O

# Science(Chemistry) O Level Exam Paper Set 4
## Preliminary Examination
## Secondary Four Express & Five Normal

CANDIDATE NAME:

CLASS: /

INDEX NUMBER:

**Science(Chemistry)** **5076/01**

Paper 1 Multiple Choice **5078/01**

**1 hour**

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid/tape.
Write your name, class and index number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** or **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

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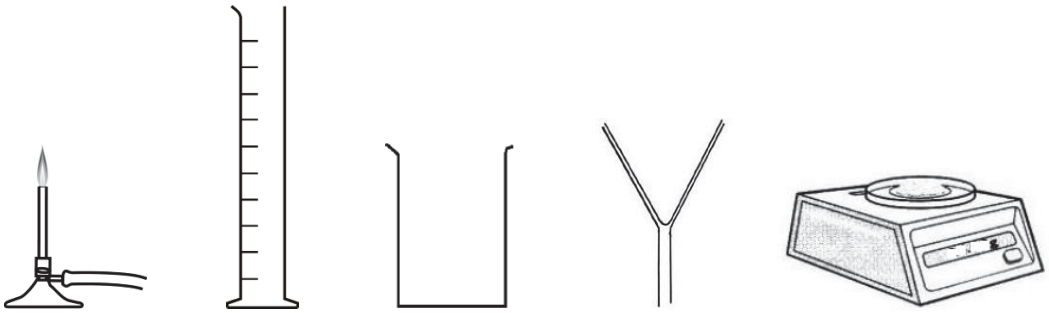
**1** Silver chloride is insoluble in water.

Silver chloride is made by adding 20.0 $cm^3$ of aqueous silver nitrate to 20.0 $cm^3$ of dilute hydrochloric acid.

Which pieces of apparatus are needed to obtain solid silver chloride from aqueous silver nitrate and dilute hydrochloric acid?

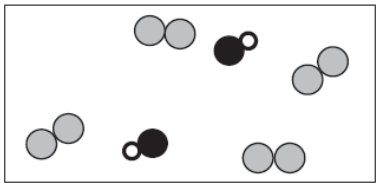


1 2 3 4 5

**A** 1, 2 and 4
**B** 1, 4 and 5
**C** 2, 3 and 4
**D** 2, 4 and 5

**2** The diagram below shows the arrangement of gases in a balloon.

Which pair of gases could be in the balloon?



**A** argon and hydrogen chloride
**B** argon and nitrogen
**C** hydrogen and nitrogen
**D** hydrogen chloride and nitrogen

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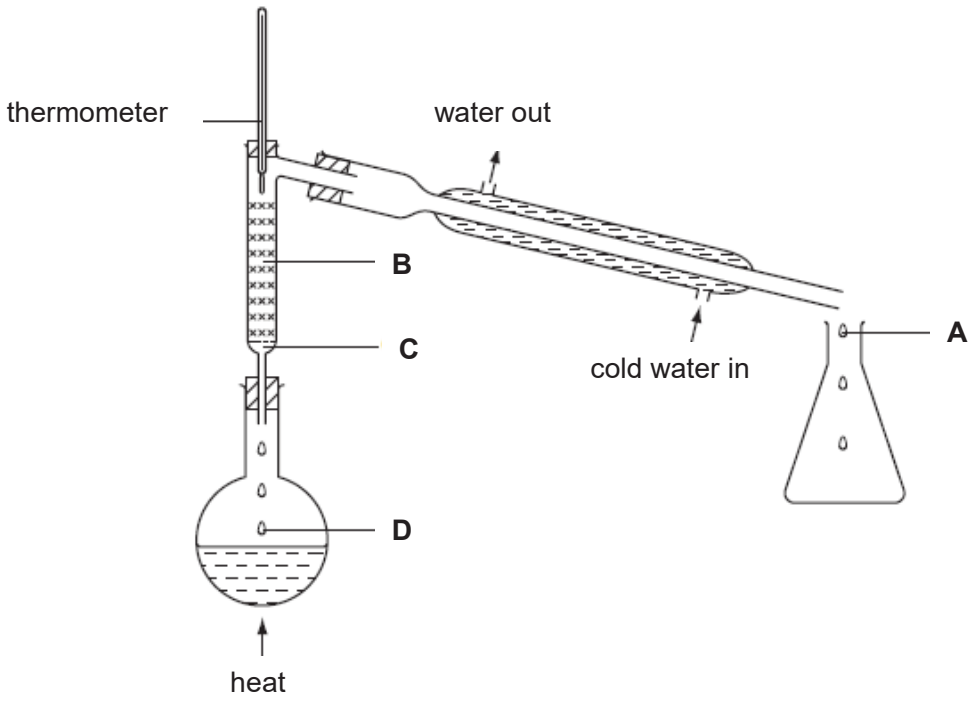
**3** Salt can be separated from sand by using the processes shown.

What is the correct order for the processes?

| | first → | | | last |
|---|---|---|---|---|
| **A** | filter | dissolve | evaporate | crystallise |
| **B** | dissolve | evaporate | crystallise | filter |
| **C** | dissolve | evaporate | filter | crystallise |
| **D** | dissolve | filter | evaporate | crystallise |

**4** A mixture containing equal volumes of two liquids that mix completely but do not react together is placed in the apparatus shown and heated until the thermometer first shows a steady reading.

At which position will there be the highest proportion of the liquid with the lower boiling point?




**5** Which of the following changes will result in the particles moving at a higher speed?

**A** $I_2$ (g) → $I_2$ (s)
**B** $CO_2$ (s) → $CO_2$ (g)
**C** $H_2O$ (*l*) → $H_2O$ (s)
**D** $N_2$ (g) → $N_2$ (*l*)

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**6** An imaginary element Gemsium(Gm) contains 111 protons and 141 neutrons.

