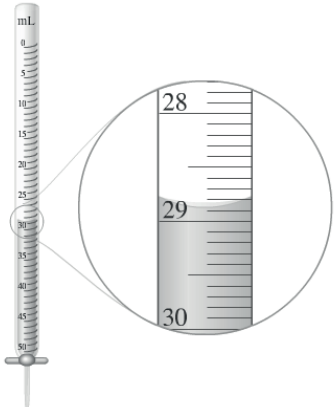
1. Which of the apparatus can be used to measure $25cm^3$ accurately?

A. Pipette
B. Measuring cylinder
C. Gas cylinder
D. Burette

2. An isotope is

A. atoms of the same element with different atomic number but the same number.
B. atoms of the different elements with the same atomic number but different mass number.
C. atoms of the same element with the same atomic number but different mass number.
D. atoms of the same element with different atomic number and mass number.

3. The diagram shows a burette. What is the reading shown?



A. 29*ml* **B.** 29,2*ml* **C.** 29,1*ml* **D.** 29,3*ml*

4. Separation of dyes by thin-layer chromatography depends on

A. different solubility and adsorption.
B. different melting point.
C. different boiling point.
D. different freezing point.

5. The main ingredients of beer are ethanol, water and sugar. How can the three be separated?

A. Evaporation followed by fractional distillation
B. Simple distillation followed by chromatography
C. Filtration followed by evaporation
D. Chromatography followed by filtration

14. Tear gas is used to disperse demonstrators. Its effects are not quickly felt when it is

A. cold **B.** hot **C.** windy **D.** sunny

15. Which of these has the least diffusion rate?

A. NH_3 **B.** H_2 **C.** CI_2 **D.** CO_2

16. Carbon 13 and Carbon 12 are both isotopes. What is common between these two isotopes?

A. Neutron number
B. Nucleon number
C. Electronic configuration
D. Density

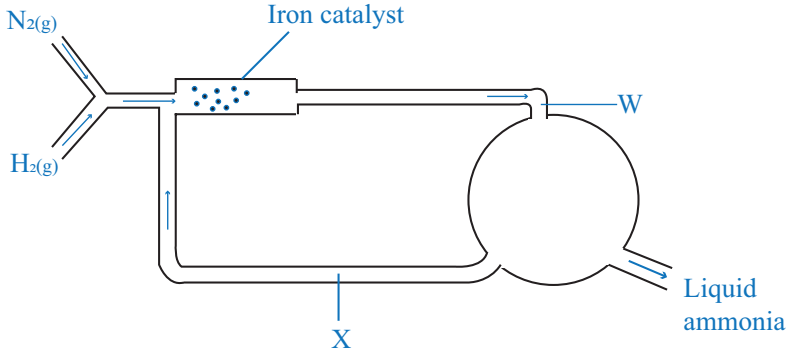
17. Which elements have the same electronic configuration as argon?

A. Period 3 elements
B. Period 3 cations only
C. Period 3 anions
D. Group 1 elements

18. A reversible reaction

A. can come to an end in a closed system.
B. can have 100% yield.
C. cannot come to an end in a closed system.
D. has a forward reaction that occurs first and a backward reaction that occurs afterwards.

19. Below is a simplified flow chart for the production of ammonia.



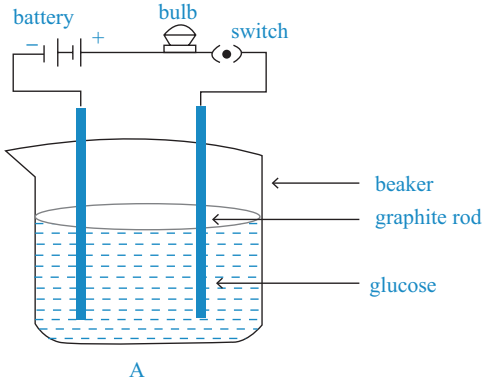
Identify what is at point W and X.

A	W	X
B	NH_3, H_2, N_2	N_2 and H_2
C	NH_3	N_2 and H_2
D	H_2 and N_2	N_2

20. Which step in the manufacture of sulphuric acid involves the use of the Vanadium V oxide as a catalyst?

A. Production of sulphur dioxide
B. Production of sulphur trioxide
C. Production of oleum
D. Reaction of oleum with water

21. A sample of sugar was dissolved in distilled water. A graphite electrode was then dipped into the solution and connected to a battery in series with a bulb.



Explain what will happen.

A. The bulb does not light because of the presence of free ions.
B. The bulb will light because of the presence of mobile ions.
C. The bulb does not light because of the absence of free ions.
D. The bulb lights because of the presence of mobile electrons.

22. The elements have the following electronic configuration

X 2, 1
Y 2, 8

Which statement correctly describes the above elements?

A. X and Y can react to form an ionic compound
B. X and Y can react to form a covalent compound
C. Y is more reactive than X
D. Y is inert

23. Different metal strips were added to cold water. Which strip does not produce bubbles?

A. Mg and Cu
B. Zn and Ca
C. K and Cu
D. Fe and Al

24. An ionic compound has the formula X_3Y_2. In which group does X belong to?

A. Group 3
B. Group 2
C. Group 4
D. Group 5

25. A chemist was given a sample of a substance. He found out that the compound does not conduct electricity in a solid state but conducts in a molten and aqueous state. In addition to that, the substance has a high melting point and boiling point.

What is the bond type exhibited by the substance?

A. Ionic
B. Covalent
C. Metallic
D. Electrovalent

SPECIMEN EXAMINATION 1

PAPER 2

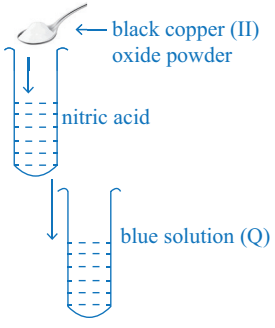
TIME: 2 hours

Answer **all** questions.
No additional materials required.
The number of marks is given in brackets [ ] at the end of each question or part question.

Section A

*Answer **all** the questions.*

1. **(a)** Sasha prepared a blue solution, Q, by adding copper (II) oxide powder to nitric acid as shown in the diagram below.



(i) State **two** observations made by the learner. [2]

(ii) Name **two** chemical substances in the blue solution. [2]

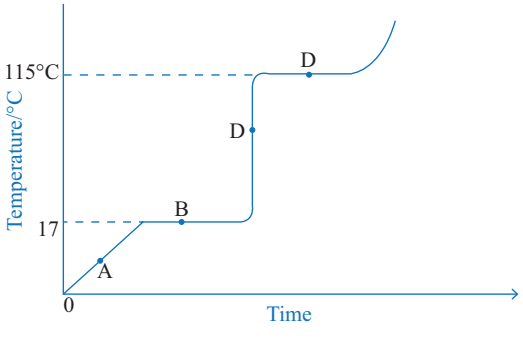
(iii) Write a word equation for the reaction. [1]

(b) Write a balanced chemical equation for the reaction. [1]

(i) Write a balanced chemical equation for the reaction that will occur when zinc granules are added to copper sulphate solution. [1]

(ii) Explain what happens when sodium carbonate is heated strongly. [1]

2. The graph shows the heating curve for a pure substance. The temperature rises with time as the substance is heated.



(a) What physical state(s) is the substance exhibiting at points A, B, C and D? [4]

(b) What is the melting point of the substance? [1]

(c) What is the boiling point? [1]

(d) What happens to the temperature while the substance is changing its state? [1]

(e) How do we know from the graph that the substance is not water? [1]

3. Electrolysis is one of the methods used in the extraction and purification of elements.

(a) Magnesium is manufactured by the electrolysis of molten magnesium chloride. Write equations for the two electrode reactions that occur during electrolysis. [2]

(b) Copper can be purified via the electrolysis of aqueous copper (II) sulphate.

(i) What is used as the anode? [1]

(ii) What is used as the cathode? [1]

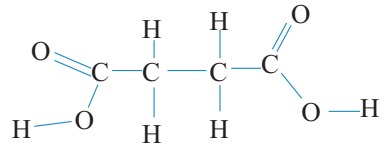
(c) Chlorine can be made by the electrolysis of concentrated aqueous sodium chloride.

$$2NaCl_{(aq)} + 2H_2O_{(l)} \longrightarrow 2NaOH_{(aq)} + Cl_{2(g)} + H_{2(g)}$$

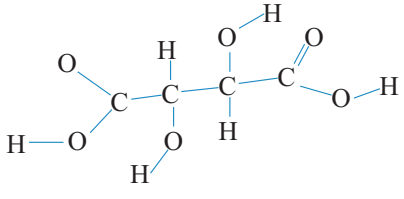
$55dm^3$ of $3{,}5mol/dm^3$ of aqueous sodium chloride is electrolysed.

