

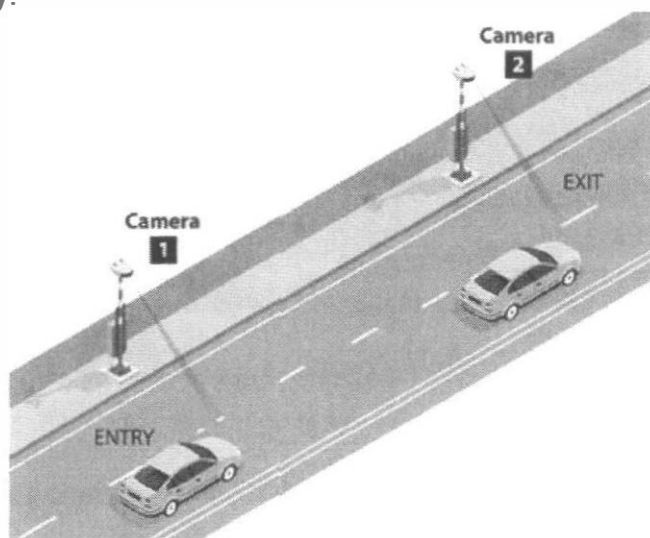
Name: Register no: Class:

**NGEE ANN SECONDARY SCHOOL****0****PRELIMINARY EXAMINATION****SCIENCE PHYSICS/CHEMISTRY****5086/01****PAPER 1****23 August 2024****1 h****Additional
Materials:** **Optical Answer Sheet****READ THESE INSTRUCTIONS FIRST**

1. Write in soft pencil.
2. Do not use staples, paper clips, highlighters, glue or correction fluid.
3. Write your name and index number on the Optical Answer Sheet in the spaces provided unless this has been done for you.
4. There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.
5. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Optical Answer Sheet.
6. **Read the instructions on the Optical Answer Sheet very carefully.**
7. Each correct answer will score one mark. A mark will not be deducted for a wrong answer. The total number of marks for this paper is **40**.
8. Any rough working should be done in this booklet.
9. A copy of the Data sheet and Periodic Table are printed on page **20** and **21** respectively.
10. The use of an approved scientific calculator is expected, where appropriate.

This document consists of **21** printed pages and **1** blank page.

- 1 Which pair consists of two vector quantities?
- A velocity and moment
B pressure and force
C mass and energy
D potential difference and acceleration
- 2 The diagram shows two cameras used to determine the average speed of a car along a stretch of road. Cameras 1 and 2 detect the entry and exit of the vehicle along that stretch respectively.



The diagrams below show the times at which cameras 1 and 2 capture the entry and the exit of the vehicle. The distance between the two cameras is 800 m.



At entry



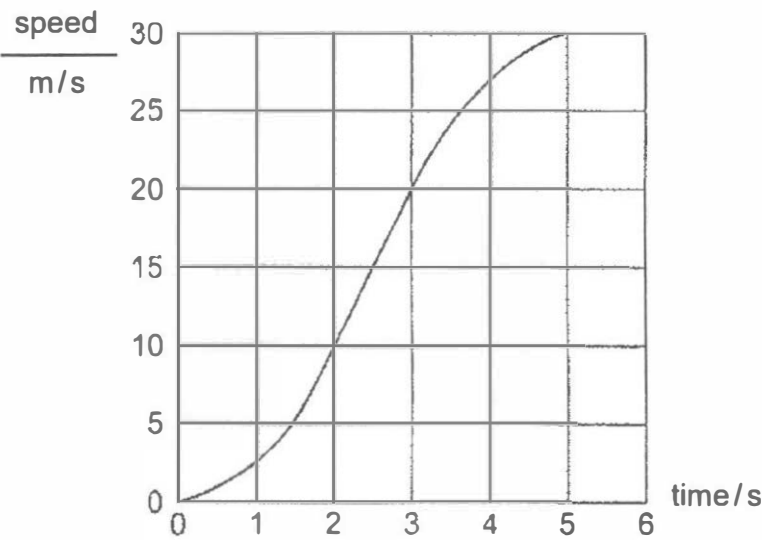
At exit

What is the average speed of the vehicle between the two cameras?

- A 6.6 m/s B 7.4 m/s C 8.4 m/s D 31 m/s

3 The graph shows the speed of a car as it starts from rest.

During part of this time, the acceleration is uniform.

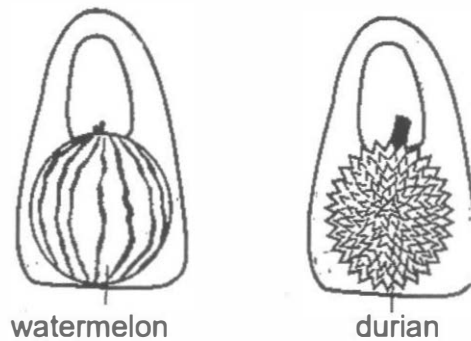


What is the magnitude of this uniform acceleration?