Which one of the following represents an atom of Gemsium?

**A** $^{141}_{30}Gm$

**B** $^{141}_{111}Gm$

**C** $^{111}_{141}Gm$

**D** $^{252}_{111}Gm$

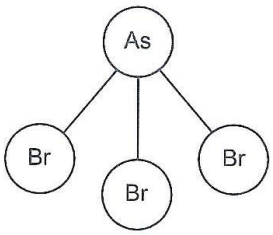
**7** The nucleon number and proton number of an atom of P and atom of Q are shown.

| | P | Q |
|---|---|---|
| nucleon number | 85 | 80 |
| proton number | 37 | 35 |

Which statement about P and Q is correct?

**A** An atom of P has fewer electrons than an atom of Q.
**B** An atom of P has more neutrons than an atom of Q.
**C** P is above Q in the same group of the Periodic Table.
**D** P is in the same period in the Periodic Table as Q.

**8** A molecule of arsenic bromide, $AsBr_3$, has the structure shown.




Which properties could be correct for arsenic bromide?

| | melting point/°C | electrical conductivity at room temperature |
|---|---|---|
| **A** | 31 | does not conduct |
| **B** | 39 | conducts |
| **C** | 650 | conducts |
| **D** | 755 | does not conduct |

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**9** A student thinks that element Q is a metal because it has a high melting point and a high boiling point.

What other properties could element Q have if it is a metal?

1 Q conducts electricity when solid.
2 Q forms an acidic oxide, $QO_2$.
3 Q is malleable.

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

**10** In the Periodic Table, caesium, lithium and sodium are in the same group.

Which statement about caesium is likely to be correct?

**A** It forms a nitrate, $Cs(NO_3)_2$.
**B** It forms an insoluble hydroxide.
**C** It has a density greater than potassium.
**D** It reacts slowly with water at room temperature.

**11** Astatine is at the bottom of Group VII in the Periodic Table.

Which of the following is a property of astatine?

**A** It forms a basic oxide.
**B** It is a good conductor of electricity.
**C** It forms a covalent compound of formula NaAt.
**D** It is displaced by chlorine from aqueous potassium astatide.

**12** When two aqueous solutions are mixed in a test-tube, a reaction occurs and the test-tube feels hot.

Which statement is correct?

**A** An exothermic reaction takes place as the reacting chemicals gain energy.
**B** An exothermic reaction takes place as the reacting chemicals lose energy.
**C** An endothermic reaction takes place as the reacting chemicals gain energy.
**D** An endothermic reaction takes place as the reacting chemicals lose energy.

**13** 2.0 g of magnesium are completely burnt in pure oxygen.

$$2Mg + O_2 \rightarrow 2MgO$$

Which volume of oxygen is used in this reaction at room temperature and pressure?

**A** 0.5 $dm^3$
**B** 1.0 $dm^3$
**C** 1.5 $dm^3$
**D** 2.0 $dm^3$

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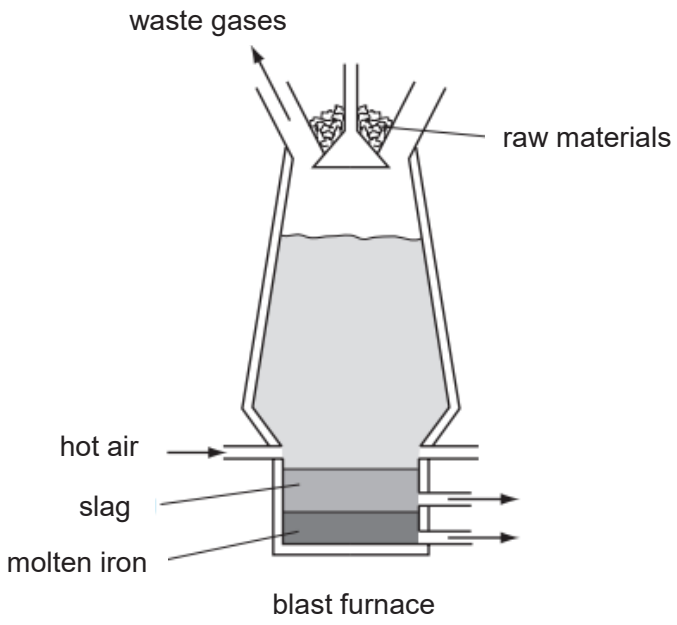
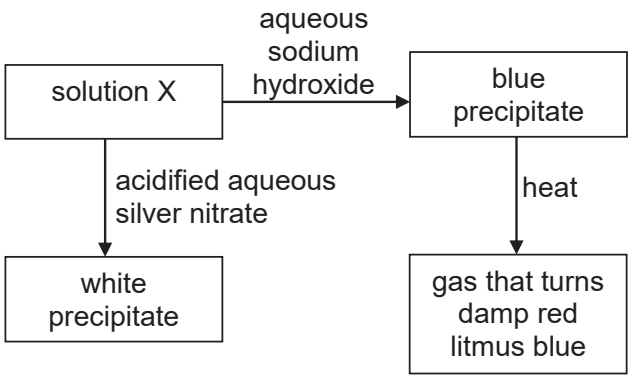
**14** Iron is produced in a blast furnace as shown in the diagram below.




Which statement about this process is correct?

**A** Carbon is oxidised to carbon dioxide.
**B** Carbon monoxide is produced by the thermal decomposition of calcium carbonate.
**C** Haematite is reduced by calcium carbonate.
**D** Impurities are removed by the hot air blast.

**15** The diagram below shows some of the reactions of solution X.




Which of the following the substance(s) is/are present in solution X?