What is the maximum volume of chlorine that can be formed, measured at rtp? [4]

4. Succinic acid and tartaric acid are colourless organic acids. The structures of these acids are shown below.



Succinic acid



Tartaric acid

(a) Name the group which is present in tartaric acid but not in succinic acid. [1]

(b) Tartaric acid is reduced to succinic acid by acidified aqueous potassium iodide. What colour change is observed in the reaction mixture? [2]

(c) Succinic acid is a weak acid. What is the meaning of the term "weak acid"? [1]

(d) Succinic acid is neutralised by aqueous sodium hydroxide.

$$C_2H_4(COOH)_2 + 2NaOH \longrightarrow C_2H_4(COONa)_2 + 2H_2O$$

Calculate the volume of $0{,}02mol/dm^3$ of sodium hydroxide required to neutralise $25cm^3$ of $0{,}05mol/dm^3$ of succinic acid.

Give your answer to three significant figures. [4]

5. **(a)** How many atoms of the different elements are present in the compounds below?

(i) Methane, CH_4

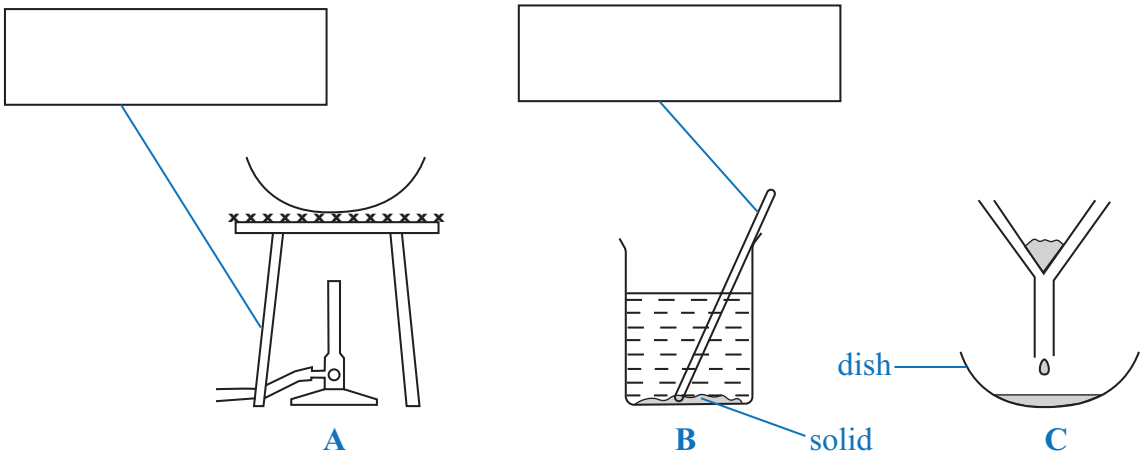
SPECIMEN EXAMINATION 1

PAPER 3

TIME: 3 hours

Answer **all** questions.
No additional materials required.
The number of marks is given in brackets [ ] at the end of each question or part question.

1. The diagram shows the apparatus used by a learner to obtain crystals of calcium chloride from a mixture of solid calcium chloride and solid calcium carbonate. Calcium chloride is soluble in water. Calcium carbonate is insoluble in water.

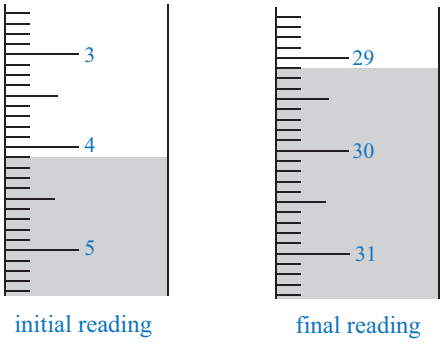


(a) Complete the boxes to name the apparatus. [2]
(b) Write down the order in which the apparatus should be used in this experiment. [1]
(c) Name the separation process in **C**. [1]
(d) What has been added to the mixture in **B**? [1]
(e) What is the general name given to the liquid in the dish in **C**? [1]
(f) How would you know when to stop heating the dish in **A**? [1]
(g) Write a balanced equation to show the behaviour of calcium chloride in water.
Include state symbols in your answer. [2]

2. A learner investigated the reaction between dilute hydrochloric acid and two different aqueous solutions of sodium hydroxide labelled **A** and **B**. The two experiments were carried out.

Experiment 1

A burette was filled with dilute hydrochloric acid. The initial reading of the burette was recorded. Using a measuring cylinder, 20cm^3 of solution **A** was poured into a conical flask. Phenolphthalein indicator was added to the conical flask. The dilute hydrochloric acid was added from the burette while swirling the flask until the solution changed colour. The final burette reading was recorded.



(a) Use the burette diagram to record the readings in the table below.

Final burette reading/cm^3	
Initial burette reading/cm^3	
Difference/cm^3	

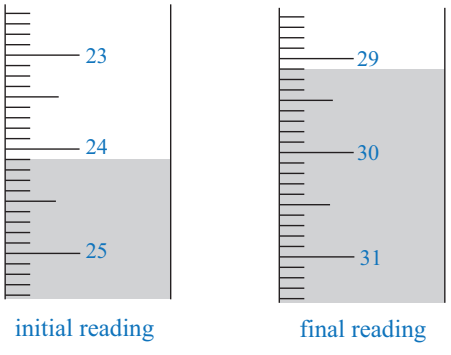
[3]

Experiment 2

The conical flask was emptied and rinsed with distilled water.

Experiment 1 was repeated using solution **B** instead of solution **A.**

(b) Use the burette diagrams to record the readings in the table below.



Final burette rading/cm^3	
Initial burette reading/cm^3	
Difference/cm^3	

[3]

(c) **(i)** What type of chemical reaction occurs when dilute hydrochloric acid reacts with sodium hydroxide solution? [1]

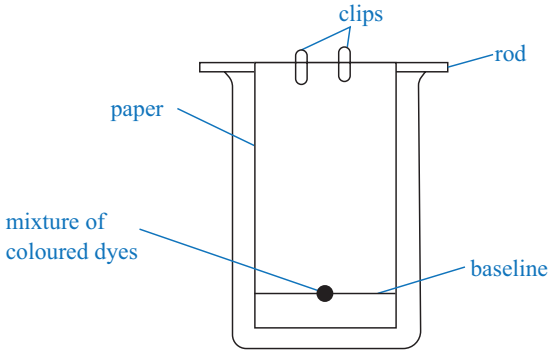
(ii) Write a balanced chemical equation for the reaction taking place. [1]

(d) Which solution of sodium hydroxide, **A** or **B** is more concentrated? Explain your answer. [2]

(e) **Experiment 2** was repeated using 10cm^3 of the solution. What volume of dilute hydrochloric acid is needed? [2]

(f) What is the accurate method of measuring the volume of the aqueous sodium hydroxide solution? [1]

3. A learner used paper chromatography to separate a mixture of coloured dyes.



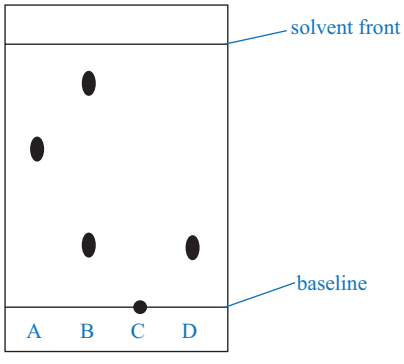
(a) Draw a line on the diagram to show the level of the solvent. [1]

(b) Suggest a suitable solvent for this separation. [1]

(c) What could be used to place the mixture of the coloured dyes onto the paper? [1]

(d) The clips hold the paper in position. Why is this important in the chromatography experiment? [1]

4. The diagram shows the chromatogram obtained from four dyes **A**, **B**, **C** and **D**.



(a) Give **one** conclusion that can be drawn about dye **B**. [1]

(b) Suggest why dye **C** remained on the baseline. [1]

(c) R_f values are used to identify compounds. Calculate the R_f values of dyes **A** and **B**. [3]

5. The table shows tests which were carried out on substance P.

(a) Complete the table. [8]

Test	Observation	Conclusion
P was dissolved in distilled water and the solution was divided into three parts	**(i)**_____	Cu^{2+} ions
To the first part of solution **P**, aqueous sodium hydroxide was added until in excess	**(ii)**_____	**(iii)**_____
To the second part of **P** aqueous ammonia was added until in excess	**(iv)**_____	**(v)**_____

SPECIMEN EXAMINATION 3

PAPER 1

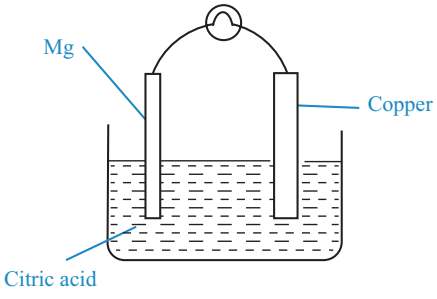
TIME: 1 hour 45 minutes

Answer **all** questions.
No additional materials required.