- A** 5.0 m/s² **B** 6.0 m/s² **C** 10 m/s² **D** 20 m/s²
- 4 An astronaut sits in a space shuttle which takes off from the surface of the Earth.
- During his journey into space, what happens to the mass and weight of the astronaut due to the gravitational field of the Earth?

	mass	weight
A	unchanged	increases
B	unchanged	decreases
C	decreases	increases
D	decreases	decreases

- 5 The diagram shows a watermelon and durian placed in two similar plastic bags. Both the watermelon and durian have the same mass.



Why is the plastic bag containing the durian more likely to tear than the one containing the watermelon?

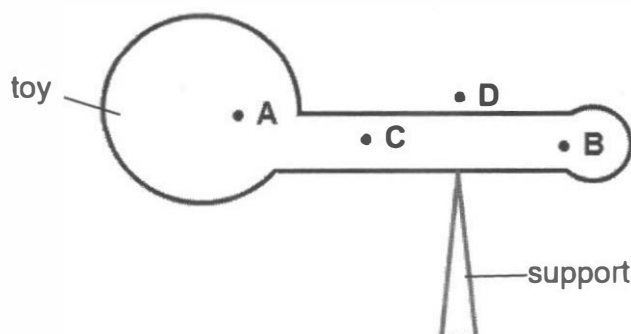
- A** The force exerted by the durian on the plastic bag is larger than that exerted by the watermelon on the plastic bag.
- B** The force exerted by the durian on the plastic bag is smaller than that exerted by the watermelon on the plastic bag.
- C** The pressure exerted by the durian on the plastic bag is smaller.
- D** The pressure exerted by the durian on the plastic bag is larger.
- 6 An object is moving to the right at constant speed. It is then acted upon by the three forces as shown in the diagram below.



What is the effect of these three forces on the motion of the object?

- A** The object moves to the right with constant speed.
- B** The object moves to the right with a constant acceleration.
- C** The object moves to the left with constant speed.
- D** The object comes to a stop immediately.

- 7 The diagram shows a toy being balanced on the tip of a support



Which point is likely to be the centre of gravity of the toy?

- 8 A boat pulls a fishing net with some fish for 5.0 km. The force it has to apply is 2000 N.

What is the work done in pulling the net with the fish?

- A 10 kJ B 10 MJ C 10 GJ D 10 TJ
- 9 A substance consists of particles that are close together and moving past each other at random.

During heating, the substance changes its state of matter.

What happened to the substance and its internal kinetic energy during change in state?

	substance	internal kinetic energy
A	changes from solid to liquid	unchanged
B	changes from solid to liquid	increases
C	changes liquid to gas	unchanged
D	changes liquid to gas	increases

- 10 A sound wave travels from a point X to a point Y.

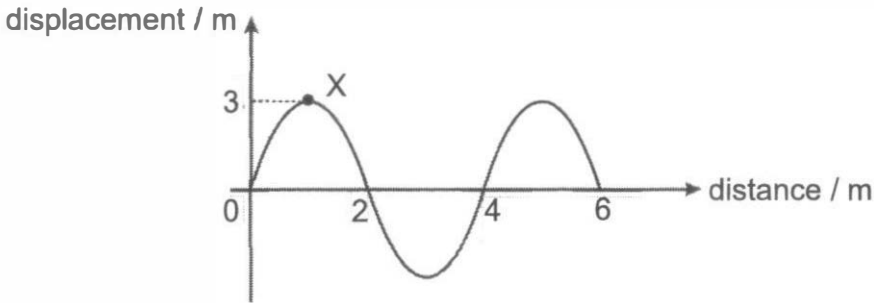


Which diagram represents the movement of the air molecules, due to the sound waves, in the region between X and Y?



- 11 The diagram shows the displacement-distance graph of a wave travelling along a rope at a particular instant. Particle X in the rope has a displacement of 3 m.

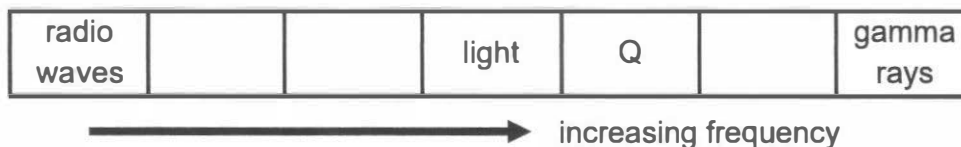
For the next 0.2 s, particle X moves a distance of 3 m.



Which statement is correct?

