



**SERANGOON SECONDARY SCHOOL
PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS**

CANDIDATE
NAME

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CLASS

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CENTRE
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INDEX
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SCIENCE (PHYSICS, CHEMISTRY)

Paper 1 Multiple Choice

5086/01

28 August 2024

1 hour

Additional Materials: Multiple Choice Answer Sheet

Setter(s):

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **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.

A copy of the Data Sheet is printed on page 20.

A copy of the Periodic Table is printed on page 21.

The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of **21** printed pages, including this **cover** page.

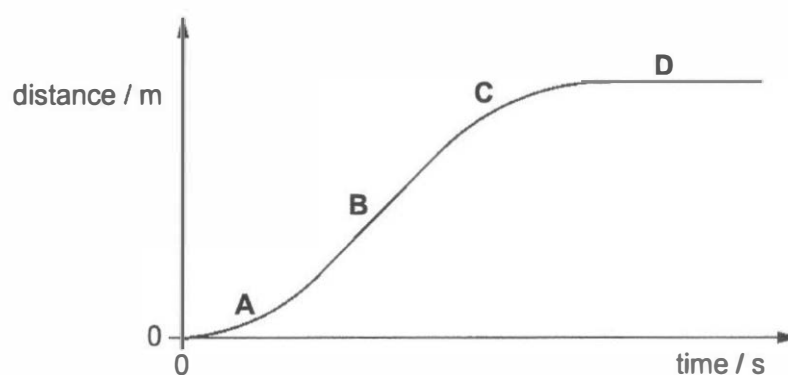
- 1 A length of copper wire is labelled: length 0.50 m and diameter 0.50 mm.

Which instruments are most suitable to measure accurately the length and the diameter of the wire?

	length	diameter
A	metre rule	digital calipers
B	metre rule	digital micrometer
C	digital calipers	metre rule
D	digital calipers	digital micrometer

- 2 The diagram shows a distance-time graph for a car travelling in a straight line.

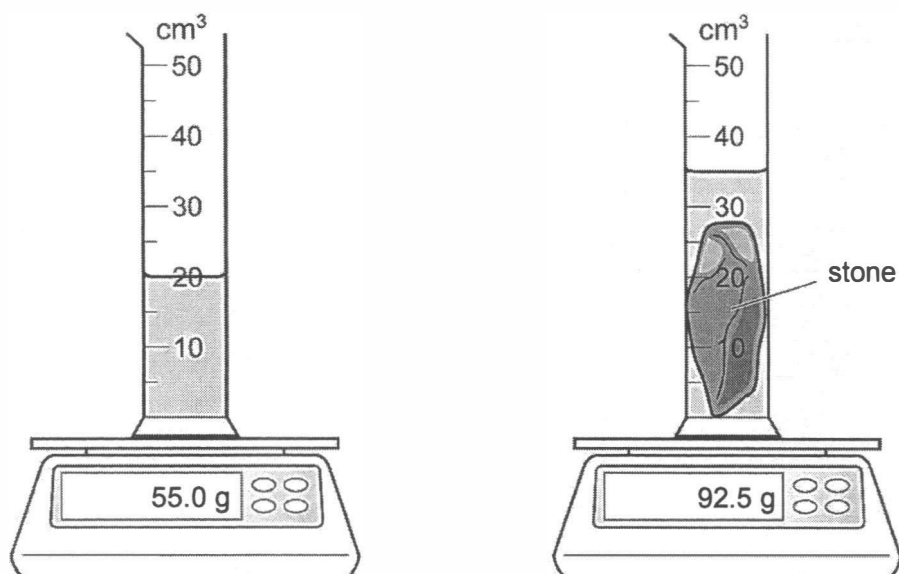
In which region is the car decelerating?



- 3 A measuring cylinder containing water is placed on a balance.

A stone is placed into the water.

The diagram shows the readings on the balance and on the measuring cylinder.



What is the density of the stone?

- A 1.1 g/cm³ B 1.5 g/cm³ C 2.5 g/cm³ D 2.6 g/cm³
- 4 Newton's third law describes a pair of forces.

Which row shows whether the two forces are of the same type and whether they act on the same object?

	the type of forces in the pair	the objects which they act
A	different	different
B	different	same
C	same	different
D	same	same

- 5** Each tyre of a car has an area of 250 cm^2 in contact with the ground.

The car has a mass of 1600 kg . The weight of the car is equally distributed amongst the four tyres. What is the pressure exerted on the ground?

The gravitational field strength g is 10 N/kg .

- A** 4.0 N/cm^2 **B** 16 N/cm^2 **C** 40 N/cm^2 **D** 160 N/cm^2

- 6** Some water is heated from room temperature to its boiling point using an electric kettle.

What is the principal energy transfer taking place during this period?

- A** internal store to chemical potential store
B internal store to kinetic store
C chemical potential store to kinetic store
D chemical potential store to internal store

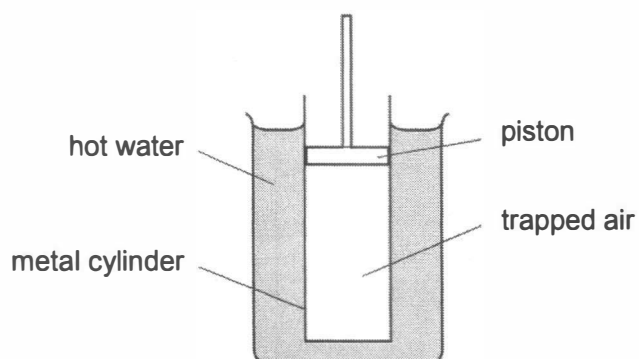
- 7** A 1 kW , 240 V electrical device is switched on.

How much energy does it use in 5.0 minutes?

- A** 5000 J
B $12\,000 \text{ J}$
C $72\,000 \text{ J}$
D $300\,000 \text{ J}$

- 8 Air is trapped in a metal cylinder by a piston. The piston is free to move and the trapped air is at atmospheric pressure.

The cylinder is in hot water.



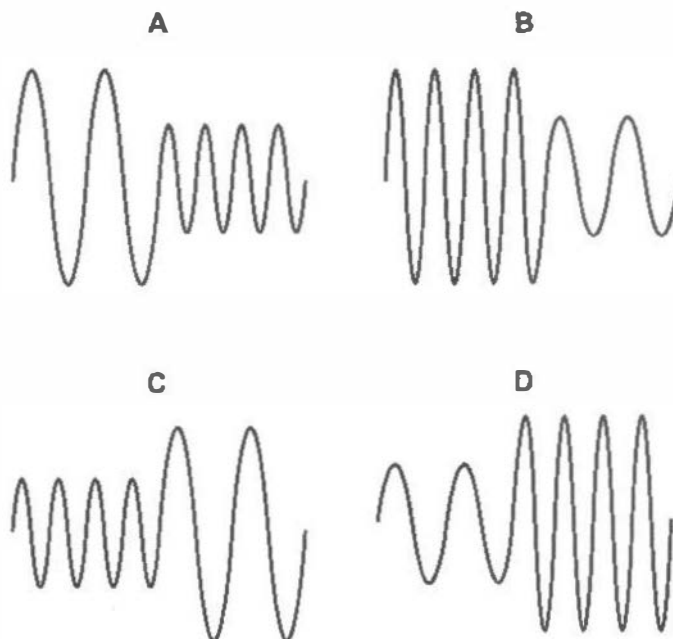
The cylinder is taken out of the hot water and left to cool.