1. Calculate the oxidation state of carbon in CO_3^{2-}.

A. +2 **B.** +4 **C.** –2 **D.** +6

2. A wet cell was produced by dipping a magnesium metal strip and a copper strip into citric acid as shown by the diagram below.

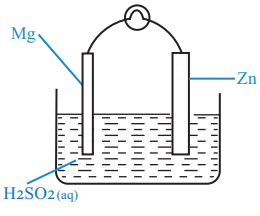


Which statement best describes what happens to the magnesium electrode?

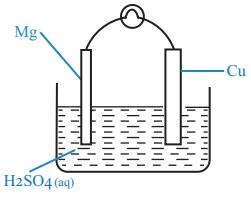
A. The magnesium strip gets bigger
B. The magnesium strip is the cathode electrode
C. The magnesium strip is the anode electrode
D. The magnesium strip undergoes reduction

3. Which cells produces the brightest bulb?

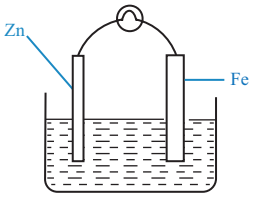
A.



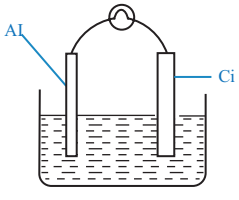
B.



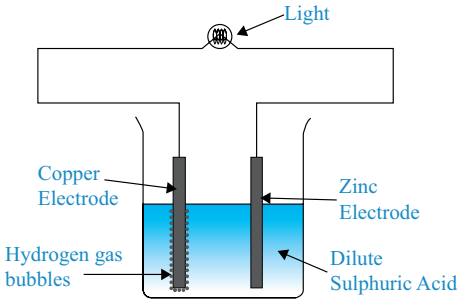
C.



D.



4. A cell is made up of two electrodes, zinc and copper dipped into an electrolyte as shown by the diagram below.



The movement of the electrons will be from

A. copper to zinc through the external wire.
B. zinc to copper through the external wire.
C. zinc to copper through the electrolyte.
D. copper to zinc through the electrolyte.

5. A laboratory technician mixed up metal rods **W**, **X**, **Y** and **Z**, was left with only one labelled electrode which was magnesium. He set up cells to identify electrodes.

Rod 1	**Rod 2**	**Voltmeter reading/*V***
Mg	**W**	2,72
Mg	**X**	0,78
Mg	**Y**	0,00
Mg	**Z**	3,00

The Mg electrode is

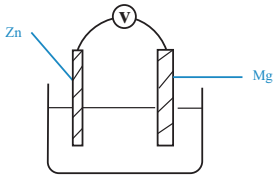
A. **W** **B.** **X** **C.** **Y** **D.** **Z**

6. Monica wants to make a cell with the greatest voltage. What advice would you give her?

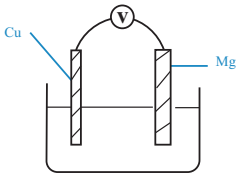
A. She should use a very dilute electrolyte
B. She should use electrodes further away from each other in the reactivity series
C. She should use electrodes closer to each other in the reactivity series
D. She should decrease the temperature of the electrolyte

7. Which of the following cells has the least voltage?

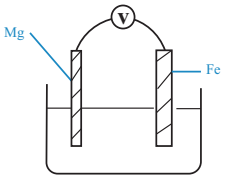
A.



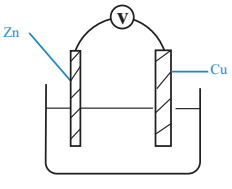
B.



C.



D.



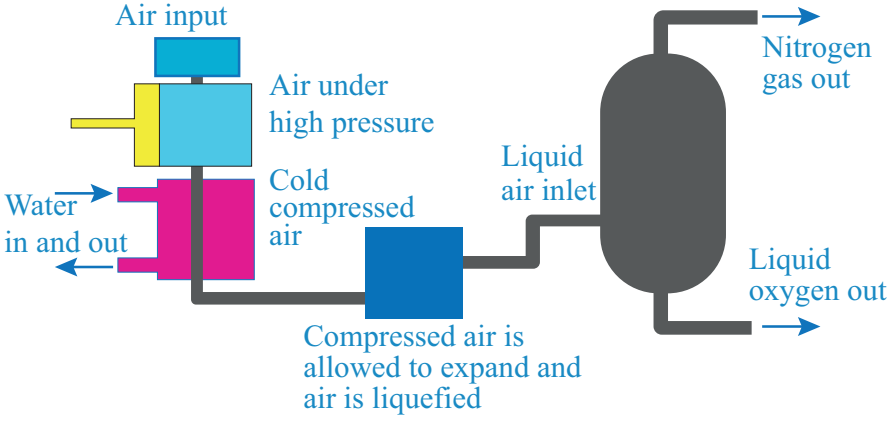
8. The table below shows the results when rods of three metals, **W**, **X**, **Y** and **Z** are used in separate experiments. *Note: All metals are more reactive than iron.*

Rod 1	**Rod 2**	**Voltmeter reading/*V***
Iron	**W**	2,72
Iron	**X**	0,78
Iron	**Y**	1,10
Iron	**Z**	3,00

Which is the correct order of reactivity of metals **W**, **X**, **Y** and **Z** starting with the least reactive?

A. **X**, **Y**, **W**, **Z**
B. **Z**, **W**, **Y**, **X**
C. **W**, **Y**, **X**, **Z**
D. **W**, **X**, **Y**, **Z**

9. The diagram shows fractional distillation of liquid air.



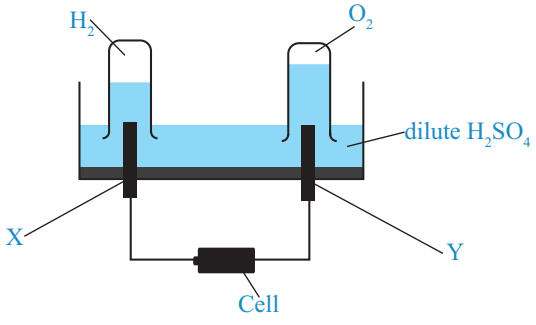
Nitrogen is obtained at the top of the fractionating column while oxygen is obtained at the bottom because

A. oxygen is more flammable than nitrogen.
B. nitrogen is less flammable than oxygen.
C. nitrogen has a lower boiling point than oxygen.
D. oxygen has a lower boiling point than nitrogen.

15. _____ is the material that is used during electrolysis of acidified water.

A. Graphite
B. Diamond
C. Copper
D. Zinc

The diagram shows the electrolysis of acidified water. Use it to answer questions **16** and **17**.



16. The anode is

A. X.
B. Y.
C. the negative terminal.
D. the positive terminal.

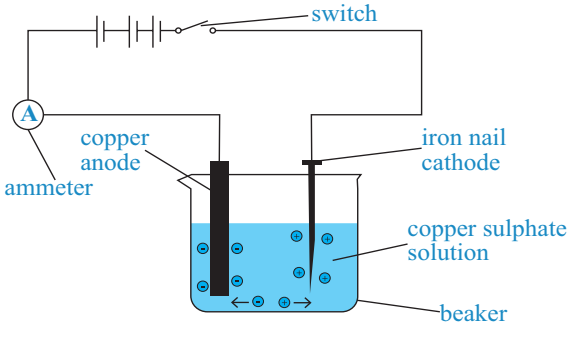
17. Which one is the cathode?

A. X
B. Y
C. Oxygen chamber
D. Hydrogen chamber

18. Which of these is the least reactive?

A. Magnesium **B.** Copper **C.** Zinc **D.** Iron

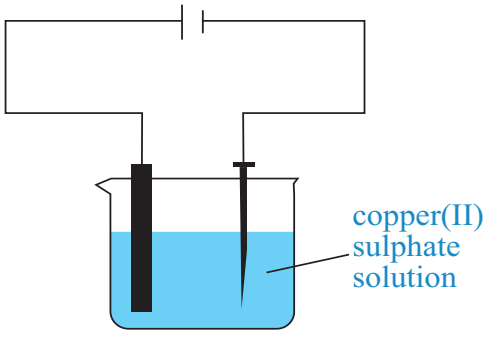
19. An iron nail was electroplated with copper. Dilute copper (II) sulphate solution was used as an electrolyte as shown in the diagram below.