- A The period of the wave is 0.8 s.
- B The wavelength of the wave is 2 m.
- C The wave is a longitudinal wave.
- D The speed of the wave is 0.8 m/s.

- 12 The diagram shows the main components of the electromagnetic spectrum arranged in the order of increasing frequency. Some of the components are labelled.

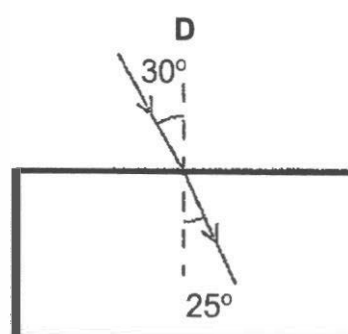
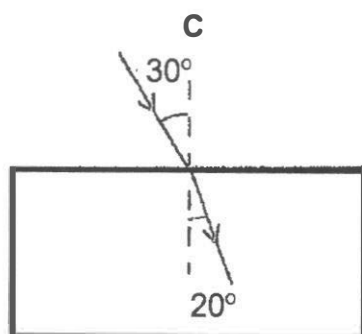
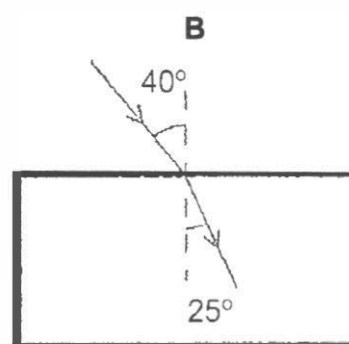
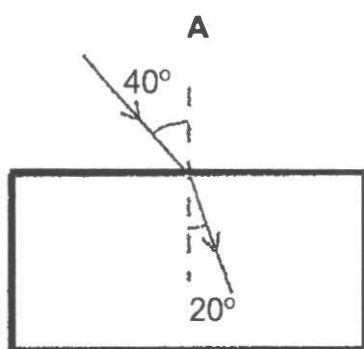


Which row describes electromagnetic wave Q?

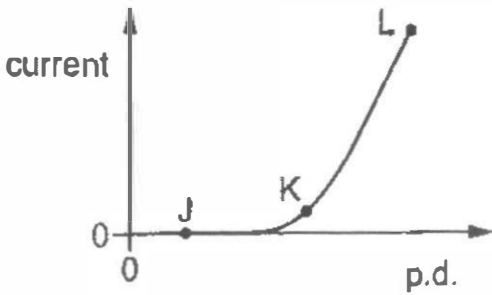
	name of Q	application of Q
A	infrared waves	sterilise medical equipment
B	infrared waves	television remote controller
C	ultraviolet waves	sterilise medical equipment
D	ultraviolet waves	television remote controller

- 13 Light travels from air into a transparent block.

Which block is made from the material in which the speed of light is 1.97×10^8 m/s ?



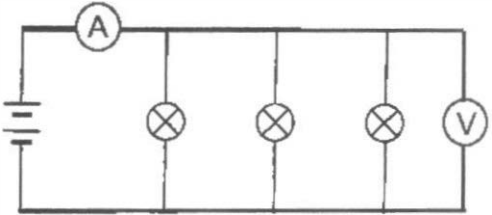
- 14 The graph shows how the current in an electrical device varies with the potential difference (p.d) across it.



What is the order of the resistance values of the electrical device at points J, K and L?

	largest	→	smallest
A	J	K	L
B	J	L	K
C	K	L	J
D	L	K	J

- 15 Three similar light bulbs are connected to a set of batteries as shown in the diagram.



The filament of one of the bulbs breaks.

What happens to the voltmeter reading and ammeter reading?

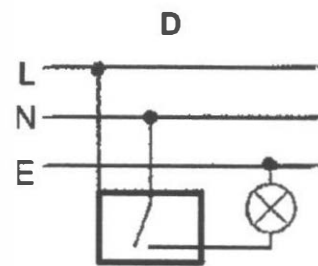
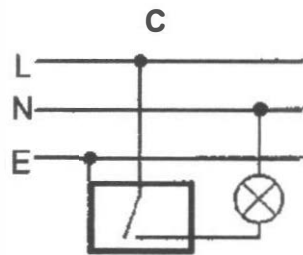
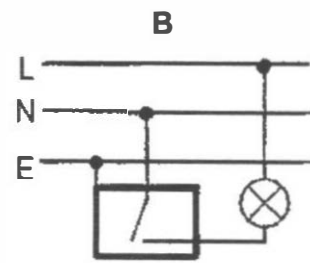
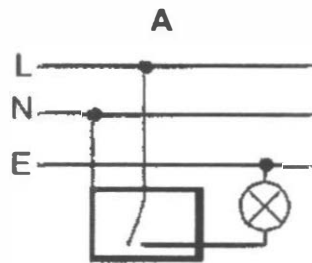
	voltmeter reading	ammeter reading
A	decreases	increases
B	decreases	decreases
C	unchanged	increases
D	unchanged	decreases

- 16** The power rating of a 37-inch LCD television is 300 W. The consumer is charged 30 cents per kWh of energy transferred electrically from the mains supply.