**A** copper(II) nitrate only
**B** ammonium chloride only
**C** zinc nitrate and copper(II) nitrate
**D** ammonium chloride and copper(II) chloride

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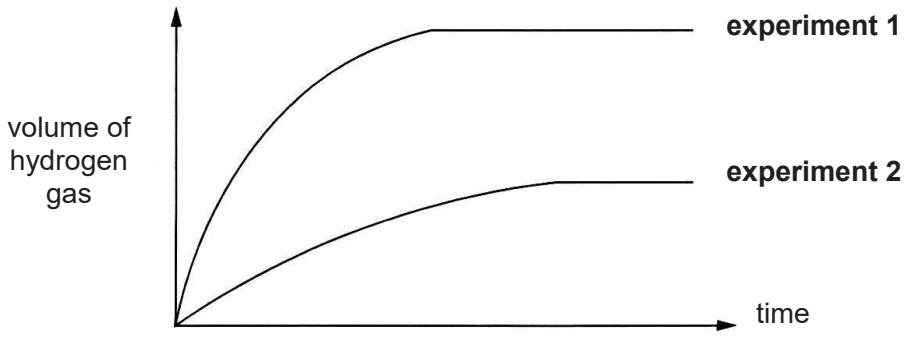
**16** Zinc powder was added to excess dilute sulfuric acid at room temperature. The volume of hydrogen gas produced was measured over a period of time.

The graph labelled **experiment 1** shown below was obtained.




Which change was made to obtain the results shown in **experiment 2**?

**A** Half the mass of zinc granules was used.
**B** Half the concentration of dilute sulfuric acid was used.
**C** Larger zinc strip of the same mass was used.
**D** Dilute sulfuric acid at lower temperature was used.

**17** Crude oil is fractionally distilled into useful fractions.

Which option matches the fraction to its use?

| | fraction | use |
|---|---|---|
| **A** | bitumen | feedstock for the petrochemical industry |
| **B** | diesel oil | fuel for aircraft engines |
| **C** | petrol | fuel for engines in buses, lorries and trains |
| **D** | petroleum gas | fuel for cooking and heating |

**18** Many countries have taken measures to ensure that the amount of sulfur in unleaded petrol and diesel fuels are kept low.

Which of the following could be the reason for such measures?

**A** To cut down the amount of fuel used in vehicles.
**B** To reduce the acidity of the rain.
**C** To reduce incomplete combustion.
**D** To prevent the pH of soil from increasing.

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**19** Which reaction describes the following equation?

$$C_{15}H_{32} \rightarrow C_{10}H_{22} + C_3H_6 + C_2H_4$$

**A** addition
**B** cracking
**C** oxidation
**D** substitution

**20** The table shows the observations made when an organic compound X reacts with aqueous bromine and acidified potassium manganate (VII).

| reagent | observation |
|---|---|
| aqueous bromine | no change |
| acidified potassium manganate(VII) | purple solution turns colourless |

What is compound X?

**A** ethane
**B** ethanoic acid
**C** methanol
**D** propene

**End of paper**

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# DATA SHEET
## The Periodic Table Of Elements

**Key**

| proton (atomic) number |
|---|
| **atomic symbol** |
| name |
| relative atomic mass |