Describe what happens to the mass of the nail.

A. The mass increases.
B. The mass decreases.
C. The mass stays the same.
D. Mass neither decreases nor increases.

20. An iron nail was electroplated with copper, and dilute copper (II) sulphate solution was used as an electrolyte as shown.



Describe what happens to the concentration of the copper (II) sulphate solution.

A. The concentration of copper (II) sulphate solution increase.
B. The concentration of copper(II) sulphate solution decrease.
C. The concentration of copper(II) sulphate solution remains constant.
D. The concentration of copper (II) sulphate decrease and increase.

21. Which statement correctly describes what happens during electropurification of copper?

A. The anode is pure copper that dissolves
B. The cathode is an impure copper that dissolves
C. The cathode is pure copper that dissolves
D. The anode is an impure copper that dissolves

22. Which of the following describes what happens during electropurification of copper?

	Mass of anode/*g*	**Mass of cathode/*g***	**Concentration of electrolyte**
A.	Decrease	Decrease	Remains constant
B.	Decrease	Increase	Remains constant
C.	Increase	Decrease	Decrease
D.	Decrease	Increase	Increase

23. Which half equation occurs at the cathode during the electroplating of an iron nail with copper?

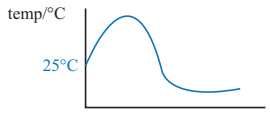
A. $Cu \longrightarrow Cu^{2+} + 2e$
B. $Cu^{2+} + 2e \longrightarrow Cu$
C. $Fe \longrightarrow Fe^{2+} + 2e$
D. $Fe^{2+} + 2e \longrightarrow Fe$

24. During electrolysis of acidified water, the volume of hydrogen was found to be $60cm^3$. What is the volume of oxygen?

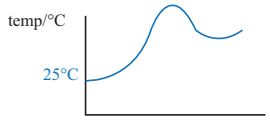
A. $60cm^3$
B. $30cm^3$
C. $120cm^3$
D. $20cm^3$

25. Which is the correct energy diagram for an exothermic reaction?

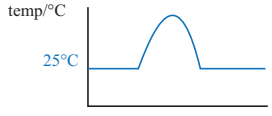
A.



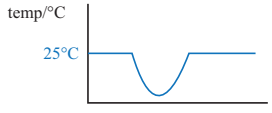
B.



C.



D.



26. Which of the equations represents an endothermic reaction?

A. $O_{2\,(g)} \longrightarrow 2O_{(g)}$

B. $CI_{(g)} + CI_{(g)} \longrightarrow CI_{2(g)}$

C. $H_2O_{(g)} \longrightarrow H_2O_{(l)}$

D. $NaOH + HCI \longrightarrow NaCI + H_2O$

27. Which statement correctly describes an exothermic reaction?

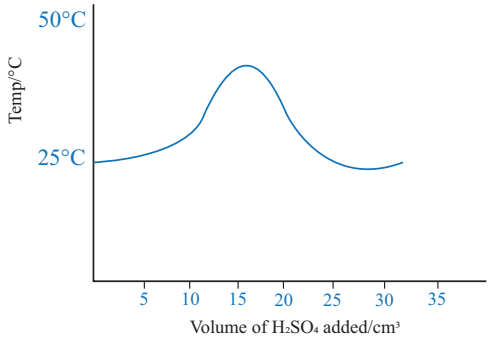
A. Bonds are formed during the reaction

B. The temperature decreases during the reaction

C. The temperature increases during the reaction

D. The temperature increase and comes back to room temperature after the reaction

28. Sulphuric acid was added to 5*g* of magnesium. The temperature was recorded after the addition of 2cm^3 of sulphuric acid. A graph of temperature against volume was drawn.



Deduce the volume of the acid that completely reacts with the magnesium.

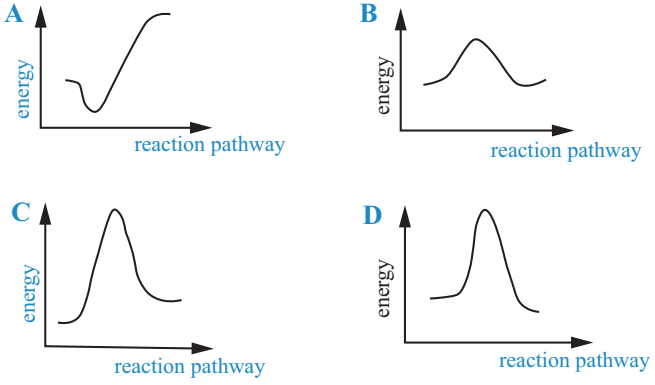
A. 1cm^3

B. 10cm^3

C. 25cm^3

D. 50cm^3

29. Which is the correct energy profile diagram for the thermal decomposition of calcium (II) carbonate?



30. $20cm^3$ of 2M H_2S0_4 was added to 0,5M NaOH and the temperature rose by 5°C.

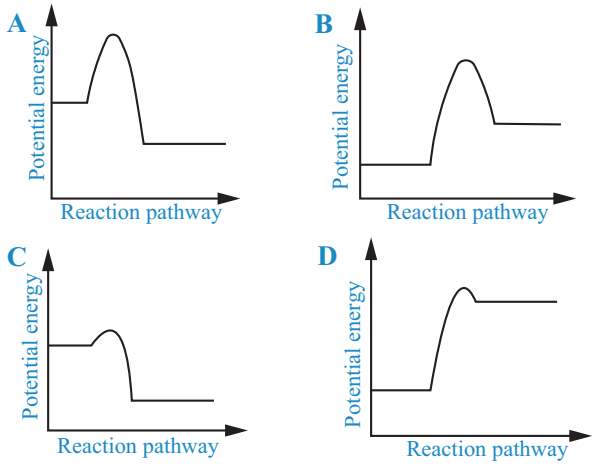
The equation for the reaction is shown below.

$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$ $\quad Q = 4,12$

How much heat was evolved during the reaction?

A. $67J$
B. $100J$
C. $150J$
D. $750J$

31. Which graph shows the exothermic reaction that is likely to take place at room temperature?



32. Which statement correctly describes the energy profile diagram of an exothermic reaction?

A. The temperature increases
B. Bonds are broken
C. The temperature decreases
D. The energy content of the products is less than that of the reactant

SPECIMEN EXAMINATION 3

PAPER 2

TIME: 2 hours

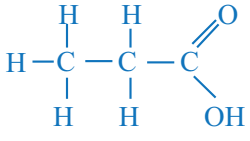
Answer **all** questions.
No additional materials required.
The number of marks is given in brackets [ ] at the end of each question or part question.

Section A

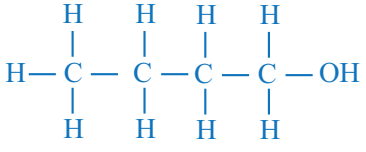
*Answer **all** the questions.*

1. Each compound can be used once, more than once or not at all.

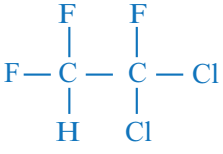
A



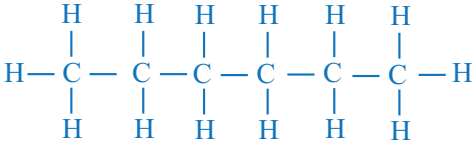
B



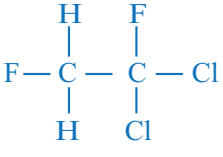
C



D



E



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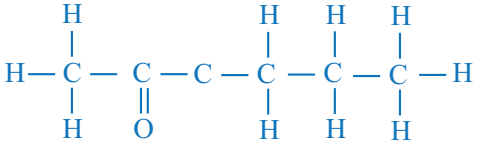

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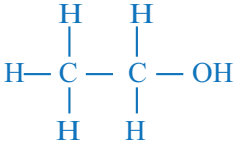
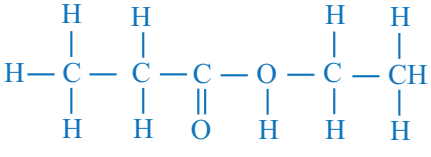


H



Give the letter of the compound(s) which:

(a) **(i)** is a CFC. [1]

(ii) is propanoic acid. [1]

(iii) is propyl ethanoate. [1]

(iv) can be oxidised to ethanoic acid. [1]

(b) react together to make an ester. [2]

(c) is ethanol. [1]

(d) is part of the alkane homologous series. [1]

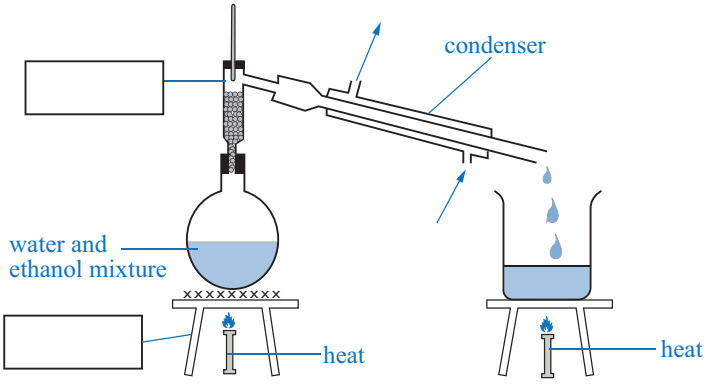
SPECIMEN EXAMINATION 3

PAPER 3

TIME: 3 hours

Answer **all** questions.
No additional materials required.
The number of marks is given in brackets [ ] at the end of each question or part question.