What is the cost of using LCD television for 5 hours?

- A** 45 cents **B** 450 cents **C** 4500 cents **D** 45 000 cents

- 17** Which diagram shows the correct connections for a switch and lamp in a light circuit?



key

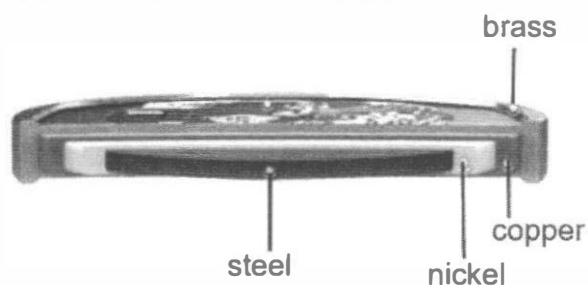
L live

N neutral

E earth

 metal case

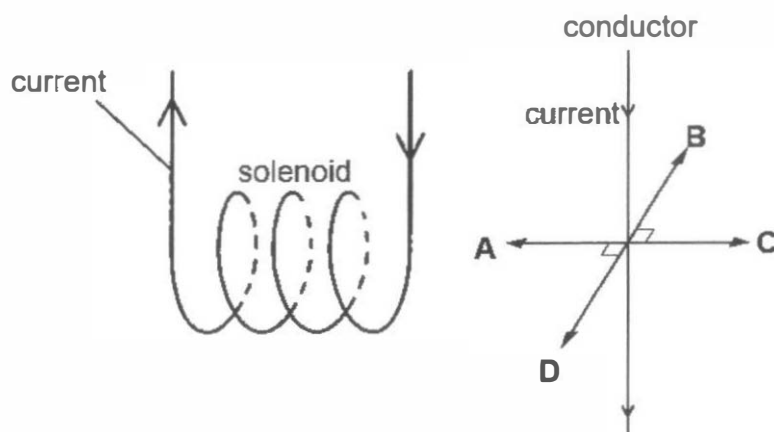
- 18 The diagram shows the cross-sectional composition of a third series Singapore \$1 coin and the metals that are used to construct the coin.



A magnet is placed near to the coin and the coin is attracted to the magnet.

Which of the following pair of metals accounts for the attraction?

- A steel and copper
 - B copper and brass
 - C brass and nickel
 - D steel and nickel
- 19 The diagram shows a solenoid near to a conductor. Current flows through the solenoid and conductor in the direction as shown.



A magnetic force exerts on the conductor.

What is the direction of the force on the conductor?

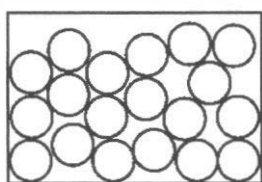
- 20** A researcher wants to use a radioactive source with a count rate of 100 counts per second for an experiment he plans to start at 10.00 am.

He has four different sources, each of which has a count rate of 400 counts per second at 9.00 am.

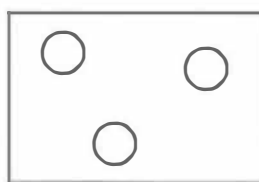
Which source should he choose?

- A** a source with a half-life of 15 minutes
- B** a source with a half-life of 20 minutes
- C** a source with a half-life of 30 minutes
- D** a source with a half-life of 60 minutes

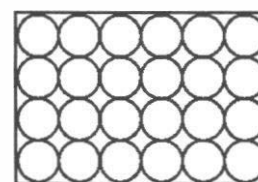
- 21** The arrangements of particles of a substance in three different physical states are shown.