What happens to the mass of the air in the cylinder and the position of the piston as it cools?

	mass of air	position of piston
A	does not change	does not change
B	does not change	changes
C	changes	does not change
D	changes	changes

- 9 Sound waves are displayed as a trace on the screen of an oscilloscope.

Which trace shows a sound that becomes quieter with a higher pitch?

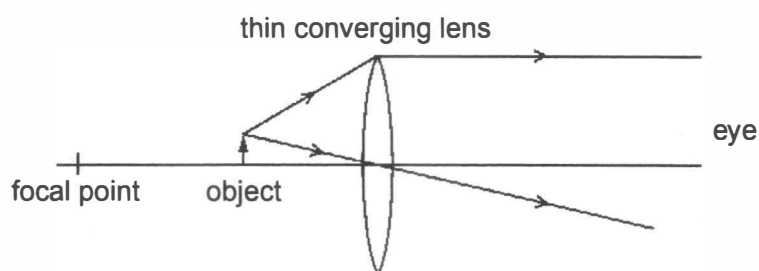


- 10 Which characteristics describe the image formed by a plane mirror?

- A real and upside down
- B virtual and upright
- C real and larger than the object
- D virtual and smaller than the object

- 11 An object is viewed through a thin converging lens.

The diagram shows the paths of two rays from the top of the object to an eye.



How does the image compare with the object?

- A It is larger and inverted.
 - B It is larger and upright.
 - C It is smaller and inverted.
 - D It is smaller and upright.
- 12 Ultraviolet radiation is a component of the electromagnetic spectrum.
- Which application uses ultraviolet radiation?
- A Bluetooth technology
 - B prenatal scanning
 - C sterilising water
 - D thermal imaging
- 13 When the flash on a camera is used, a charge of 1.5 C flows for 0.0030 s through the flash lamp.

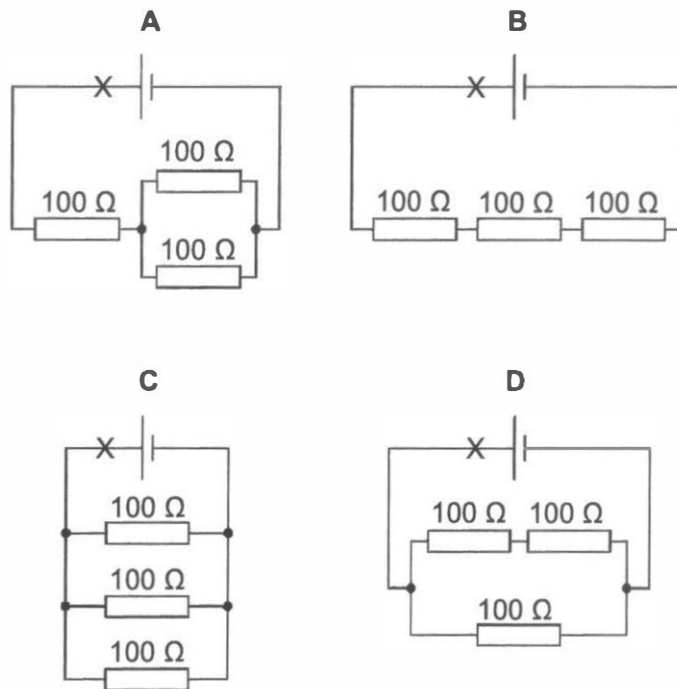
The average voltage across the flash lamp is 3600 V.

What is the energy supplied to the flash lamp and what is the average power supplied?

	energy / J	power / W
A	2400	7.2
B	2400	800 000
C	5400	16.2
D	5400	1 800 000

- 14 The diagrams show four circuits. Each circuit contains three $100\ \Omega$ resistors.

Which circuit has the largest current flowing at point X?



- 15 A metal wire of length l and cross-sectional area A has resistance R .

A second wire is made from the same material. It has a length of $2l$ and a cross-sectional area $4A$.

What is the resistance of the second wire?

- A $8R$ B $2R$ C $\frac{R}{2}$ D $\frac{R}{8}$

- 16 The cost of electricity is \$0.2989 per kWh.

It takes 0.060 hours and costs 4.0 cents to boil the water in a kettle.

What is the power rating of the kettle?

- A 0.45 kW B 2.2 kW C 120 kW D 2000 kW

- 17 A three-pin mains plug contains a fuse. A device with double insulation has a cable connected to the plug.

Which part of the plug is **not** connected to the cable?

- A earth pin
- B fuse
- C live pin
- D neutral pin

- 18 One end of each of two bars is marked with an X or a Y, as shown.



End X of bar 1 is brought close to the N-pole and then to the S-pole of a magnet.

End Y of bar 2 is brought close to the N-pole and then to the S-pole of the magnet.

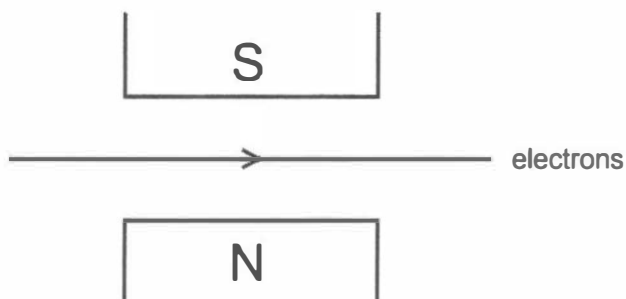
The table shows what happens.

	end X of bar 1	end Y of bar 2
N-pole of magnet	attracted	attracted
S-pole of magnet	attracted	repelled

What materials are bar 1 and bar 2 made from?

	bar 1	bar 2
A	iron	steel
B	copper	steel
C	steel	copper
D	steel	iron

- 19 A beam of electrons travels through a vacuum. The beam passes between the poles of a magnet as shown.



What are the directions of the conventional current, the magnetic field, and the force acting on the beam of electrons?

	direction of the conventional current	direction of the magnetic field	direction of the force
A	→	↓	into the page
B	→	↑	out of the page
C	←	↓	out of the page
D	←	↑	into the page

- 20 $^{14}_6\text{C}$ is a natural radioactive isotope of carbon and is present in all living things. It has a half-life of 5700 years.

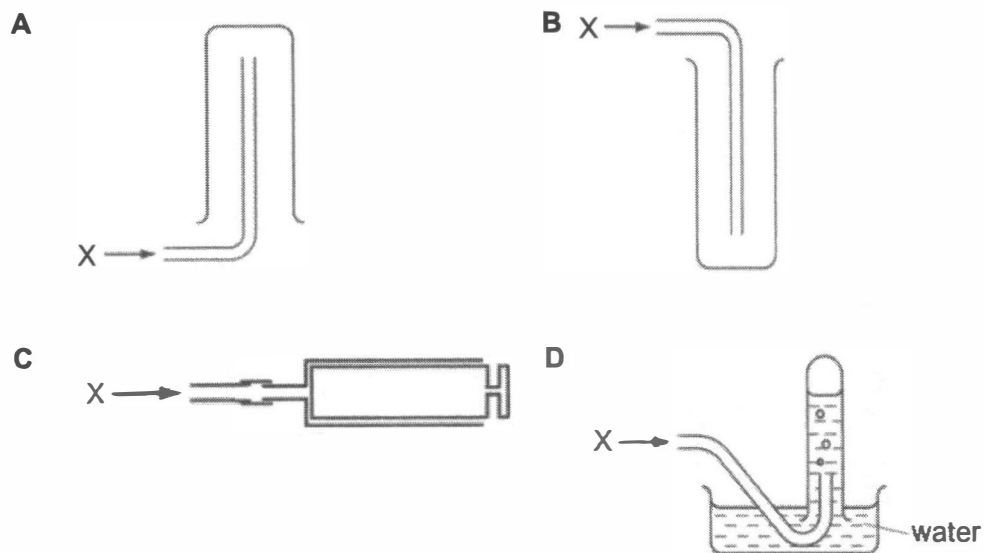
The initial mass of this radioactive isotope of carbon in a sample of an old bone is thought to be 448 g.