1. The diagram shows the apparatus used to separate a mixture of water, with a boiling point of 100°C and ethanol with a boiling point of 78°C.



(a) Complete the boxes to name the apparatus. [2]

(b) Label the arrows on the condenser. [2]

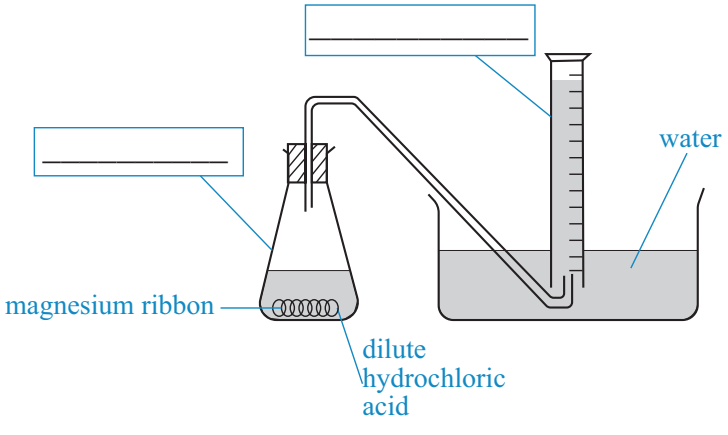
(c) Identify **one** error in the apparatus. [1]

(d) Which liquid will collect first? Explain your answer. [2]

(e) What name is given to the liquid that is collected in the beaker? [1]

(f) Why would it be better to use an electrical heater instead of a bunsen burner to heat the water and ethanol mixture? [2]

2. A learner investigated the rate of reaction between an excess of dilute hydrochloric acid and magnesium ribbon. Two experiments were carried out. The temperature was the same in both experiments.



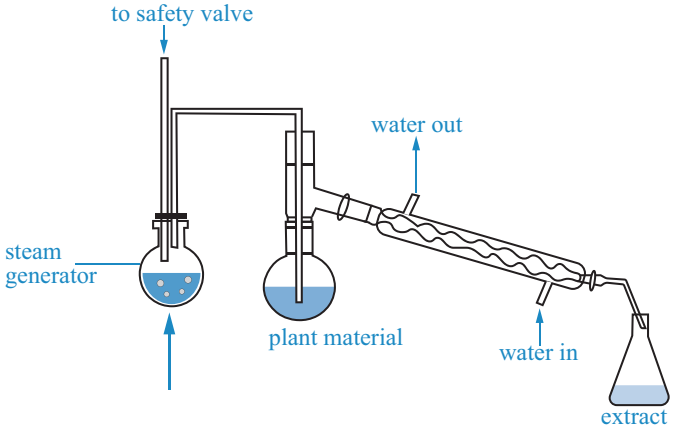
SPECIMEN EXAMINATION 8

PAPER 1

TIME: 1 hour 45 minutes

Answer **all** questions.
No additional materials required.

1. State the name of separation technique shown.



A. Steam distillation. **B.** Fractional distillation.
C. Distillation. **D.** Crystallisation.

2. Which change of state is an exothermic reaction?

A. Sublimation **B.** Freezing **C.** Evaporation **D.** Boiling

3. The isotopes of carbon are ^{12}C ,^{13}C and ^{14}C.

Which statement is not correct about these isotopes?

A. They have the same proton number **B.** They have the same number of electrons
C. They have same number of shells **D.** They have the same neutron number

4. Which compound is formed by both ionic and covalent bonds?

A. Mg_3N_2 **B.** NH_3 **C.** CO_2 **D.** $CaCO_3$

5. A hydrocarbon C_xH_y burns in air to form carbon dioxide and water.

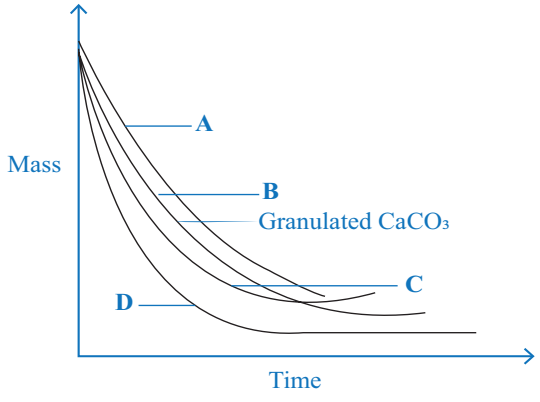
$C_xH_y + zO_2 \longrightarrow 3CO_2 + 4H_2O$

The value of *x, y* and *z* is

	x	*y*	*z*
A.	3	4	5
B.	1	8	3
C.	3	8	5
D.	1	4	6

15. A learner carried out an experiment of the reaction calcium carbonate with hydrochloric acid. Two experiments were done. The first experiment was done with 50*g* of granulated $CaCO_3$ and an excess of 0,5M HCI. The second experiment was done with 50*g* of powdered $CaCO_3$ and an excess of 0,5M HCI.

Which is the correct graph of the change of mass of calcium carbonate with time?

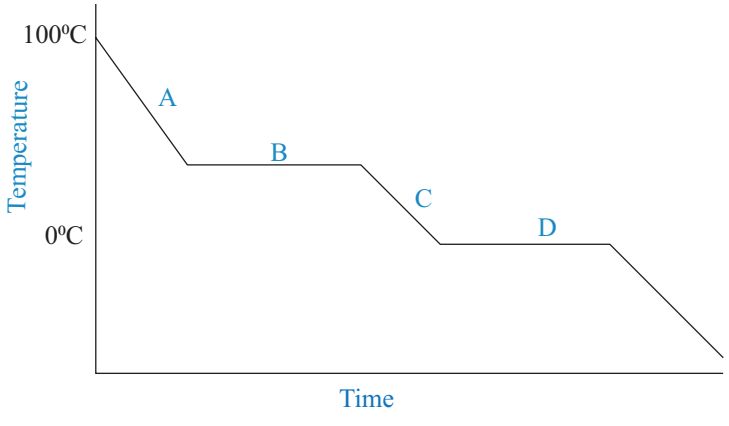


16. Aqueous sodium hydroxide was added in excess to a sample. A red brown precipitate was formed which was filtered off. Dilute nitric acid was added to the filtrate followed by aqueous silver nitrate. A white precipitate was observed. Which compound is in the sample?

A. $FeCI_2$ **B.** $FeCI_3$ **C.** $ZnSO_4$ **D.** $CuSO_4$

17. The diagram shows the cooling curve for water vapour.

Which segment represents condensation?



18. Eutrophication is one of the environmental problems caused by _____ ion.

A. NH_4^+ **B.** Ca^{2+} **C.** NO^{3-} **D.** Pb^{2+}

19. Which equation does not give the following ionic equation.

$H^+ + OH^- \longrightarrow H_2O$

A. $Ca(OH)_{2\,(aq)} + H_2SO_{4(aq)} \longrightarrow CaSO_{4(aq)} + 2H_2O_{(l)}$

B. $Zn_{(s)} + 2HCI_{(aq)} \longrightarrow ZnCI_{2(aq)} + H_{2(g)}$

C. $CuO_{(s)} + H_{2(g)} \longrightarrow Cu_{(s)} + H_2O_{(l)}$

D. $HNO_{3\,(aq)} + NaO_{2\,(aq)} \longrightarrow NaNO_{3(s)} + H_2O_{(l)}$

20. Mr Moyo uses hard water for cooking and washing. What is the effect of hard water?

A. It increase the solubility of soap
B. It decreases the solubility of soap
C. It has no effect on solubility of soap
D. The water causes itchness

21. Which is the correct the trend down of physical properties of group 7 elements?

	Colour	Melting point	Volatility
A.	Darker	Increase	Increases
B.	Lighter	Decreases	Decreases
C.	Darker	Increases	Decreases
D.	Lighter	Increases	Decreases

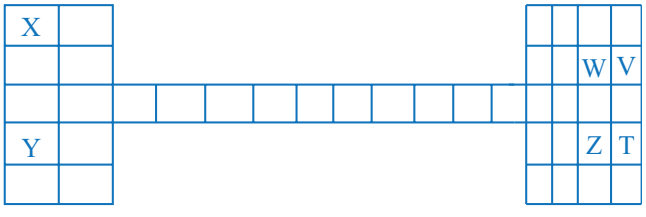
22. Why does the speed of fermentation decrease at 37°C?