state 1



state 2

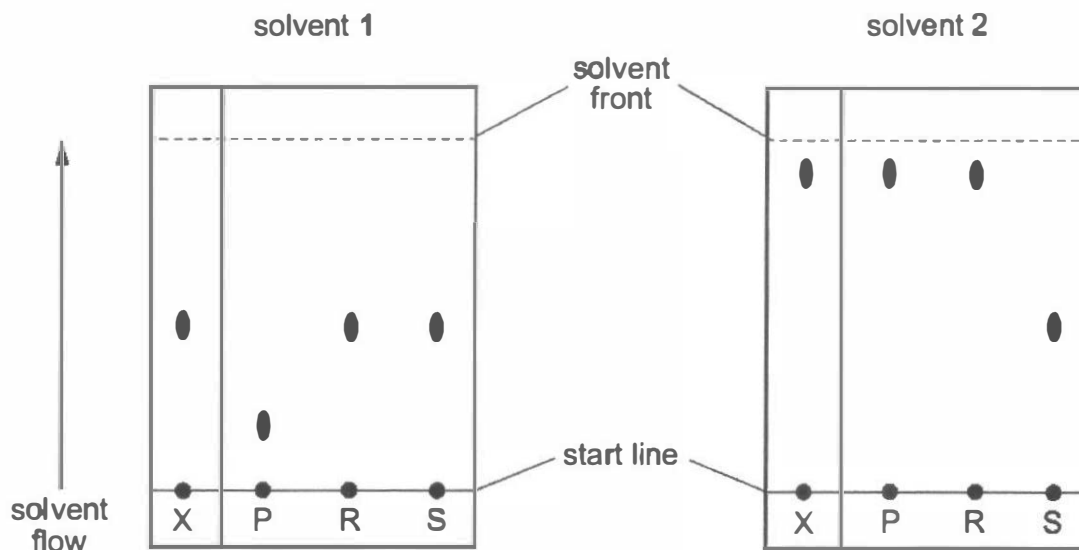


state 3

Which statement is correct?

- A** State 1 changes to state 3 by evaporation.
- B** State 2 changes to state 1 by freezing.
- C** State 1 changes to state 2 by condensing.
- D** State 3 changes to state 2 by sublimation.

- 22 Solution X contains one or more of three substances, P, R and S. Two different solvents are used to produce two chromatograms comparing solution X with the three substances. The results are shown.



What does X contain?

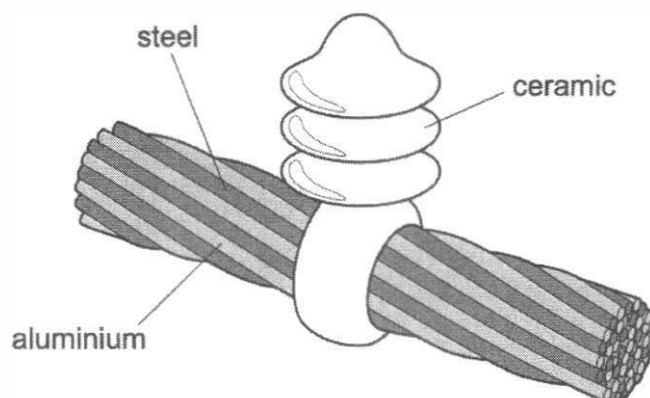
- A R only
 B P and R
 C R and S
 D P, R and S
- 23 The relative abundance of three different isotopes of lead in a sample of lead ore is shown in the following table.

isotope	% abundance	Ar
1	50	206
2	25	208
3	25	209

What is the relative atomic mass of the lead in the sample?

- A 207.00
 B 207.25
 C 207.50
 D 207.67

- 24 The diagram shows a section of an overhead power cable.



- Which statement explains why a particular substance is used?
- A Aluminium has a low density and is a good conductor of electricity.
- B Ceramic is a good conductor of electricity.
- C Steel can rust in damp air.
- D Steel is more dense than aluminium.
- 25 A compound of element X has the formula XCl_4 and a relative formula mass of 190. What is element X?
- A cadmium, Cd
- B gadolinium, Gd
- C sulfur, S
- D titanium, Ti

- 26 The pH value of some of the common household substances are shown below.

household substance	pH value
bicarbonate of soda	9
bleach	12
drain cleaner	14
lemonade	2
milk	6
vinegar	3

Which statement is correct?

- A Drain cleaner can neutralise bicarbonate of soda.
- B Lemonade, milk and bicarbonate of soda are all acidic.
- C Milk, lemonade and vinegar are all bases.
- D Vinegar can neutralise bicarbonate of soda.
- 27 54.75 g of hydrated calcium chloride crystals are heated to produce anhydrous calcium chloride and water vapour.



What is the mass of anhydrous calcium chloride formed?

- A 0.5 g
- B 25.9 g
- C 27.8 g
- D 43.7 g

- 28** Y gives a white precipitate when aqueous silver nitrate is added.

When heated with aqueous potassium hydroxide, Y gives off a gas that turns moist litmus paper blue.

What is Y?

- A** ammonium chloride
- B** ammonium sulfate
- C** sodium chloride
- D** sodium hydroxide

- 29** X, Y and Z are three metals.

When Z is heated with the oxide of X, the metal X is formed.

When X is added to a solution of Y^{2+} ions, no reaction takes place. What is the order of reactivity of the metals?

	least reactive	→	most reactive
A	X	Y	Z
B	Y	X	Z
C	Y	Z	X
D	Z	Y	X

- 30** Which statements about elements in Group 1 of the Periodic Table are correct?