| Group I | Group II | | | | | | | | | | | Group III | Group IV | Group V | Group VI | Group VII | Group 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1<br>**H**<br>hydrogen<br>1 | | | | | | | | | | 2<br>**He**<br>helium<br>4 |
| 3<br>**Li**<br>lithium<br>7 | 4<br>**Be**<br>beryllium<br>9 | | | | | | | | | | | 5<br>**B**<br>boron<br>11 | 6<br>**C**<br>carbon<br>12 | 7<br>**N**<br>nitrogen<br>14 | 8<br>**O**<br>oxygen<br>16 | 9<br>**F**<br>fluorine<br>19 | 10<br>**Ne**<br>neon<br>20 |
| 11<br>**Na**<br>sodium<br>23 | 12<br>**Mg**<br>magnesium<br>24 | | | | | | | | | | | 13<br>**Al**<br>aluminium<br>27 | 14<br>**Si**<br>silicon<br>28 | 15<br>**P**<br>phosphorus<br>31 | 16<br>**S**<br>sulfur<br>32 | 17<br>**Cl**<br>chlorine<br>35.5 | 18<br>**Ar**<br>argon<br>40 |
| 19<br>**K**<br>potassium<br>39 | 20<br>**Ca**<br>calcium<br>40 | 21<br>**Sc**<br>scandium<br>45 | 22<br>**Ti**<br>titanium<br>48 | 23<br>**V**<br>vanadium<br>51 | 24<br>**Cr**<br>chromium<br>52 | 25<br>**Mn**<br>manganese<br>55 | 26<br>**Fe**<br>iron<br>56 | 27<br>**Co**<br>cobalt<br>59 | 28<br>**Ni**<br>nickel<br>59 | 29<br>**Cu**<br>copper<br>64 | 30<br>**Zn**<br>zinc<br>65 | 31<br>**Ga**<br>gallium<br>70 | 32<br>**Ge**<br>germanium<br>73 | 33<br>**As**<br>arsenic<br>75 | 34<br>**Se**<br>selenium<br>79 | 35<br>**Br**<br>bromine<br>80 | 36<br>**Kr**<br>krypton<br>84 |
| 37<br>**Rb**<br>rubidium<br>85 | 38<br>**Sr**<br>strontium<br>88 | 39<br>**Y**<br>yttrium<br>89 | 40<br>**Zr**<br>zirconium<br>91 | 41<br>**Nb**<br>niobium<br>93 | 42<br>**Mo**<br>molybdenum<br>96 | 43<br>**Tc**<br>technetium<br>– | 44<br>**Ru**<br>ruthenium<br>101 | 45<br>**Rh**<br>rhodium<br>103 | 46<br>**Pd**<br>palladium<br>106 | 47<br>**Ag**<br>silver<br>108 | 48<br>**Cd**<br>cadmium<br>112 | 49<br>**In**<br>indium<br>115 | 50<br>**Sn**<br>tin<br>119 | 51<br>**Sb**<br>antimony<br>122 | 52<br>**Te**<br>tellurium<br>128 | 53<br>**I**<br>iodine<br>127 | 54<br>**Xe**<br>xenon<br>131 |
| 55<br>**Cs**<br>caesium<br>133 | 56<br>**Ba**<br>barium<br>137 | 57 – 71<br>lanthanoids | 72<br>**Hf**<br>hafnium<br>178 | 73<br>**Ta**<br>tantalum<br>181 | 74<br>**W**<br>tungsten<br>184 | 75<br>**Re**<br>rhenium<br>186 | 76<br>**Os**<br>osmium<br>190 | 77<br>**Ir**<br>iridium<br>192 | 78<br>**Pt**<br>platinum<br>195 | 79<br>**Au**<br>gold<br>197 | 80<br>**Hg**<br>mercury<br>201 | 81<br>**Tl**<br>thallium<br>204 | 82<br>**Pb**<br>lead<br>207 | 83<br>**Bi**<br>bismuth<br>209 | 84<br>**Po**<br>polonium<br>– | 85<br>**At**<br>astatine<br>– | 86<br>**Rn**<br>radon<br>– |
| 87<br>**Fr**<br>francium<br>– | 88<br>**Ra**<br>radium<br>– | 89 – 103<br>actinoids | 104<br>**Rf**<br>Rutherfordium<br>– | 105<br>**Db**<br>dubnium<br>– | 106<br>**Sg**<br>seaborgium<br>– | 107<br>**Bh**<br>bohrium<br>– | 108<br>**Hs**<br>hassium<br>– | 109<br>**Mt**<br>meitnerium<br>– | 110<br>**Ds**<br>darmstadtium<br>– | 111<br>**Rg**<br>roentgenium<br>– | 112<br>**Cn**<br>copernicium<br>– | | 114<br>**Fl**<br>flerovium<br>– | | 116<br>**Lv**<br>livermorium<br>– | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lanthanoids | 57<br>**La**<br>lanthanum<br>139 | 58<br>**Ce**<br>cerium<br>140 | 59<br>**Pr**<br>praseodymium<br>141 | 60<br>**Nd**<br>neodymium<br>144 | 61<br>**Pm**<br>promethium<br>– | 62<br>**Sm**<br>samarium<br>150 | 63<br>**Eu**<br>europium<br>152 | 64<br>**Gd**<br>gadolinium<br>157 | 65<br>**Tb**<br>terbium<br>159 | 66<br>**Dy**<br>dysprosium<br>162 | 67<br>**Ho**<br>holmium<br>165 | 68<br>**Er**<br>erbium<br>167 | 69<br>**Tm**<br>thulium<br>169 | 70<br>**Yb**<br>ytterbium<br>173 | 71<br>**Lu**<br>lutetium<br>175 |
| actinoids | 89<br>**Ac**<br>actinium<br>– | 90<br>**Th**<br>thorium<br>– | 91<br>**Pa**<br>protactinium<br>– | 92<br>**U**<br>uranium<br>238 | 93<br>**Np**<br>neptunium<br>– | 94<br>**Pu**<br>plutonium<br>– | 95<br>**Am**<br>americium<br>– | 96<br>**Cm**<br>curium<br>– | 97<br>**Bk**<br>berkelium<br>– | 98<br>**Cf**<br>californium<br>– | 99<br>**Es**<br>einsteinium<br>– | 100<br>**Fm**<br>fermium<br>– | 101<br>**Md**<br>mendelevium<br>– | 102<br>**No**<br>nobelium<br>– | 103<br>**Lr**<br>lawrencium<br>– |

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



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# Science(Chemistry) Level Exam Paper Set 4
## Preliminary Examination
## Secondary Four Express & Five Normal

CANDIDATE NAME:

CLASS: /

INDEX NUMBER:

## Science(Chemistry)

Paper 2 Theory

**5076/03**

**5078/03**

**1 hour 15 minutes**

**READ THESE INSTRUCTIONS FIRST**

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid/tape.

**Section A**
Answer **all** questions.

**Section B**
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

| | |
|---|---|
| Section A | |
| Section B | |
| Total | |

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## Section A

Answer all the questions in this section.
Write your answers in the spaces provided on the question paper.

**1** The diagram shows part of the Periodic Table. Only some of the elements are shown.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | H | | | | | | | | | | |
| | | | | | | | | | | | | | C | N | | F | |
| | | | | | | | | | | | | | Si | P | S | Cl | |
| | | | Ti | | | | Fe | | | Cu | Zn | | | As | | Br | |
| | | | | | | | | | | | | | | | | | |

**(a)** Answer each of the following questions using only those elements shown in the diagram. Each element may be used once, more than once or not at all.

Give one element which

**(i)** oxidises in the presence of water and air to form rust,

.....

**(ii)** forms an ion of $Y^-$ which has only three completely filled shells of electrons,

.....

**(iii)** forms an oxide which is amphoteric,

.....

**(iv)** is a colourless diatomic gas,

.....

**(v)** is found as an impurity in fossil fuels and burns in air to produce an air pollutant that causes acid rain.

.....
[5]

**(b)** Element **X** is a noble gas with two electron shells. Label this element as **X** in the Periodic Table above. [1]

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**2** Fig. 2.1 shows some reactions of copper(II) nitrate, $Cu(NO_3)_2$.