A. It is because glucose decomposes to produce carbon dioxide and water
B. It is because ethanol produced has evaporated
C. It is because yeast molecules have the most kinetic energy
D. It is because yeast has been denatured

23. Calcium oxide

A. neutralises alkaline soil.
B. decreases soil acidity.
C. increases soil acidity.
D. decreases soil alkalinity.

24. The diagram shows a periodic table.



Which elements are the most vigorous?

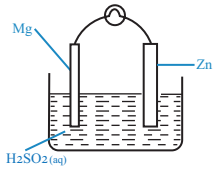
A. **Y** and **Z** **B.** **X** and **Z** **C.** **Y** and **T** **D.** **Y** and **W**

25. A learner added salt to ice. What is the effect of salt on ice?

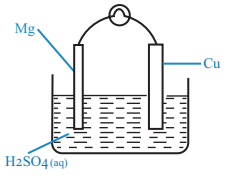
A. The melting point decreases
B. The melting point increases
C. The melting point remains constant
D. The water becomes tasteless

26. Which cell has the brightest bulb?

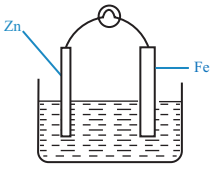
A.



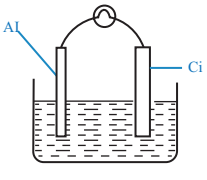
B.



C.



D.



33. Gas **X** has the following properties.

1. Colourless.

2. No effect on either damp red or blue litmus papers.

3. No effect on lime water.

4. Flammable.

What is gas **X**?

A. Ammonia **B.** Chlorine **C.** Hydrogen **D.** Oxygen

34. **J** is an aqueous solution. The addition of aqueous sodium hydroxide to **J** results in a green precipitate being formed. The resulting mixture is heated and no gas is formed.

Aluminium foil is added to the warmed mixture. A gas is formed that turns damp red litmus paper blue.

Which ions could be present in **J**?

A. Fe^{3+} and NH_4^+ **B.** Fe^{3+} and NO_3^- **C.** Fe^{2+} and NH_4^+ **D.** Fe^{2+} and NO_3^-

35. A chemist wants to make calcium nitrate. They start with 8*g* of pure calcium oxide and an excess of dilute nitric acid. They produce 12,65*g* of pure, dry anhydrous calcium nitrate crystals.

What is the percentage yield of calcium nitrate?

[relative atomic masses, Ar: Ca, 40; N, 14; H, 1; O, 16]

A. 54,0 **B.** 63,2 **C.** 67,1 **D.** 86,8

36. An aqueous mixture of copper(II) nitrate and silver nitrate is electrolysed with pure copper electrodes. Which half equation correctly describes the change occurring at the anode?

A. $Cu \longrightarrow Cu^{2+} + 2e^-$ **B.** $Cu2^+ + 2e^- \longrightarrow Cu$

C. $Ag \longrightarrow Ag^+ + e^-$ **D.** $Ag^+ + e^- \longrightarrow Ag$

37. In which equations is the change in the underlined species correct?

1. $\underline{C}H_4 + 2O_2 \rightarrow \underline{C}O_2 + 2H_2O$ (Oxidation)

2. $2H_2\underline{S} + SO_2 \rightarrow 3\underline{S} + 2H_2O$ (Reduction)

3. $BrO_3^- + 5\underline{Br}^- + 6H^+ \rightarrow 3\underline{Br}_2 + 2H_2O$ (Reduction)

A. 1 only
B. 2 only
C. 1 and 3
D. 2 and 3

38. Magnesium reacts with dilute sulphuric acid.

$$Mg_{(s)} + H_2SO_{4(aq)} \longrightarrow MgSO_{4(aq)} + H_{2(g)}$$

Two experiments are carried out at 25°C.

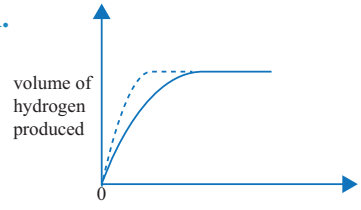
Experiment 1: 24*g* of powdered magnesium is reacted with 100cm^3 of 1mol/dm^3 sulphuric acid.

Experiment 2: 24*g* of powdered magnesium is reacted with 50cm^3 of 2mol/dm^3 sulphuric acid.

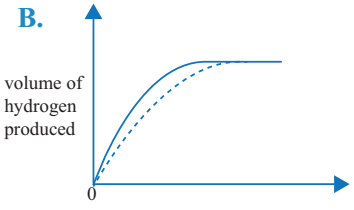
During each experiment the volume of hydrogen produced is measured. The results are plotted on a graph.

Which graph is correct?

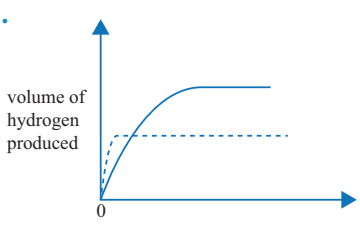
A.



B.



C.



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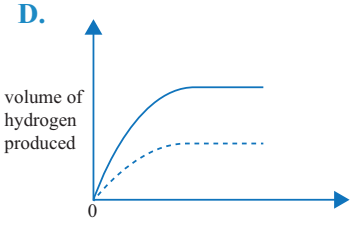
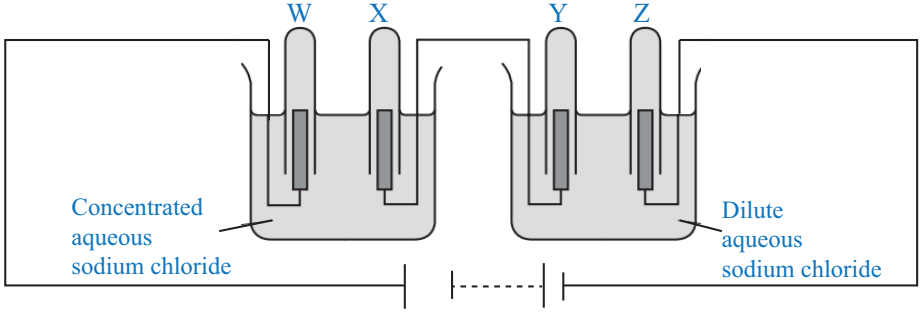


39. The diagram shows the electrolysis of concentrated and dilute aqueous sodium chloride using inert electrodes. Gases are produced and collected in each of the test-tubes **W**, **X**, **Y** and **Z**.



Which statements are correct?

1. Approximately equal volumes of gas are produced and collected in test tubes **W** and **X**.
2. Approximately equal volumes of gas are produced and collected in test tubes **Y** and **Z**.
3. Three different gases are produced in the experiment.

A. 1, 2 and 3. **B.** 1 and 2 only. **C.** 2 and 3 only. **D.** 1 and 3 only.

40. Attaching pieces of magnesium to underground iron pipes can protect the iron from corrosion.

Which reaction protects the iron from corrosion?

A. $Fe^{2+}_{(aq)} + 2e^- \longrightarrow Fe(s)$

B. $Fe(s) \longrightarrow Fe^{2+}_{(aq)} + 2e^-$

C. $Mg^{2+}_{(aq)} + 2e^- \longrightarrow Mg_{(s)}$

D. $Mg(s) \longrightarrow Mg^{2+}_{(aq)} + 2e^-$

SPECIMEN EXAMINATION 9

PAPER 2

TIME: 2 hours

Answer **all** questions.
No additional materials required.
The number of marks is given in brackets [ ] at the end of each question or part question.

Section A

*Answer **all** the questions.*

1. Choose from the following elements to answer the following questions.

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

calcium	*chlorine*	*chromium*	*copper*	*krypton*
nitrogen	*oxygen*	*sodium*	*sulphur*	

(a) Which element:

(i) is a monatomic gas, [1]

(ii) makes up 78% of dry air, [1]

(iii) has an oxide which reacts with the impurities in a blast furnace to form slag, [1]

(iv) forms aqueous ions with a 2+ charge which gives a dark blue solution on addition of excess aqueous ammonia? [1]

(b) Complete the table to show the number of electrons and neutrons in the sulphur atom and in the magnesium ion.