- 1 They become less reactive going down the group.
- 2 Sodium forms positive ions more easily than lithium.
- 3 Their melting points increase going down the group.
- 4 Rubidium is more dense than sodium.

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

- 31** Carbon dioxide reacts with carbon to form carbon monoxide.



Which row describes what happens to the carbon dioxide and to the carbon during the reaction?

	carbon dioxide	carbon
A	oxidised	oxidised
B	oxidised	reduced
C	reduced	oxidised
D	reduced	reduced

- 32** Excess magnesium ribbon is reacted with 10 cm³ of dilute hydrochloric acid. The hydrogen gas produced is collected and measured.

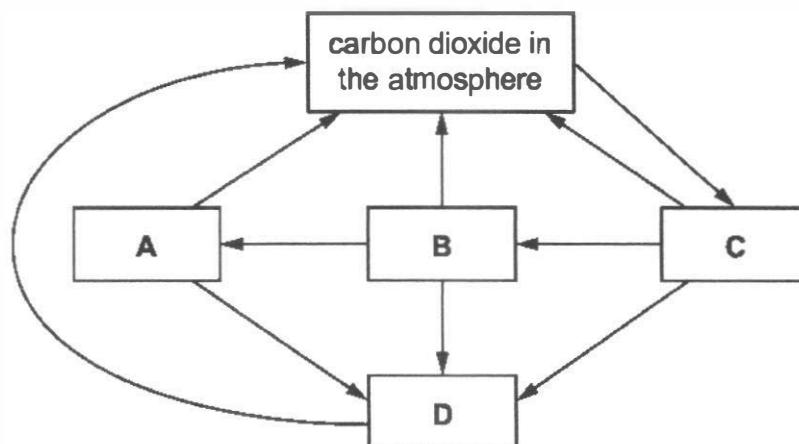
Which change to the reaction conditions would increase the rate of reaction **and** the volume of the hydrogen produced?

- A** Use a lower temperature.
- B** Use a transition metal catalyst.
- C** Use concentrated hydrochloric acid.
- D** Use powdered magnesium.

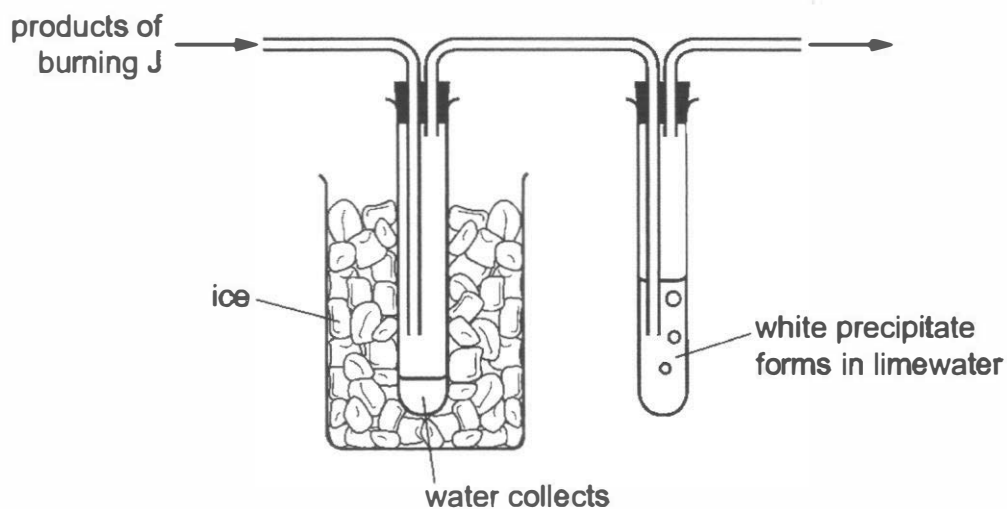
- 33** Which row identifies a substance present in clean air and a substance that is a pollutant in air?

	present in clean air	pollutant in air
A	oxides of nitrogen	nitrogen
B	carbon dioxide	sulfur dioxide
C	carbon monoxide	lead compounds
D	nitrogen	argon

- 34 Which labelled box represents plants in the carbon cycle?



- 35 The products formed by burning substance J are passed through the apparatus shown.