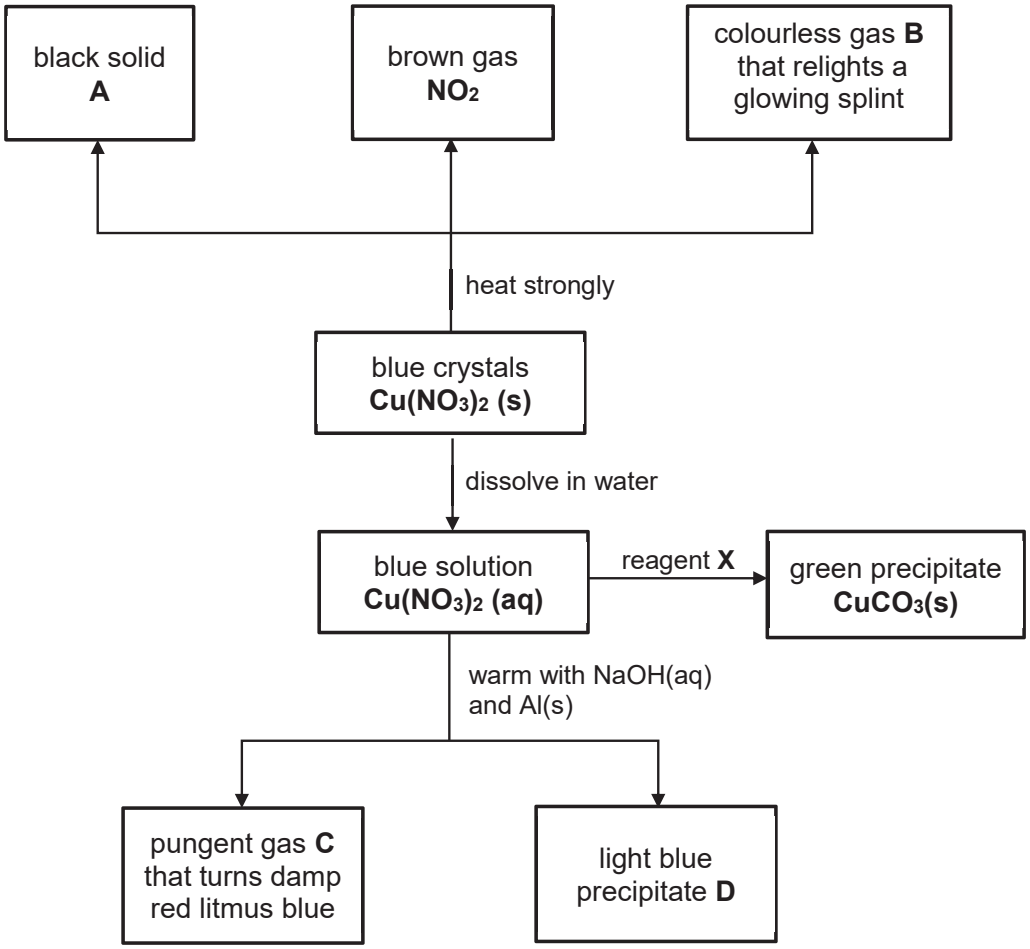


**Fig. 2.1**

**(a)** Identify the substances **A** – **D**.

**A** .....

**B** .....

**C** .....

**D** .....

[4]

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**(b)** Copper(II) nitrate solution reacts with reagent **X** to form copper(II) carbonate.

**(i)** Suggest the name of reagent **X**.

……..
[1]

**(ii)** Construct the balanced chemical equation, with state symbols, for the reaction between copper(II) nitrate solution with reagent **X** to form copper(II) carbonate.

……..
[2]

**(iii)** Describe the steps used in a laboratory to prepare a pure sample of powdered copper(II) carbonate from copper(II) nitrate solution and reagent **X**.

……..

……..

……..

……..

……..

……..

……..
[3]

**(c)** Describe how hydrochloric acid and limewater can be used to show that carbonate ions are present in copper(II) carbonate.

……..

……..

……..

……..
[2]

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**3** Titanium, Ti, is a metal used in the aerospace industry. It exists naturally as titanium-iron oxide, $FeTiO_3$, in a mineral called ilmenite. To extract titanium, the compound is first converted to titanium tetrachloride, $TiCl_4$, which is being heated to 2000°C with magnesium in an atmosphere of a noble gas, argon.

The extraction of titanium from its chloride is represented by the following equation.

$$TiCl_4 + 2Mg \rightarrow 2MgCl_2 + Ti$$

**(a)** What is the mass of magnesium chloride formed when 12 kg of titanium is extracted?
[Relative atomic masses: $A_r$: Ti, 48; Mg, 24; Cl, 35.5]

mass of magnesium chloride = ..... kg [2]

**(b)** Calculate the smallest mass of titanium-iron oxide, $FeTiO_3$, needed to produce 12 kg of titanium.
[Relative atomic masses: $A_r$: Ti, 48; Fe, 56; O, 16]

mass of titanium-iron oxide = ..... kg [2]

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**4** Fig. 4.1 shows the materials used to make ballpoint pen.

**Fig. 4.1**

**(a)** With reference to the arrangement of atoms, explain why alloys such as steel are used as materials in the pen, instead of pure metals.

……..

……..

……..

……..
[2]

**(b)** Give one advantage and one disadvantage of recycling the materials from this ballpoint pen.

……..

……..

……..

……..
[2]

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**5** **(a)** Use your knowledge of electronic structures to explain the following statements.

**(i)** Elements in Group II have similar chemical properties.

……...

**(ii)** Elements in Group 0 lack chemical reactivity.

……...
[2]

**(b)** Element **Z** with an atomic number of 85 is a highly unstable radioactive element.

**(i)** Suggest two ways in which chlorine differs in properties from element **Z**.

……...

……...