How old is this sample of bone if the mass of the radioactive isotope of carbon in it is found to be 28 g?

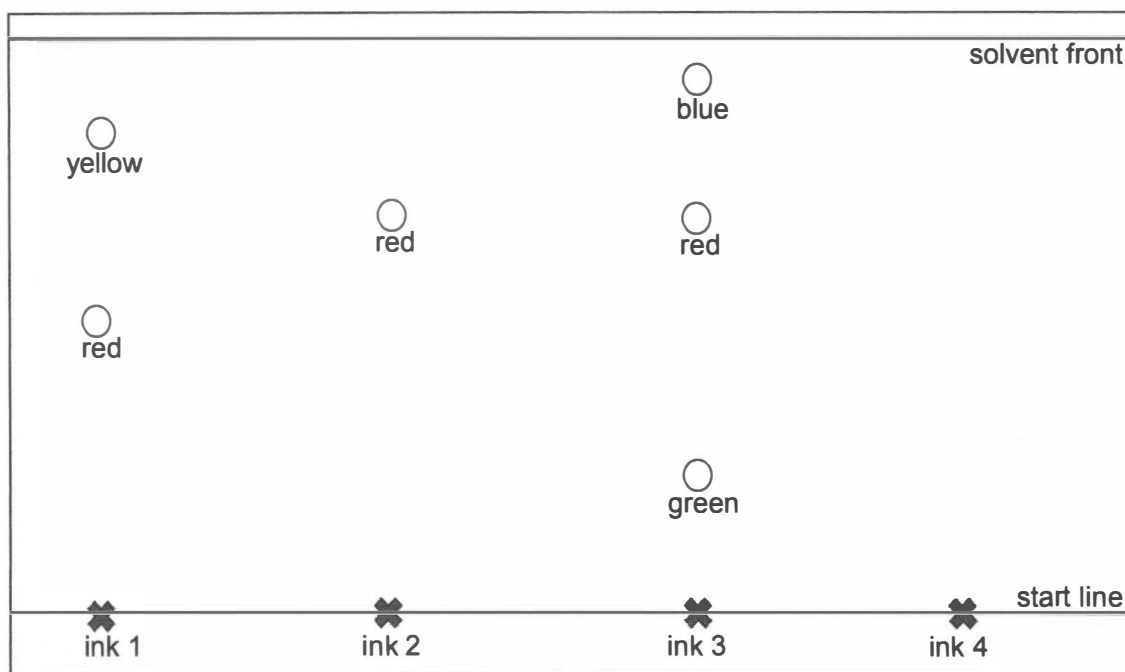
- A** 5700 years
- B** 11 400 years
- C** 17 100 years
- D** 22 800 years

- 21 A gas, X, is denser than air and insoluble in water.

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



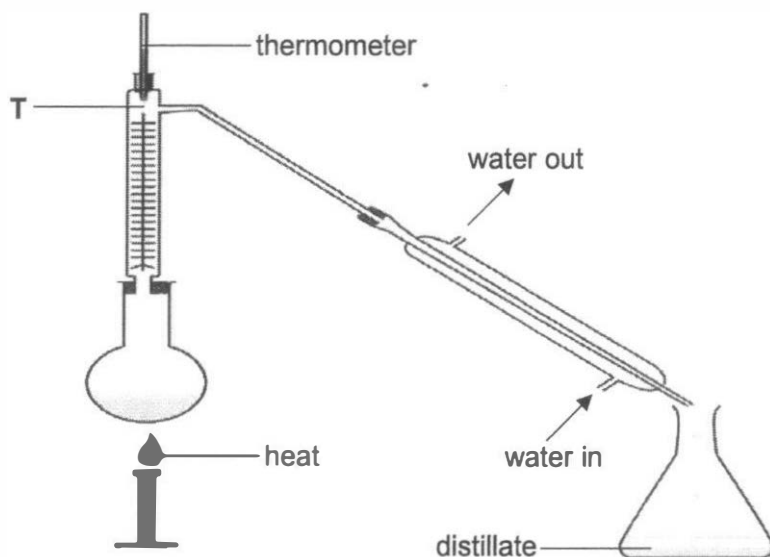
- 22 The dyes in four different inks, 1, 2, 3, and 4, were analysed using paper chromatography with ethanol as a solvent. The results are shown in the chromatogram below.



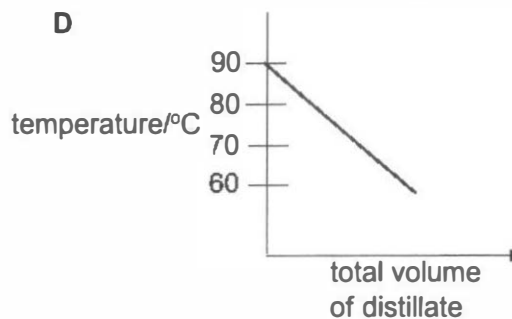
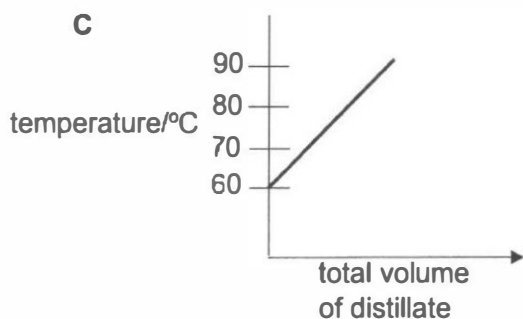
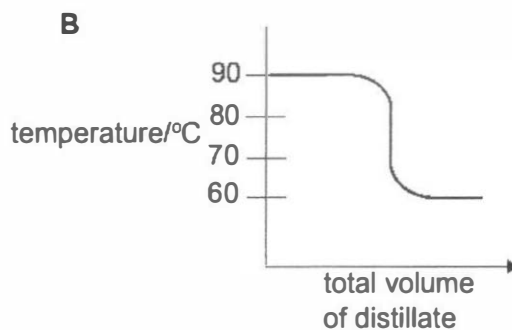
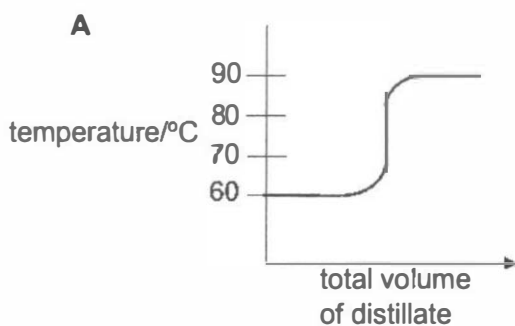
Which statement is true?