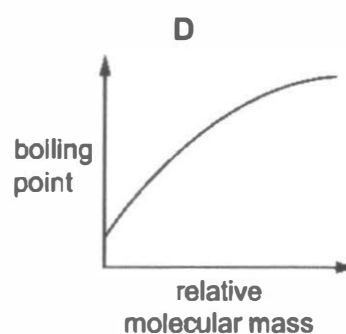
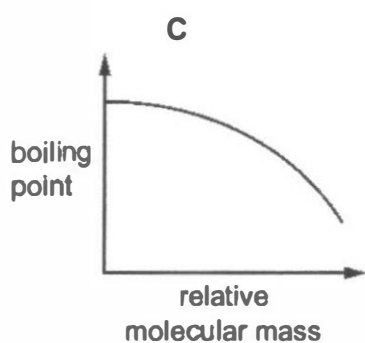
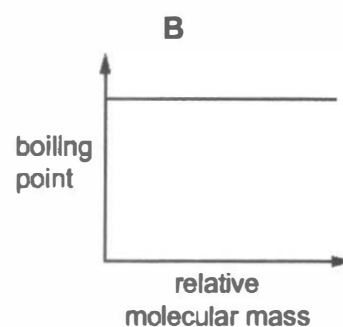
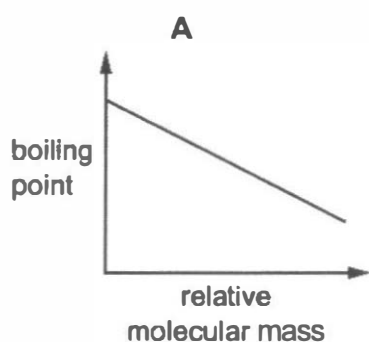
What is substance J?

- A carbon monoxide
- B hydrogen
- C propane
- D sulfur

- 36 Methane reacts with an excess of chlorine in the presence of ultraviolet light to form a mixture of products.

How many of these products contain one carbon atom and one or more chlorine atoms?

- A 1
B 2
C 3
D 4
- 37 Which graph represents the change in boiling point of the alcohols as their relative molecular mass increases?



- 38 Ethanoic acid, CH_3COOH , reacts with magnesium carbonate.

Which of the following equation represents the reaction?

- A $\text{CH}_3\text{COOH} + \text{MgCO}_3 \rightarrow \text{CH}_4\text{C}_2\text{O}_5\text{Mg}$
 B $\text{CH}_3\text{COOH} + \text{MgCO}_3 \rightarrow \text{CH}_2\text{COOMg} + \text{H}_2\text{O} + \text{CO}_2$
 C $2\text{CH}_3\text{COOH} + \text{MgCO}_3 \rightarrow (\text{CH}_4\text{C}_2\text{O}_3)_2\text{Mg}$
 D $2\text{CH}_3\text{COOH} + \text{MgCO}_3 \rightarrow (\text{CH}_3\text{COO})_2\text{Mg} + \text{H}_2\text{O} + \text{CO}_2$

- 39 Some plastics can be recycled using the physical method or the chemical method. Before recycling is carried out, the plastic waste needs to undergo the pre-treatment process.



Which of the following is the correct sequence to the pre-treatment process?

- A manual sorting → shredding into smaller pieces → washing
 - B manual sorting → washing → shredding into smaller pieces
 - C shredding into smaller pieces → washing → manual sorting
 - D washing → shredding into smaller pieces → manual sorting
- 40 What happens to plastic waste when left in the environment?



- A It is a biodegradable material so it eventually disintegrates.
- B It never fully goes away as it breaks into little pieces.
- C The animals will consume the plastic waste.
- D There is no plastic waste as all plastic is recycled.

-- End of paper --

Name: Register no: Class:

**NGEE ANN SECONDARY SCHOOL****PRELIMINARY EXAMINATION**
SCIENCE (PHYSICS, CHEMISTRY)
SCIENCE (BIOLOGY, CHEMISTRY)
5086/03**5088/03****26 August 2024**

Paper 3 Chemistry

1 h 15 min
Candidates answer on the Question Paper.
No additional materials are required.
READ THESE INSTRUCTIONS FIRST
Write your name, register number and class at the top of this page.
You may use an HB pencil for any diagrams, graphs or rough working.
Write in dark blue or black pen.
Do not use staples, 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 AAnswer **all** questions.

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

For Examiner's Use**Section B**Answer **any one** question.

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

A copy of the Data Sheet is printed on page 17.

A copy of the Periodic Table is found on page 18.

Section	Marks
A	/55
B	/10
Total	/65

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

Checked by student:

Date:

This document consists of **18** printed pages and **2** blank pages.

Section A

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

- 1** Use the list of substances to answer the questions.

You may use each substance once, more than once, or not at all.

bromine

helium

ammonia

sulfur dioxide

aluminium oxide

calcium hydroxide

ammonium chloride

Identify a substance which:

- (a)** is a monatomic substance.

..... [1]

- (b)** reacts with both alkalis and acids.

..... [1]

- (c)** is used by farmers to reduce the acidity of soil.

..... [1]

- (d)** exists as a diatomic molecule.

..... [1]

[Total: 4]

2 (a) Table 2.1 describes and names different types of reactions.

Complete Table 2.1.