	Number of electrons	Number of neutrons
^{33}S		
$^{25}Mg^{2+}$		

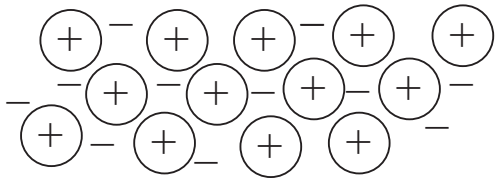
[4]

2. **(a)** Describe the uses of herbs. [4]

(b) Discuss the advantages of using herbs. [2]

(c) List **two** sources of pollutants. [2]

3. The diagram shows the structure of a metal.



key

⊕ metal ion

– electron

(a) Refer to this structure to explain why:

(i) metals are malleable. [2]

(ii) metals conduct electricity. [1]

SPECIMEN EXAMINATION 9

PAPER 3

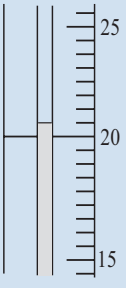
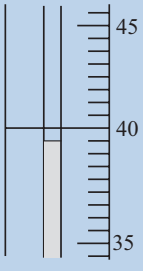
TIME: 3 hours

Answer **all** questions.
No additional materials required.
The number of marks is given in brackets [ ] at the end of each question or part question.

*Answer **all** questions.*

1. The reaction between magnesium and aqueous copper (II) sulphate was investigated. A $5cm^3$ sample of aqueous copper (II) sulphate was measured into a test tube. The initial temperature of the solution was measured. Magnesium powder was then added to the test tube and the maximum temperature reached was measured.

(a) Use the thermometer diagrams to complete the results table. [2]

Initial temperature of aqueous copper (II) sulphate		
Maximum temperature reached after magnesium added		

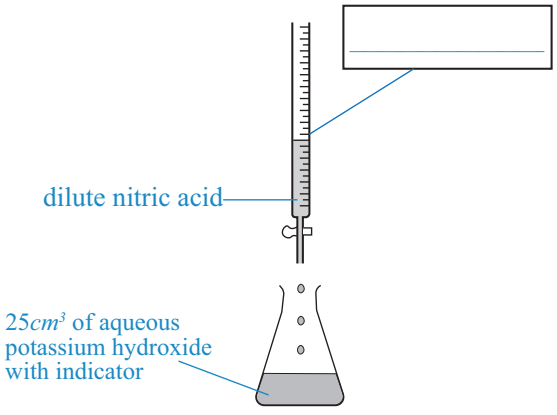
(b) State **two** uses of a thermometer in this experiment. [2]

(c) How do the observations show that the reaction between magnesium and aqueous copper (II) sulphate is exothermic? [2]

(d) What type of exothermic reaction occurs when magnesium is added to aqueous copper (II) sulphate? [2]

(e) Write a balanced chemical equation for the reaction that takes place between magnesium and aqueous copper (II) sulphate. [2]

2. The volume of dilute nitric acid that reacts with $25cm^3$ of aqueous potassium hydroxide can be found by titration using the apparatus shown.



(a) Name the apparatus. [1]

(b) Name a suitable indicator that could be used. [1]

A learner did the titration 4 times and recorded the following results.

Titration number	1	2	3	4
Volume of dilute nitric acid/cm^3	18,1	18,9	18,3	18,2

(c) **(i)** Which one of the results has an error? [1]

(ii) Suggest a possible cause of this error. [1]

(iii) Use the other results to calculate the average volume of dilute nitric acid that reacted with the aqueous potassium hydroxide. [2]

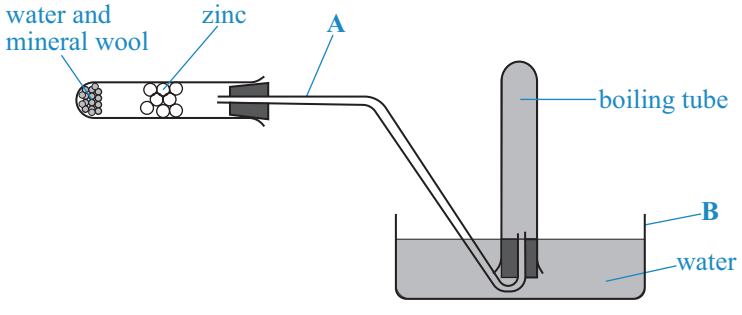
(d) Write a balanced equation for the reaction taking place. [2]

(e) What type of reaction is taking place? [1]

(f) The learner concluded that the aqueous potassium hydroxide was more concentrated than the dilute nitric acid. Explain whether or not the learner's conclusion was correct. [2]

3. Hot zinc reacts with steam to make zinc oxide and hydrogen gas.

A learner wanted to use the apparatus shown to react zinc with steam and collect the hydrogen.



(a) Name the apparatus labelled **A** and **B**. [2]

(b) State the purpose of the mineral wool. [1]

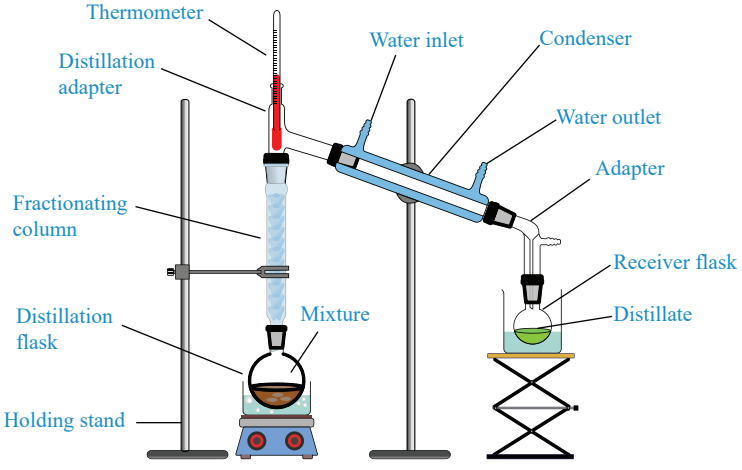
SPECIMEN EXAMINATION 10

PAPER 1

TIME: 1 hour 45 minutes

Answer **all** questions.
No additional materials required.

1. Fractional distillation apparatus are arranged as follows.



The use of the thermometer is

A. to increase the boiling point.
B. to reduce the boiling point.
C. to give the temperature reading of the boiling liquid.
D. to mix the two liquids sufficiently.

2. Which apparatus cannot be used to measure volume?

A. Gas syringe **B.** Burrette **C.** Pipette **D.** Beaker

3. During which process does temperature increase?

A. Boiling
B. Condensation
C. Exothermic reaction
D. Melting

4. Which is the correct statement about the electronic configuration of elements in the same period?

A. It shows the same total number of electrons
B. The number of electrons in the outer shell is the same
C. The total number of electrons in the inner shells is the same
D. It requires the same number of electrons to have the noble gas configuration

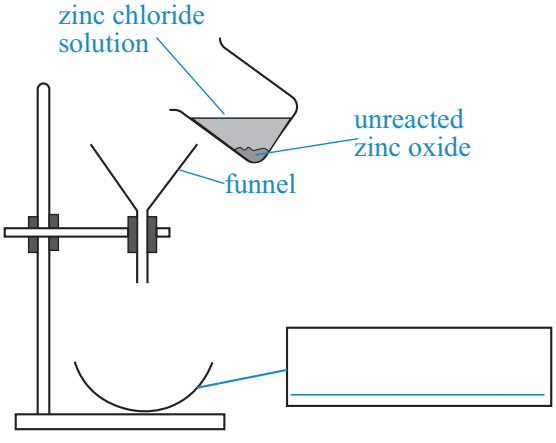
SPECIMEN EXAMINATION 10

PAPER 3

TIME: 3 hours

Answer **all** questions.
No additional materials required.
The number of marks is given in brackets [ ] at the end of each question or part question.

1. Dilute hydrochloric acid was reacted with zinc oxide to prepare a zinc chloride solution. The diagram shows the apparatus used.



(a) Name the apparatus. [1]

(b) Which of the reactants was in excess? [1]

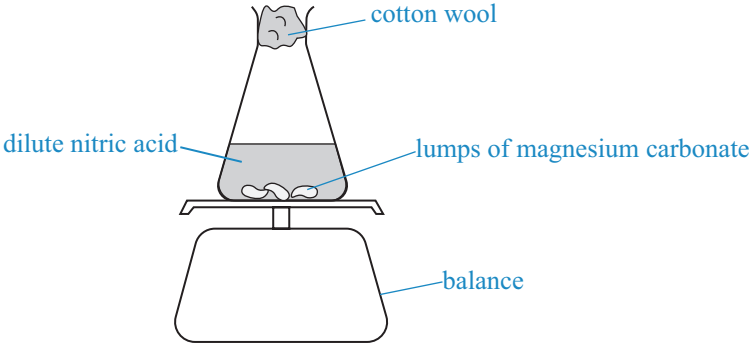
(c) Name the separation process carried out using this apparatus. [1]

(d) Suggest why this apparatus is not suitable for this experiment. [1]

(e) Describe how crystals of zinc chloride could be obtained from the zinc chloride solution. [3]

(f) Write a balanced chemical equation for the reaction taking place. [2]

2. A learner investigated the rate of reaction between dilute nitric acid and lumps of magnesium carbonate. The apparatus shown was used.