- A Ink 1 is a pure substance.
- B Ink 4 is insoluble in ethanol.
- C In the four inks, there are three different red dyes.
- D In ink 3, green dye has the highest solubility in ethanol.

- 23 The diagram shows the apparatus used to separate a mixture of liquid Q, which boils at 60°C , and liquid R, which boils at 90°C .

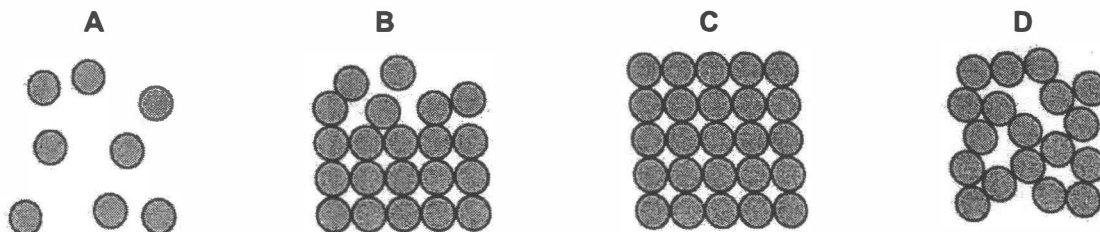


Which graph would be obtained if the temperature at point T was plotted against the volume of distillate collected?

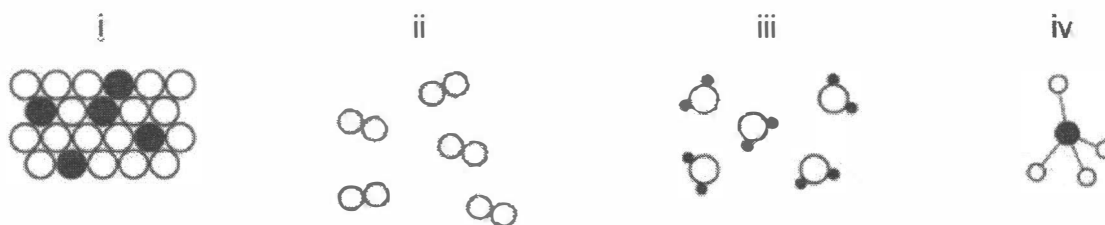


- 24 Substance E has a melting point of 12 °C and a boiling point of 95 °C.

Which diagram represents the particles in substance E at –24 °C?



- 25 Which of the following best describes the substances shown below?



	elements	compounds	mixtures
A	ii	i, iii, iv	none
B	i, ii	iv	iii
C	ii	iii, iv	i
D	ii,iii	i	iv

- 26 The formulae of two ionic compounds of vanadium are VCO_3 and VCl_2 .

What are the charges on the vanadium ion in both compounds?

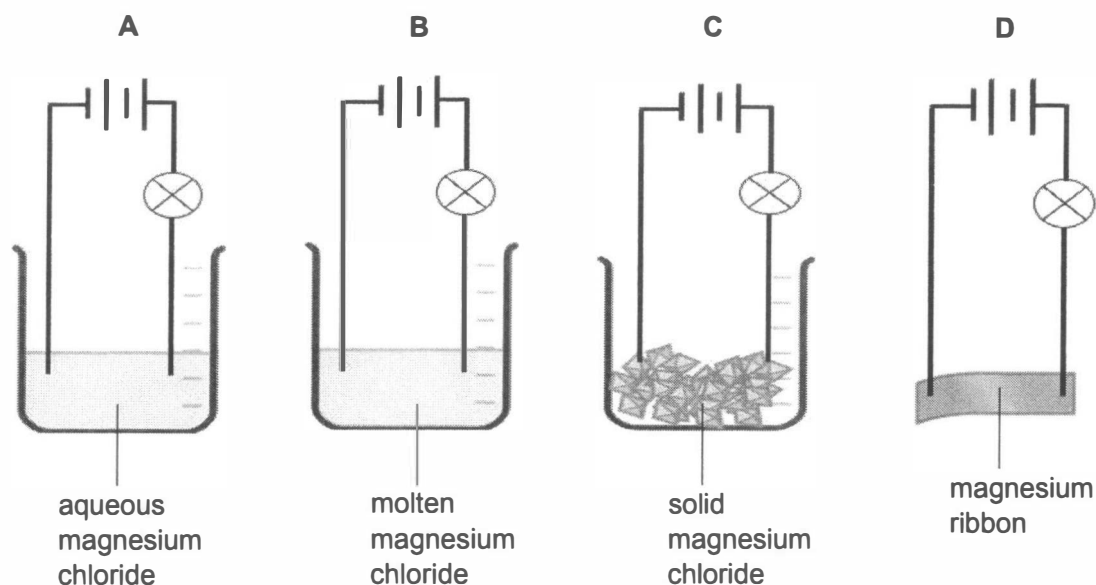
	VCO_3	VCl_2
A	V^{2+}	V^{2+}
B	V^{2+}	V^{3+}
C	V^{3+}	V^{2+}
D	V^{3+}	V^{3+}

27 Four setups are shown below.

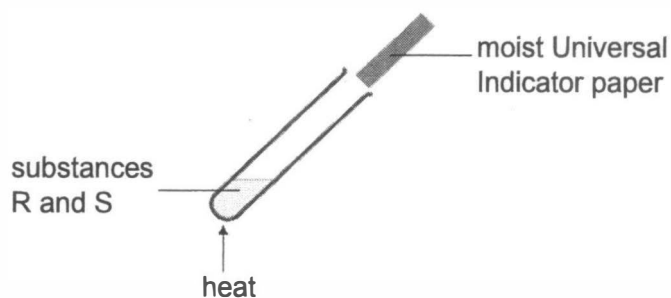
In which setup will the bulb **not** light up?

Key

⊗ - bulb; | | | - batteries



28 The diagram shows two substances, R and S, being heated together in a test tube.



Which row is correct?

	substance R	substance S	colour change of moist Universal Indicator paper
A	ammonium chloride	aqueous sodium hydroxide	turns blue
B	ammonium chloride	hydrochloric acid	turns red
C	aluminium foil	aqueous sodium nitrate	turns blue
D	aluminium foil	hydrochloric acid	turns red

- 29 In an experiment, a student dropped a piece of sodium into water and made the following observations:

1. Effervescence was seen.
2. The metal burned with a lilac flame.
3. The metal sunk to the bottom of the container.
4. The metal moved rapidly across the water surface.

Which of the student's observation(s) are **wrong**?

- | | |
|------------------|------------------|
| A 2 only | B 1 and 3 |
| C 1 and 4 | D 2 and 3 |
- 30 What is the number of molecules in 0.3 dm^3 of carbon dioxide gas at room temperature and pressure?
- | | |
|--------------------------------|--------------------------------|
| A 7.53×10^{21} | B 1.51×10^{22} |
| C 7.53×10^{22} | D 6.02×10^{23} |

- 31 Sodium hydroxide reacts with sulfuric acid.

The equation for the reaction is shown.