……...

……...
[2]

**(ii)** Excess chlorine is bubbled through a solution of Na**Z**.

Write a chemical equation for the reaction. State symbols are not required.

……...
[1]

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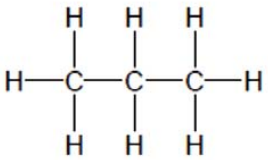
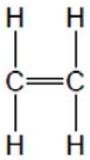
**6** The structures of five organic compounds are shown below.

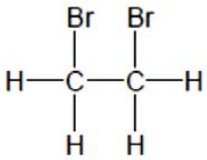
**A**



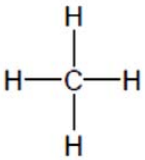
**B**



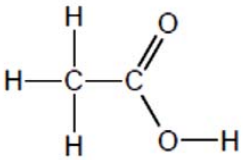
**C**



**D**



**E**



**(a)** Answer each of the following questions using the letters that represent each compound.

**(i)** Which two compounds are in the same homologous series?

……..

**(ii)** Which compound is formed when ethanol reacts with atmospheric oxygen?

……..

**(iii)** Which compound reacts with steam to form ethanol?

……..

[3]

**(b)** A solution of ethanol can be made by fermentation of glucose.

**(i)** Draw the structural formula of ethanol.

[1]

**(ii)** State two conditions required for the fermentation of glucose.

……..

……..

[2]

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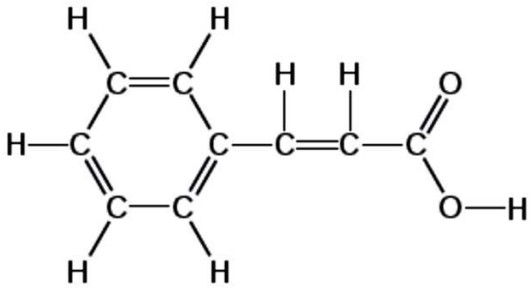
**(iii)** Calculate the relative molecular mass of ethanol and the percentage by mass of carbon in each molecule of ethanol.
[Relative atomic masses: $A_r$: H, 1; C, 12; O, 16]

[2]

**7** Cinnamic acid is found in plants called balsams.

The structure of cinnamic acid is shown below.



**(a)** Cinnamic acid is an unsaturated compound.

**(i)** What is meant by the term *unsaturated*?

……
[1]

**(ii)** Describe a chemical test to show that cinnamic acid is unsaturated.

chemical test

……

……

result with cinnamic acid

……

……
[2]

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**(b)** Balsam flowers contain a mixture of pigments.

A student uses chromatography to separate the pigments in balsam flowers. He puts the pigment mixture on a sheet of chromatography paper as well as five spots of pure pigments **A**, **B**, **C**, **D** and **E**.

The results are shown as a chromatogram in Fig. 7.1.

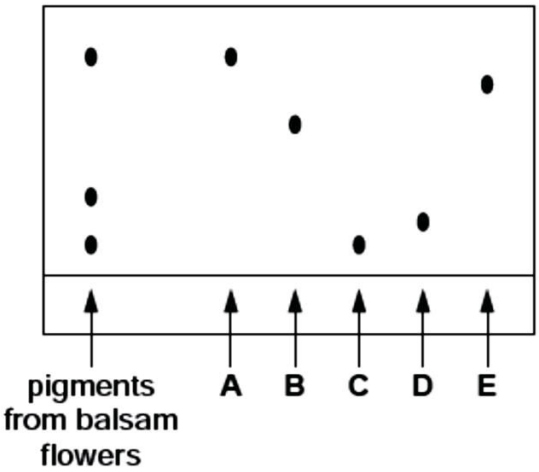


**Fig. 7.1**

**(i)** Which of the pigments are present in balsam flowers?

……..
[1]

**(ii)** Draw the apparatus that could be used to produce this chromatogram.

[2]

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## Section B

Answer any **two** questions in this section.

Write your answers in the writing papers provided.

**8** Fluorine is the lightest halogen and exists as a highly reactive pale yellow diatomic gas at room temperature and pressure. Fluorine is found in nature in the form of calcium fluoride crystals, called fluorite.

**(a)** The following equation describes the reaction between fluorine gas and water.

$$2F_2\ (g) + 2H_2O\ (l) \rightarrow O_2\ (g) + 4HF\ (aq)$$

Given that 48 $cm^3$ of fluorine gas reacts with excess water, calculate the **volume** and **mass** of oxygen gas produced at room temperature and pressure. [2]

**(b)** Draw and label the electronic structures of fluorine gas and calcium fluoride.
[Proton numbers: F, 9; Ca, 20] [4]

**(c)** Use these structures to explain why, at room temperature and pressure, calcium fluoride is a solid and fluorine is a gas. [4]

**9** **(a)** The reaction of metal **X** with water places it between calcium and iron in this order of reactivity. Explain why **X** would displace copper if added to a solution of copper(II) sulfate. [2]

**(b)** Aluminium does not react with cold water. Does this give a true indication of the reactivity of this element? Explain your answer. [2]

**(c)** Iron is produced in the blast furnace by heating a mixture of iron(III) oxide, coke and limestone with air.

Describe the reactions involved in this extraction.
Include an equation of a redox reaction. [6]

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**10** Dilute hydrochloric acid reacts with calcium carbonate to produce carbon dioxide.