PAPER 2 ANSWERS

EXAMINATION 1 PAPER 2

Section A

1. **(a) (i)** colour change of solution in beaker from colourless to blue

(ii) copper ions/ nitrate ions/ copper nitrate solution/ water

(iii) Copper oxide + nitric acid → copper nitrate + water

(iv) $CuO_{(s)} + 2HNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + H_2O_{(l)}$

(b) (i) $Zn_{(s)} + CuSO_{4\,(aq)} \rightarrow ZnSO_{4\,(aq)} + Cu_{(s)}$

(ii) it decomposes to form sodium oxide and carbon dioxide gas is evolved

2. **(a)** A. solid/ B. solid and liquid/ C. liquid/ D. liquid and gas

(b) 17˚C

(c) 115˚C

(d) The temperature remains constant/ does not change

(e) The melting point of the substance is higher than 0˚C, which is the typical water melting point/ same point referring to its boiling point

3. **(a)** **Cathode**: $Mg^{2+}_{(l)} + 2e^- \rightarrow Mg_{(l)}$

Anode: $2Cl^-_{(l)} \rightarrow Cl_{2\,(l)} + 2e^-$

(b) (i) Impure copper electrode

(ii) Pure copper electrode

(c) $n = C \times V$

$n = 3{,}5\ mol/dm^3 \times 55\ dm^3$

$n = 192{,}5$ moles

Comparing stoichiometric ratios:

$NaCl: Cl_2$

2: 1

192,5 moles: x

$n(Cl_2) = 96{,}25$ moles

At rtp, 1 mole of a substance occupies a volume of $24dm^3$

Therefore 96,25 moles Cl_2 occupies

$96{,}25 \text{ moles} \times 24dm^3$

Volume of Cl_2 produced = 2 310 dm^3

2 rtp, 1 mole of a substance occupies a volume of $24dm^3$

Therefore 96,25 moles Cl_2 occupies

$96{,}25 \text{ moles} \times 24dm^3$

Volume of Cl_2 produced = 2 310 dm^3

4. **(a)** alcohol/ hydroxyl group

(b) colourless to brown

(c) acid which is only partially ionised (in water) to form H^+ ions / acid which is partially dissociated in water to form H^+ ions

(d) moles succinic acid = $\mathbf{C} \times \mathbf{V}$

$= (25 \div 1000) \times 0{,}05\ mol/dm^3$

$= 1{,}25 \times 10^{-3}$ moles

moles sodium hydroxide = n (succinic acid × 2)

$= 1{,}25 \times 10^{-3} \times 2$ moles

$= 2{,}50 \times 10^{-3}$ moles

Volume of NaOH = (n ÷ C)

$= 0{,}0025 \div 0{,}002$

$= 0{,}125dm^3$

$= 125cm^3$

5. **(a) (i)** 2

(ii) 3

(iii) 3

(iv) 3

(v) 4

(b) (i) $Fe_{(s)} + Cl_{2(g)} \rightarrow FeCl_{2(s)}$

(ii) $2\,Li_{(s)} + O_2(g) \rightarrow Li_2O_{(s)}$

(iii) $2\,Mg_{(s)} + CO_{2(g)} \rightarrow 2\,MgO(s) + C_{(s)}$

Filtration

– Remaining solids following coagulation and sedimentation are removed in the filtration tank. The water is passed through beds of sand and gravel.

Chlorination

– The water is disinfected to eliminate pathogenic micro-organisms by addition of chlorine, in the form of a liquid (such as sodium hypochlorite, NaOCl) or a gas.
– When chlorine is added to water it reacts with any pollutants present, including micro-organisms.

Supplementary treatment

– May include addition of fluorine to water.

(b) Aluminium sulphate

– Causes microscopic impurities to clump together into larger and larger particles. These clumps settle at the bottom of the container and can be filtered out. This makes the water safer to drink.

Chlorine

– Kills parasites, bacteria, and viruses.

EXAMINATION 5 PAPER 3

1. **(a)** Gas syringe

(b) **(i)** Volume of gas

(ii) The reaction is complete and calcium carbonate has been used up.

(c) $2HNO_3 + CaCO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O$

(d) The sketch should be less steep at the beginning.

(e) Bubble the gas in limewater. Limewater turns milky in the presence of carbon dioxide.

2. **(a)** Clamp/ retort stand; trough

(b) To hold the paraffin oil

(c) Bubble alkene in aqueous bromine. Aqueous bromine is decolourised in the presence of aqueous bromine.

(d) To prevent water flowing into the deliver tube/test tube

3. **(a)** Pipette, burette

(b) Methyl orange or phenolphthalein

(c) Methyl orange: Yellow to orange or pink or red.; Phenolphthalein: Pink to colourless

(d) Initial burette reading; final burette reading

(e) Distilled water will dilute the contents in the conical flask and affect volume used in titration.

(f) **(i)** $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

(ii) Neutralisation reaction

(g) Using a burette or pipette to measure the volume of sodium hydroxide
Repeating the experiment several times

4. **(a)** **(i)** Blue precipitate, insoluble in excess

(ii) Blue precipitate, soluble in excess to give a dark blue solution

(iii) Cu^{2+} present

(iv) Cl^- present

(b) $CuCl_2$ (copper (II) chloride)

EXAMINATION 6 PAPER 2

1. **(a)** **(i)** E

(ii) A

(iii) C

(iv) B

(v) A

(vi)

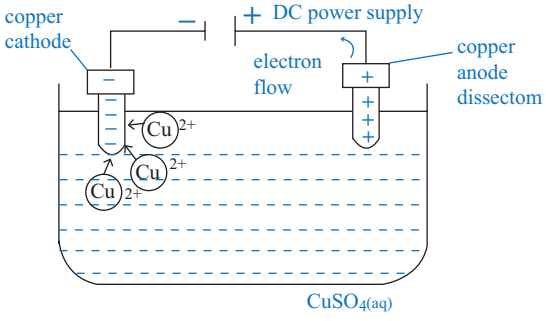
(b) **(i)** Atoms of the same element that have different number of neutrons but same proton number

(ii) 44

2. (a) (i) Mg lost electrons (oxidation) and assumed a +2 Charge while Cu^{2+} gained electrons (reduction) and became neutral

(ii) $Mg + Cu^{2+} \longrightarrow Mg^{2+} + Cu$

(b)



- Arrangement with two electrodes dipping in liquid and connected correctly to power supply with two wires
- Pure copper is negative electrode and impure copper is positive electrode
- Electrolyte is labelled copper ions/ electrolyte

(c) (light/ pale) blue precipitate at first (dark/ deep) blue solution in excess ammonia.

3. (a) Presence of the double bond

(b) Purple to colourless

(c) (i) $C_2H_2(COOH)_2 + 2NaOH \longrightarrow C_2H_2(COONa)_2 + 2H_2O$

(ii) $C_2H_2(COOH)_2 : NaOH$

$1 : 2$

$20cm^3 : ?$

$n(\text{fumaric acid}) = \frac{20}{1\,000} \times 0{,}02$

$= 0.0004$

$n(NaOH) = 0{,}0004 \times 2$

$= 0{,}0008$

$V(NaOH) = \frac{n}{c}$

$= \frac{0{,}0008}{0{,}05}$

$= 0{,}016dm^3$

$= 16cm^3$

4. (a) Any two from:

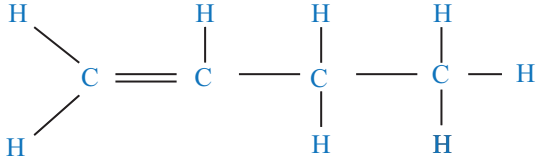
- same functional group
- same general formula
- similar chemical properties
- trend in physical properties
- successive members differ by CH_2

(b) $C_4H_8 + 6O_2 \longrightarrow 4CO_2 + 4H_2O$

Correct reactants and products

Equation balanced

(c)



(d) (i) Butane

(ii) catalyst/ to speed up the reaction

(iii) heat/ high temperature (200˚C)

5. (a) Any two from:

- number of protons/ number of electrons
- number of electrons in outer shell
- number of electron shells
- number of electrons/ protons in an atom

(b) 2,8,8

(c) (i)