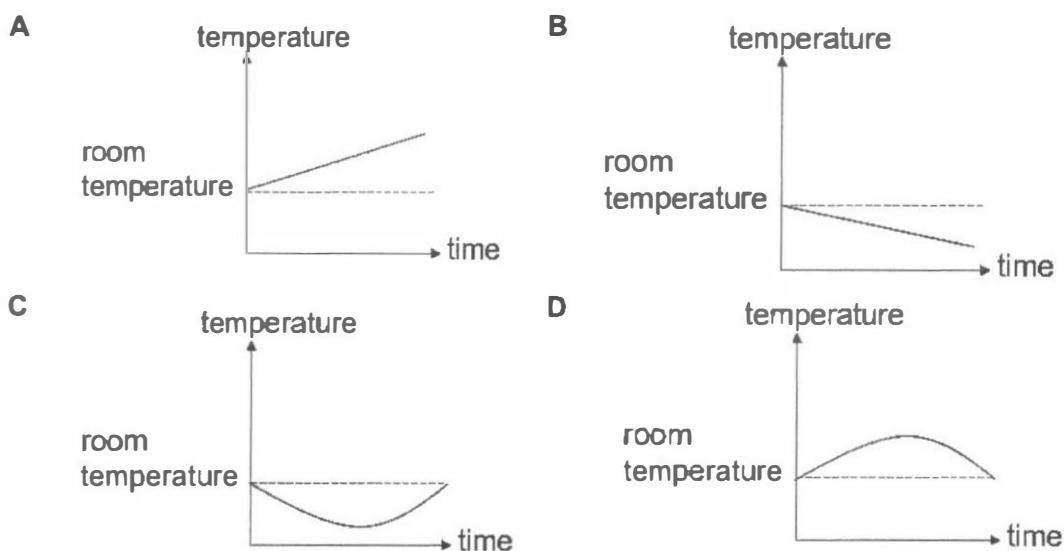
Which volume of 0.20 mol/dm^3 sodium hydroxide reacts completely with a solution containing 0.49 g of sulfuric acid?

[M_r : H_2SO_4 , 98]

- | | |
|------------------------------|-------------------------------|
| A 12.5 cm^3 | B 25.0 cm^3 |
| C 50.0 cm^3 | D 100.0 cm^3 |

- 32 The dissolving of ammonium nitrate in water is an endothermic process.

Which graph correctly shows how the temperature of the surroundings changes with time when ammonium nitrate dissolves in water?



- 33 Sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$) reacts with dilute hydrochloric acid to form solid sulfur and sulfur dioxide gas.

The equation for the reaction is shown.



What are the oxidation states of sulfur in sodium thiosulfate, solid sulfur and sulfur dioxide?

	sodium thiosulfate	sulfur	sulfur dioxide
A	+2	0	+2
B	+2	0	+4
C	-2	0	-2
D	-2	+1	+4

- 34 Which pair of reactants can be **safely** used to prepare hydrogen gas in the laboratory?

- A copper metal and dilute sulfuric acid
- B copper(II) carbonate and dilute sulfuric acid
- C sodium metal and dilute sulfuric acid
- D zinc metal and dilute sulfuric acid

- 35 The table shows the results of metal displacement experiments.

Key

✓ - reaction observed; x – no reaction observed

metal	aqueous metal ion		
	X^{2+}	Y^{2+}	Z^{2+}
X	-	✓	✓
Y	x	-	x
Z	x	✓	-

Which option gives the metals in **decreasing order** of reactivity?

- A X, Y, Z
 B X, Z, Y
 C Y, Z, X
 D Z, X, Y
- 36 Which option shows a chemical reaction with the **highest** average rate of reaction?

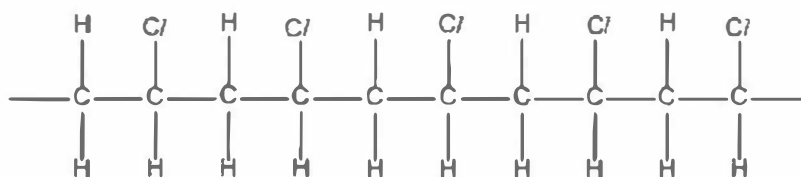
	volume of gas produced/cm ³	time/s
A	12	3
B	20	4
C	27	6
D	30	10

- 37 Which statements about ethanoic acid are correct?

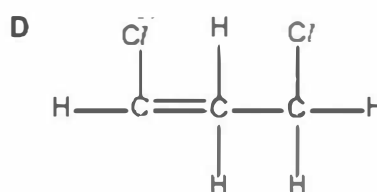
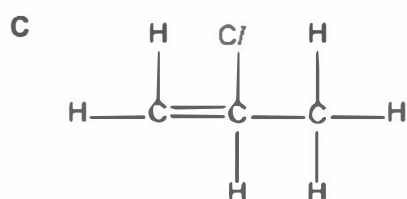
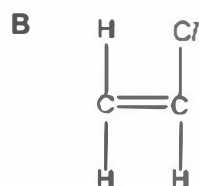
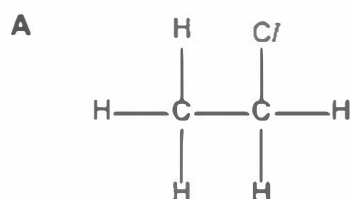
1. It burns completely to form carbon monoxide and water.
2. It reacts with sodium carbonate to form carbon dioxide.
3. It contains a C=O bond.
4. It is oxidised by potassium manganate(VII).

- A 1 and 3
 B 1 and 4
 C 2 and 3
 D 2 and 4

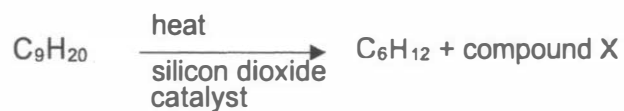
38 The diagram shows the structure of a polymer.



What is the monomer used to produce the polymer?



39 Which option about the following process is correct?



	name of process	compound X
A	cracking	propane
B	cracking	propene
C	fractional distillation	propane
D	fractional distillation	propene

40 Which statement about compounds in the same homologous series is **false**?

- A** They have the same general formula.
- B** They have the same functional group.
- C** They have the same structural formula.
- D** They have the same chemical properties.



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SECONDARY 4 EXPRESS**

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**SCIENCE (PHYSICS, CHEMISTRY)
SCIENCE (CHEMISTRY, BIOLOGY)**
Paper 3 (Section A)

**5086/03
5088/03
23 August 2024
1 hour 15 minutes**

Candidates answer on the Question Paper.

Setter(s):

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use staplers, paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

The number of marks is given in brackets [] at the end of each question or part question.

For examiner's use	
Section A	55

Section A [55 marks]

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

A1 Name the pieces of apparatus most suitable to complete the following laboratory actions:

(a) collect and measure the volume of hydrogen gas produced in a reaction:

..... [1]

(b) measure 4.50 g of zinc metal:

..... [1]

(c) add 18.9 cm³ of ethanol into a beaker.

..... [1]

[Total: 3]

A2 **Table 2.1** lists the nucleon number, proton number and number of electrons in several different particles. The letters **do not** represent the symbols of the elements.

Table 2.1

particle	nucleon number	proton number	number of electrons
A	28	14	14
B	27	13	10
C	56	26	26
D	30	14	14
E	4	2	2

Use Table 2.1 to state which of the particles **A, B, C, D, E** and **F**:

(a) belongs to an element in Period 4 of the Periodic Table, [1]

(b) are isotopes of the same element, and [1]

(c) is an atom with a stable electronic configuration, [1]

(d) contains 16 neutrons, [1]

(e) is an ion of an element in Group 13 of the Periodic Table. [1]

[Total: 5]

- A3** Fig. 3.1 below shows a 'dot-and-cross' diagram which represents the chemical bonding in boron trichloride, BCl_3 . Only valence electrons are shown in Fig. 3.1.