**(a)** **(i)** With the aid of a diagram, design and describe an experiment in a laboratory to show how the rate of reaction between these two substances depends on the particle size of calcium carbonate. [4]

**(ii)** Describe the measures you would take to ensure that your experiment is fair. [2]

**(iii)** State and explain how the rate of reaction between two substances is affected by the particle size of one substance. Use your knowledge of reacting particles in your explanation. [2]

**(b)** Increasing the concentration of acid can change the speed of a reaction. State and explain how it affects the speed of the reaction. Use your knowledge of reacting particles in your explanation. [2]

**End of Paper**

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**Paper 1**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| C | D | D | A | B | D | B | A | C | C |

| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|
| D | B | B | A | D | A | D | B | B | C |

**Paper 3 Section A**

| Question | | | Marking Point | Marks |
|---|---|---|---|---|
| 1 | (a) | (i) | Fe | 1 |
| | | (ii) | Cl | 1 |
| | | (iii) | Zn | 1 |
| | | (iv) | H or N | 1 |
| | | (v) | S | 1 |
| | (b) | | *Position of **X**: Group 0, 2nd element* (Ne) | 1 |
| | | | **Total:** | **6** |
| 2 | (a) | | **A** – copper(II) oxide<br>**B** – oxygen gas<br>**C** – ammonia gas<br>**D** – copper(II) hydroxide | 4 (1M each) |
| | (b) | (i) | Any soluble carbonate e.g.<br>sodium carbonate / potassium carbonate | 1 |
| | | (ii) | $Cu(NO_3)_2$ (aq) + $Na_2CO_3$ (aq) → $CuCO_3$ (s) + 2 $NaNO_3$ (aq)<br>Balanced chemical equation – 1<br>State symbols – 1 | 2 |
| | | (iii) | Mix the solutions together and stir. | 1 |
| | | | Filter the mixture to obtain copper(II) carbonate as the residue. | 1 |
| | | | Wash the residue with distilled water. | 1 |
| | (c) | | Add hydrochloric acid to copper(II) carbonate. | 1 |
| | | | Effervescence observed, gas produced forms white precipitate when passed into limewater. | 1 |
| | | | **Total:** | **12** |

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| Question | | | Marking Point | Marks |
|---|---|---|---|---|
| **3** | **(a)** | | No. of moles of titanium = 12 000 / 48 = 250 moles<br>No. of moles of $MgCl_2$ = 250 x 2 = 500 moles | 1 |
| | | | Mass of $MgCl_2$ = 500 x (24 + 35.5 x 2) = 47500 g = 47.5 kg | 1 |
| | **(b)** | | % mass of Ti in $FeTiO_3$<br>= 48 / (56+48+16x3) x 100% = 31.57894 % | 1 |
| | | | Mass of $FeTiO_3$ to produce 12kg of Ti<br>= 12/31.57894 x 100 = 38 kg | 1 |
| | | | **Total:** | **4** |
| **4** | **(a)** | | Alloys are harder than pure metals. | 1 |
| | | | The different sized atoms disrupt the orderly arrangement of atoms,<br>Hence making it difficult for the metal atoms to slide over one another. | 1 |
| | **(b)** | | Advantage:<br>• Conserves finite resources of crude oil/metal ores.<br>• Reduces use of landfill.<br>• Less problems caused from disposal.<br>• Materials used are non-biodegradable.<br>• Less expensive than producing from raw materials. | Any 1 |
| | | | Disadvantage:<br>• Difficulty / high cost to separate the materials.<br>• Not all materials can be recycled. | Any 1 |
| | | | **Total:** | **4** |
| **5** | **(a)** | (i) | They all have 2 valence electrons. | 1 |
| | | (ii) | They all have complete/full valence shell. | 1 |
| | **(b)** | (i) | • Chlorine has lower boiling/melting point than astatine/**Z**. OR Chlorine is a gas at room temperature but astatine/**Z** is a solid at room temperature.<br>• Chlorine is greenish yellow in colour but astatine/**Z** is black in colour.<br>• Chlorine is more reactive than astatine/**Z**. | Any 2 |
| | **(b)** | (ii) | $Cl_2 + 2\ NaZ \rightarrow Z_2 + 2\ NaCl$ | 2 |
| | | | **Total:** | **6** |
| **6** | **(a)** | (i) | A and D | 1 |
| | | (ii) | E | 1 |
| | | (iii) | B | 1 |

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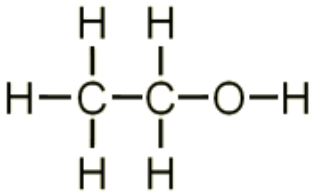
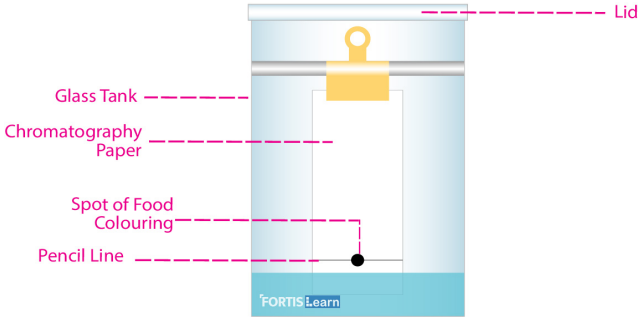
| Question | | | Marking Point | Marks |
|---|---|---|---|---|
| | **(b)** | (i) |  | 1 |
| | | (ii) | 37°C, absence of oxygen, presence of yeast | Any 2 |
| | | (iii) | Mr of ethanol = 2x12 + 6 + 16 = <u>46</u> (no units) | 1 |
| | | | %mass of carbon = 24/46 x 100% = <u>52.2%</u> (3sf) | 1 |
| | | | **Total:** | **8** |
| | | | | |
| **7** | **(a)** | (i) | Compound consists of at least one C=C bond | 1 |
| | | (ii) | Add compound to aqueous bromine/ bromine solution/ bromine water. | 1 |
| | | | Reddish brown aqueous bromine decolourises. | 1 |
| | **(b)** | (i) | A and C (both must be correct) | 1 |
| | | (ii) |   Proportional drawing – 1<br>Appropriate labels – 1 | 2 |
| | | | **Total:** | **6** |