Boron trichloride is a substance which is commonly used to synthesise various organic compounds. It has a melting point of -107°C and a boiling point of 13°C .

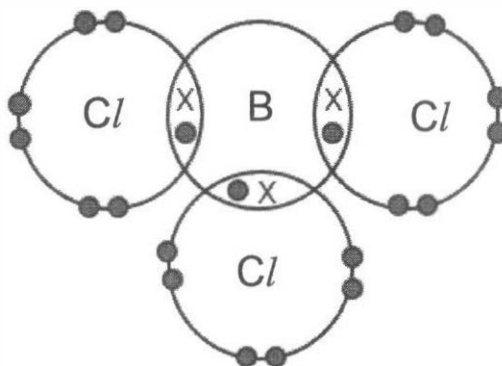


Fig. 3.1

- (a) Describe the arrangement and movement of particles in boron trichloride at room temperature.

.....

[2]

- (b) Based on the 'dot-and-cross' diagram, suggest what is unusual about the bonding in boron trichloride.

.....

[1]

- (c) Explain, in terms of structure and bonding, why boron trichloride has a low melting and boiling point.

.....

[2]

- (d) Besides boron, chlorine also reacts with magnesium to form a compound.

In the space below, draw a 'dot-and-cross' diagram to represent the bonding in the compound formed between magnesium and chlorine.

[2]

- (e) Besides melting and boiling point, describe **one** difference in physical property between boron trichloride and the compound drawn in (d).

.....

..... [1]

[Total: 8]

A4 Some reactions involving an unknown salt are shown in Fig. 4.1 below.

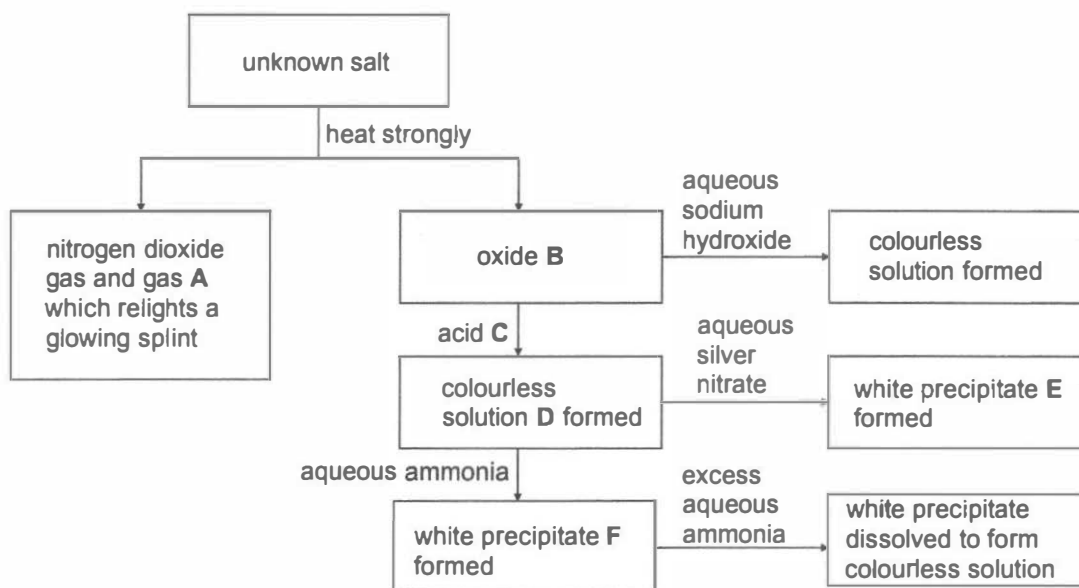


Fig. 4.1

- (a) Oxide **B** dissolves and reacts with both aqueous sodium hydroxide and acid **C**.

What type of oxide is oxide **B**?

..... [1]

- (b) Identify the following substances.

gas **A**:

oxide **B**:

acid **C**:

colourless solution **D**:

white precipitate **E**:

white precipitate **F**:

[6]

- (c) Write a balanced chemical equation for the reaction between colourless solution **D** and aqueous silver nitrate.

..... [2]

[Total: 9]

- A5 (a)** Rusting is one of the most significant factors which causes items made of iron and steel to degrade and break down.

(i) State the conditions required for rusting to occur.

..... [1]

(ii) State and explain **one** method which can be used to prevent iron and steel items from rusting.

.....
.....
..... [2]

- (b)** The main component of rust is iron(III) oxide, Fe_2O_3 .

One way of removing rust from objects made of iron and steel is to briefly dip the object into an acid, such as dilute sulfuric acid. The sulfuric acid dissolves the rust, according to the following equation:



Calculate the mass of rust which can be dissolved by 600 cm^3 of 0.7 mol/dm^3 dilute sulfuric acid.

mass of rust = g [3]

[Total: 6]

- A6** In an experiment, 5.0 g of magnesium carbonate lumps were reacted with excess dilute hydrochloric acid. The experiment was then repeated with 5.0 g of magnesium carbonate powder, using the same volume and concentration of hydrochloric acid. The results are shown in **Fig 6.1** below.

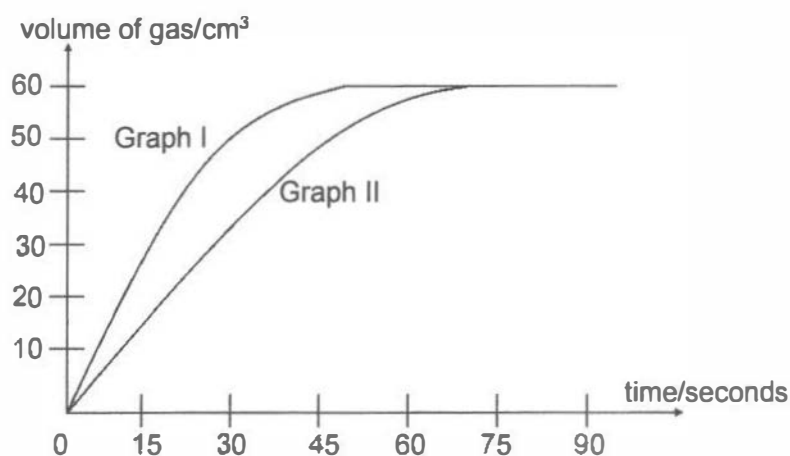


Fig. 6.1

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

..... [2]

- (b) Explain how the shapes of Graph I and Graph II show that the speed of the reactions change over time.

.....

..... [2]

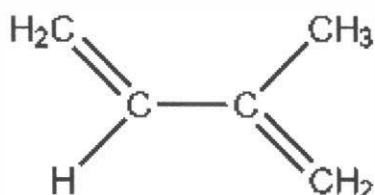
- (c) Identify the graph (Graph I or Graph II) which corresponds to magnesium carbonate **lumps** reacting with dilute hydrochloric acid. Explain your answer with reference to collision theory.

.....

..... [2]

[Total: 6]

- A7** Isoprene is a naturally-occurring organic compound which is produced by many species of plants, such as oak and eucalyptus trees. The structure of isoprene is given in Fig. 7.1 below.



isoprene

Fig. 7.1

- (a) Based on the structure of isoprene, it may be classified as a *polyunsaturated hydrocarbon*. Explain why.

.....

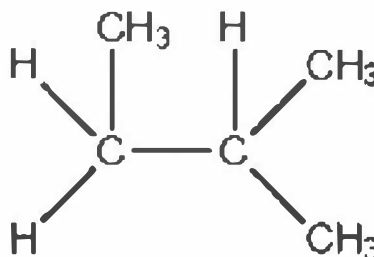
.....

.....

.....

[2]

- (b) Isoprene can be converted into 2-methylbutane, which is found in petrol. The structure of 2-methylbutane is given in Fig. 7.2 below.



2-methylbutane

Fig. 7.2

- (i) State the reactant(s) and condition(s) required to convert isoprene to 2-methylbutane.

.....

.....

[2]

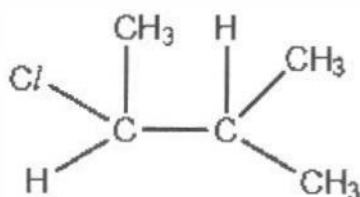
- (ii) Describe a chemical test that can be used to distinguish between isoprene and 2-methylbutane.

.....

.....

[2]

- (c) Under certain conditions, 2-methylbutane can be converted into compound Y, whose structure is given in Fig. 7.3 below.



Compound Y

Fig. 7.3

State the reactant(s) and condition(s) required to convert 2-methylbutane to Compound Y.

.....

..... [2]

[Total: 8]

- A8** Alcohols, such as ethanol, are among the most common organic compounds because of their wide variety of uses both in our daily lives and in chemistry.

- (a) Ethanol is manufactured by the fermentation of glucose.

Briefly describe this process.

Include in your answer the conditions needed for fermentation and how the ethanol is purified.

.....

.....

.....

.....

..... [3]

- (b) In certain countries, ethanol derived from plants such as sugarcane, known as bioethanol, is used as an alternative to fossil fuels to generate electricity.

Explain why burning bioethanol for energy is considered to be more environmentally sustainable than burning fossil fuels such as petrol.

.....

.....

..... [2]

The thiols are a homologous series of organic compounds which are closely related to the alcohols. However, instead of an -OH functional group, they contain an -SH functional group.

The names and chemical formulae of the first four members of the thiol homologous series are given in Table 8.1 below.

Table 8.1

name of thiol	chemical formula
methanethiol	CH ₃ SH
ethanethiol	C ₂ H ₅ SH
butanethiol	C ₄ H ₉ SH

- (c) Suggest the name and chemical formula of the third member of the thiol homologous series.

name:

chemical formula:

[2]

- (d) When alcohols, such as ethanol, are burnt completely in air, the only products formed are carbon dioxide and water.

However, when thiols are burnt completely in air, an additional product, besides carbon dioxide and water is formed. This additional product is an air pollutant.

- (i) Suggest the identity of the air pollutant which is formed when thiols are burnt.

..... [1]

- (ii) Explain why the air pollutant named in (d)(i) is harmful to the environment.

.....

.....

..... [2]

[Total: 10]



**SERANGOON SECONDARY SCHOOL
PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS**

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**SCIENCE (PHYSICS, CHEMISTRY)
SCIENCE (CHEMISTRY, BIOLOGY)**

Paper 3 (Section B)

5086/03

5088/03

**23 August 2024
1 hour 15 minutes**

Candidates answer on the Question Paper.

Setter(s):

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staplers, paper clips, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.

You may lose marks if you do not show your working or if you do not use appropriate units.

Section B

Answer only **one** question.

Write your answers in the spaces provided on the question paper.

The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Periodic Table is printed on the last page.

For examiner's use	
Section B	
Total	10

This question paper consists of 5 printed pages, including this cover page.

Section B [10 marks]

Answer **only one** question in this section.

Write your answers in the spaces provided.

B9 The Periodic Table contains an element with proton number 9 and another element with proton number 17.

- (a) Identify and name these **two** elements. State which group of the Periodic Table these elements are in.

.....

.....

.....

.....

[3]

- (b) Give the electronic structures of these **two** elements. Use these to explain why both elements appear in the same group of the Periodic Table.

.....

.....

.....

.....

[3]

- (c) Elements with proton numbers 3, 11 and 19 are in the same group of the Periodic Table. For these **three** elements, suggest **two** properties and **two** trends in their properties.

.....

.....

.....

.....

.....

[4]

[Total: 10]

B10 Shukado is a Japanese alloy of copper and a gold. The gold content in Shukado may be varied to control the colour of the alloy. Historically, Shukado was used to make items such as swords and jewellery.

- (a) Besides changing the colour of Shukado, the addition of gold also makes Shukado much harder than pure copper.

With reference to the structure of Shukado, explain why it is much harder than pure copper.

.....

.....

.....

.....

.....

[3]

- (b) In nature, copper exists as various ores, such as cuprite, Cu_2O .

Copper can be extracted from cuprite by heating it in hydrogen gas, as shown in the following equation:



Identify the substance which has been reduced in the equation above.
Explain your answer in terms of **oxygen**.

.....

.....

.....

[2]

- (c) Copper can also be used in 'Christmas Tree' toys.

In 'Christmas Tree' toys, a piece of copper wire, bent into the shape of a Christmas tree, is immersed into a transparent globe filled with colourless aqueous silver nitrate. After a while, a deposit of silver is formed, which falls onto the copper wire as 'snow'.

A diagram of a 'Christmas Tree' toy is shown in Fig. 10.1 below.

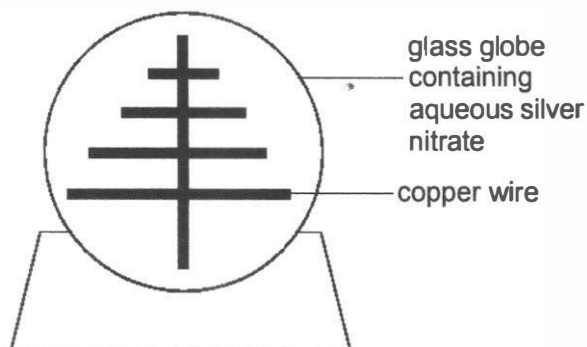


Fig. 10.1

- (i) Explain, using a balanced chemical equation, how silver is produced in the 'Christmas Tree' toy.

.....

.....

.....

.....

.....

.....

[4]

- (ii) Besides the formation of silver, suggest **one other** observation that can be made in the 'Christmas Tree' toy after a period of time.

.....

.....