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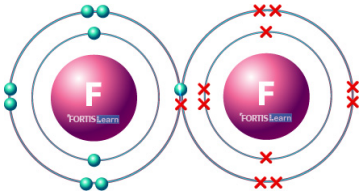
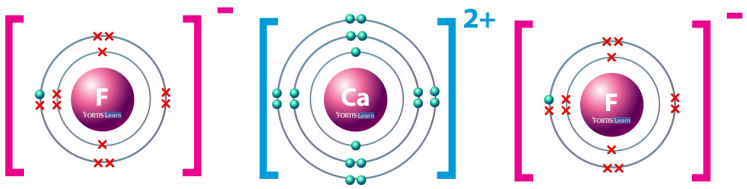
**Section B**

| Question | | | Marking Point | Marks |
|---|---|---|---|---|
| **8** | **(a)** | | Volume of oxygen = 48/2 = 24 $cm^3$ | 1 |
| | | | No. of moles of oxygen = 0.024 / 24 = 0.001<br>Mass of oxygen = 0.001 x 32 = 0.032 g. | 1 |
| | **(b)** | |  <br>Fluorine gas<br>Correct sharing – 1<br>Correct number of valence electrons – 1<br>  <br>Calcium fluoride<br>Correct calcium ion – 1<br>Correct fluoride ion – 1 | 4 |
| | **(c)** | | Fluorine is a covalent molecule.<br>It has weak intermolecular forces of attraction | 1 |
| | | | which requires small amount of energy to overcome/<br>has low boiling point hence it is a gas at r.t.p. | 1 |
| | | | Calcium fluoride is an ionic compound.<br>It has strong electrostatic forces of attraction between the ions | 1 |
| | | | which requires large amount of energy to overcome/<br>Has high melting point hence is a solid at room temperature. | 1 |
| | | | **Total:** | **10** |

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| Question | | | Marking Point | Marks |
|---|---|---|---|---|
| 9 | (a) | | X is more reactive than iron, which is more reactive than copper. | 1 |
| | | | Hence X is more reactive than copper. | 1 |
| | (b) | | No. Aluminium reacts with oxygen to form a layer of aluminium oxide | 1 |
| | | | which is unreactive and hence prevents the aluminium metal from reacting with water. | 1 |
| | (c) | | Coke burns in air to form carbon dioxide | 1 |
| | | | Carbon dioxide reacts with more coke to form carbon monoxide. | 1 |
| | | | Carbon monoxide reacts with iron(III) oxide to form iron and carbon dioxide. | 1 |
| | | | Limestone decomposes to form calcium oxide and carbon dioxide. | 1 |
| | | | Calcium oxide reacts with sand (silicon dioxide) to form calcium silicate/molten slag. | 1 |
| | | | Equation of Redox reaction<br>• $C + O_2 \rightarrow CO_2$<br>• $CO_2 + C \rightarrow 2\ CO$<br>• $Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$ | Any 1 |
| | | | **Total:** | **10** |

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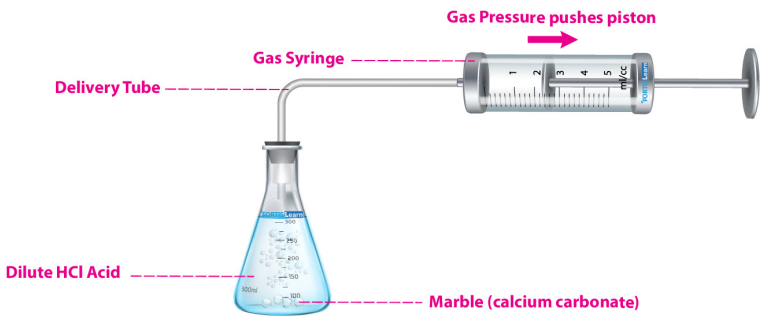
| Question | | | Marking Point | Marks |
|---|---|---|---|---|
| **10** | **(a)** | (i) |  <br>Weigh **2.0 g** of calcium carbonate **lumps** and place in a conical flask.<br>Add **50cm$^3$** of **1mol/dm$^3$ dilute hydrochloric acid** into the flask.<br>Record the **time taken for effervescence to stop / time taken to collect 10 cm$^3$ of gas**<br>Repeat experiment with **powdered** calcium carbonate and compare the time taken for both experiments.<br><br>Marking points (1M each):<br>• Appropriate **diagram** with suitable labels<br>• Use of **appropriate mass** of calcium carbonate and **volume** of acid<br>• Use of different particle size of calcium carbonate (**lumps vs powdered** or **large lumps vs small lumps**) in two experiments.<br>• Observation or change that is measured to compare the rate of reaction (**time taken for effervescence to stop / time taken to collect fixed volume of gas**) | 4 |
| | | (ii) | • **Concentration** of dilute hydrochloric acid used is the same.<br>• **Mass** of calcium carbonate used is the same.<br>• **Temperature** of both experiments is the same.<br><br>*Reject*:<br>Equal volume of dilute hydrochloric acid<br>Shake the acid to ensure reaction is complete<br>Repeat experiment and obtain average of results. | Any 2 |
| | | (iii) | The <u>smaller the particle size, the larger the total surface area</u> for particles to collide, | 1 |
| | | | resulting in <u>increased number of effective collisions</u> and hence <u>higher speed of reaction</u>. (opposite is true) | 1 |
| | **(b)** | | <u>The higher the concentration of acid, the higher the speed of reaction</u> | 1 |
| | | | The more concentrated the acid, the more <u>acid particles per unit volume</u>, resulting in increased number of effective collisions | 1 |
| | | | **Total:** | **10** |

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