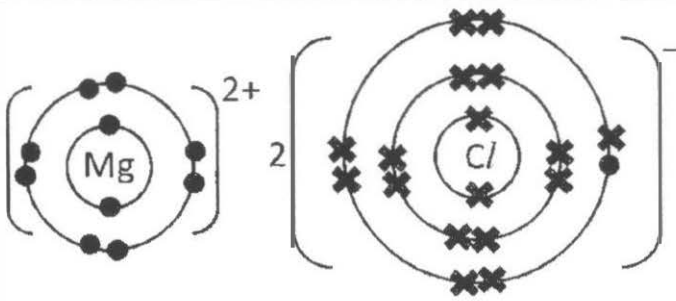
[1]

[Total: 10]

Serangoon Secondary School
4E Science (Chemistry) Prelim Exam 2024
Mark Scheme

P3 Section A

Question Number	Answer	Remarks
A1(a)	gas syringe (accept syringe)	1M per correct answer. R: spelling errors
A1(b)	electronic balance	
A1(c)	burette	
A2(a)	C	1M per blank, except A2(b) both correct for 1M
A2(b)	A, D	
A2(c)	E	
A2(d)	D	
A2(e)	B	
A3(a)	arrangement – very far apart, random arrangement movement – move freely at high speeds	Arrangement must mention both packing and arrangement for 1M. 1M for each of arrangement and movement, total 2M.
A3(b)	Boron atom does not have a fully-filled valence shell/only has 6 valence electrons instead of 8/does	R: 'Boron atom has only 6 electrons' or 'only 6 valence electrons' without reference to why it is unusual.

	not have a stable electronic configuration of a noble gas Accepted 'need two more electrons to be stable'	
A3(c)	The compound has simple molecular structure; With weak attractive forces between molecules; Only a small amount of energy required to overcome such forces, for melting/boiling to occur.	1M: structure + IMF Note: If "between molecules" or similar phrases not mentioned, no credit given. 1M: small amount of energy
A3(d)	 1M for each correct ion -1M for only valence electrons shown	
A3(e)	electrical conductivity boron trichloride does not conduct electricity in any physical state, but magnesium chloride conducts electricity in molten and aqueous states	1M for correctly stated physical properties of both compounds contrasted.

	OR solubility boron trichloride is soluble in organic solvents/insoluble in water but magnesium chloride is soluble in water/insoluble in organic solvents OR Boron trichloride has a lower density than magnesium chloride OR Magnesium chloride is hard and brittle but not boron trichloride.	
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A4(a)	Oxide B is amphoteric .	
A4(b)	gas A - oxygen oxide B – zinc oxide acid C – hydrochloric acid solution D – zinc chloride white precipitate E – silver chloride white precipitate F – zinc hydroxide	Accept correct chemical formulae in place of names. Overall penalise 1M if Zinc(II)... is written.
A4(c)	$\text{ZnCl}_2 + 2\text{AgNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + 2\text{AgCl}$	1M for formulae; 1M for balancing if formulae are correct.
A5(a)(i)	Presence of oxygen/air and water/moisture .	Both conditions for 1M. Accepted 'damp'
A5(a)(ii)	Methods: • Greasing/ lubricant • painting • galvanisation • plastic/tin coating (accept any reasonable example of barrier methods)	1M

	Explanation: A protective layer is formed on the surface of the metal; this prevents oxygen and water from coming into contact with the metal.	1M
A5(c)	no. of mole of sulfuric acid = $0.6 \times 0.7 = 0.42 \text{ mol}$ mole ratio: rust : sulfuric acid = 1:3 number of moles of rust $= 0.42 \div 3 = 0.14$ mass of rust = mol $\times$ M_r $= 0.14 \times (2 \times 56 + 3 \times 16)$ $= 22.4 \text{ g}$	1M (mole of H_2SO_4) 1M (mole of rust) 1M (mass of rust)
A6(a)	$\text{MgCO}_3 + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$	1M for formulae; 1M for balancing if formulae are correct.
A6(b)	For both graphs, the gradient becomes less steep/gentler with time; This suggests that rate of reaction decreases with time.	1M Accepted 'slope' in replacement of 'gradient'. 1M
A6(c)	Graph II	

	Magnesium carbonate lumps have a smaller surface area for reacting particles to collide into; collisions between reactant particles become less frequent; as such, there is a lower frequency of effective collisions , which results in lower rate of reaction .	1M – smaller surface area; 1M – lower frequency of effective collisions If incorrect graph chosen but correct explanation, max 1M.
A7(a)	Polyunsaturated – Isoprene contains more than 1/multiple C=C double bonds Hydrocarbon – it contains only C & H atoms	1M per correct definition
A7(b)(i)	Hydrogen gas Nickel catalyst; 150 to 200°C	1M – reactant 1M – both conditions correct (accepted a range of temperatures)
A7(b)(ii)	Add bromine water/aqueous bromine to both compounds separately. Only isoprene decolourises aqueous bromine (2-methylbutane shows no visible change)	1M – test 1M – observation
A7(c)	chlorine gas; presence of sunlight/UV light	1M – reactant 1M – condition
A8(a)	Conditions for fermentation: • presence of yeast	No conditions listed – 0M 1 or 2 conditions listed – 1M

	• temperature of 37°C • absence of oxygen/air Alcohol is purified by fractional distillation.	3 conditions listed – 2M 1M
A8(b)	When plants such as sugarcane are grown for bioethanol, they absorb carbon dioxide during photosynthesis; This offsets the carbon dioxide released during combustion of bioethanol.	1M per point
A8(c)	name: propanethiol formula: C_3H_7SH	1M per correct answer B.O.D given to minor spelling error.
A8(d)(i)	sulfur dioxide	1M
A8(d)(ii)	It reacts with oxygen and water in the atmosphere to form acid rain; Acid rain leads to death of wildlife/leaching of nutrients from soil	1M 1M – accept any reasonable environmental impact of acid rain E of CO: 1M: forms stable compound with red blood cells. 1M: prevents the transport of oxygen to other parts of the body. Reject CO is a greenhouse gas that leads to global warming.

		Methane: 1M: greenhouse gas that cause global warming 1M: any reasonable effect of global warming on the environment. Oxides of nitrogen Same marking points as sulfur dioxide.
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Section B

Students need to be aware that they only need to answer one question in Section B and not attempt both questions. In situations where both questions are attempted, only the score of the first question will be taken with the score of the second question not taken.

Question Number	Answer	Remarks
A9(a)	proton number 9 – fluorine ;	1M
	proton number 17 – chlorine ;	1M
	Elements are in Group 17 .	1M
A9(b)	Fluorine – 2.7;	1M
	Chlorine – 2.8.7;	1M
	Since both elements have same number of valence electrons/both have 7 valence electrons in their atom, they are in the same group.	1M
A9(c)	similarities: • All of them are soft • All of them have low MP & BP • All of them have low density • All of them react with water to form metal hydroxide and hydrogen	1M per correct similarity for 2M total.
	trends:	1M per correct trend for 2M total.

	• MP & BP decrease down the group • Density increases down the group • Reactivity increases down the group. Accept “malleable,” “ductile,” “good conductors of electricity” and “one valence electron” as properties. (Please remind the students not to write generic answers that can be applicable to all contexts unless the question ask for general answers like “What are the general properties of the given metals OR metals?” Students should answer the question accordingly to the given context given, which is in this case, Group 1 metals. Pls see the answer key above for the desired answers.)	
A10(a)	Gold atoms are different size from/larger than copper atoms; Presence of gold atoms prevents the layers of copper atoms from sliding over each other when a force is applied This is because the orderly arrangement of atoms is disrupted.	1M 1M 1M

A10(b)	Cu₂O is reduced. It lost oxygen to form Cu.	1M 1M
A10(c)(i)	2AgNO₃ + Cu → Cu(NO₃)₂ + 2Ag Copper is more reactive than silver; It displaces silver from silver nitrate.	2M: equation • 1M for formulae • 1M for balancing 1M 1M
A10(c)(ii)	Colourless solution turns blue.	1M