Table 2.1

description of reaction	type of reaction
many monomers forming a polymer	polymerisation
changing long-chain hydrocarbons into short-chain hydrocarbons	
gives out energy, often in the form of heat, to the surroundings	
two solutions react to form an insoluble salt	
the oxidation state of an element decreases	

[4]

(b) Potassium reacts with chlorine gas to form potassium chloride, an ionic compound. Solid potassium chloride contains a lattice of potassium ions, K^+ , and chloride ions, Cl^- .

(i) Describe how a potassium atom forms a potassium ion.

.....
..... [1]

(ii) Explain, in terms of structure and bonding, why potassium chloride cannot conduct electricity in the solid state.

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

(iii) An ion of one of the isotopes of potassium has the symbol shown.



Determine the number of each of these particles found in one ion of this isotope.

electrons protons neutrons [2]

[Total: 9]

3 Alkenes and alcohols are two different homologous series.

(a) Ethanol can be produced by the fermentation of glucose.

- (i) State the **two** conditions required for the fermentation process and give a reason for each condition.

condition 1

reason

condition 2

reason [2]

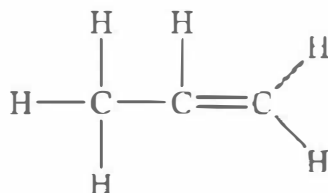
- (ii) Write a balanced chemical equation for the fermentation of glucose.

.....[1]

- (iii) Ethanol can be oxidised to form ethanoic acid. Draw the full structural formula of ethanoic acid. Show all bonds in your answer.

[1]

- (b) The structure of propene, the second member of the alkene homologous series, is shown.



- (i) Use the structure to explain why propene is unsaturated.

.....

..... [1]

(ii) Describe a chemical test to show that propene is unsaturated.

test

.....

observation

..... [2]

(iii) Propene is used to make the addition polymer, poly(propene). Draw the structural formula of **three** repeating units of poly(propene).

[2]

(iv) Describe **two** methods of recycling plastics.

1

.....

2

.....

[2]

[Total: 11]

- 4 Zinc nitrate is a soluble salt prepared from an insoluble base and an acid.

Zinc hydroxide is a suitable insoluble base.

Stage 1 – Excess zinc hydroxide is added to dilute acid. The mixture is stirred and warmed.

Stage 2 – The excess zinc hydroxide is separated from the aqueous zinc nitrate formed in stage 1.

Stage 3 – Aqueous zinc nitrate is left in air to form crystals.

- (a) Name the acid used in **stage 1**.

..... [1]

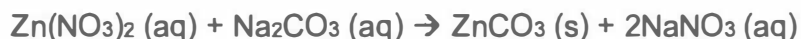
- (b) Suggest why the mixture is stirred and warmed in **stage 1**.

.....
..... [1]

- (c) Name the method of separation used in **stage 2**.

..... [1]

- (d) 1.00 g zinc nitrate powder and 1.00 g sodium carbonate powder were added to water and mixed. Solid zinc carbonate and sodium nitrate solution were formed.



- (i) Calculate the number of moles of zinc nitrate.

number of moles = mol [1]

- (ii) Calculate the number of moles of sodium carbonate.

number of moles = mol [1]

- (iii) Determine the limiting reagent, showing your working and reasoning clearly. Hence, calculate the mass of zinc carbonate produced.

limiting reagent

explanation

.....

.....

mass of zinc carbonate = g [2]

[Total: 7]

- 5 Air pollution is a result of both natural processes and human activities. Carbon monoxide, nitrogen dioxide, nitrogen monoxide and sulfur dioxide are common pollutants found in the air.

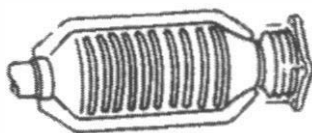
(a) State the source of sulfur dioxide and its effect on health or the environment.

source

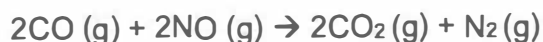
effect [1]

- (b) Carbon monoxide, CO, and nitrogen monoxide, NO, are both produced in a car engine.

When a catalytic converter is fitted into the car, it changes these two gases into less harmful gases.



The chemical reaction between these two gases is shown below.



- (i) The reaction between carbon monoxide and nitrogen monoxide is a redox reaction. Explain why the reaction involves both reduction and oxidation.

reduction

.....

oxidation

.....

[2]

- (ii) Draw a 'dot-and-cross' diagram to show the bonding in a molecule of CO₂.

Show only the outer shell electrons.

[2]

- (iii) "Installing catalytic converters in cars does not solve all environmental problems."

Using the information given in the question, suggest a reason for the statement above.

.....

..... [1]

[Total: 6]

- 6 Fig. 6.1 describes some of the substances that result from the chemical reactions of a mixture of two metal oxides, **R**. It also shows some of the chemical reactions of the products **S** and **T**.

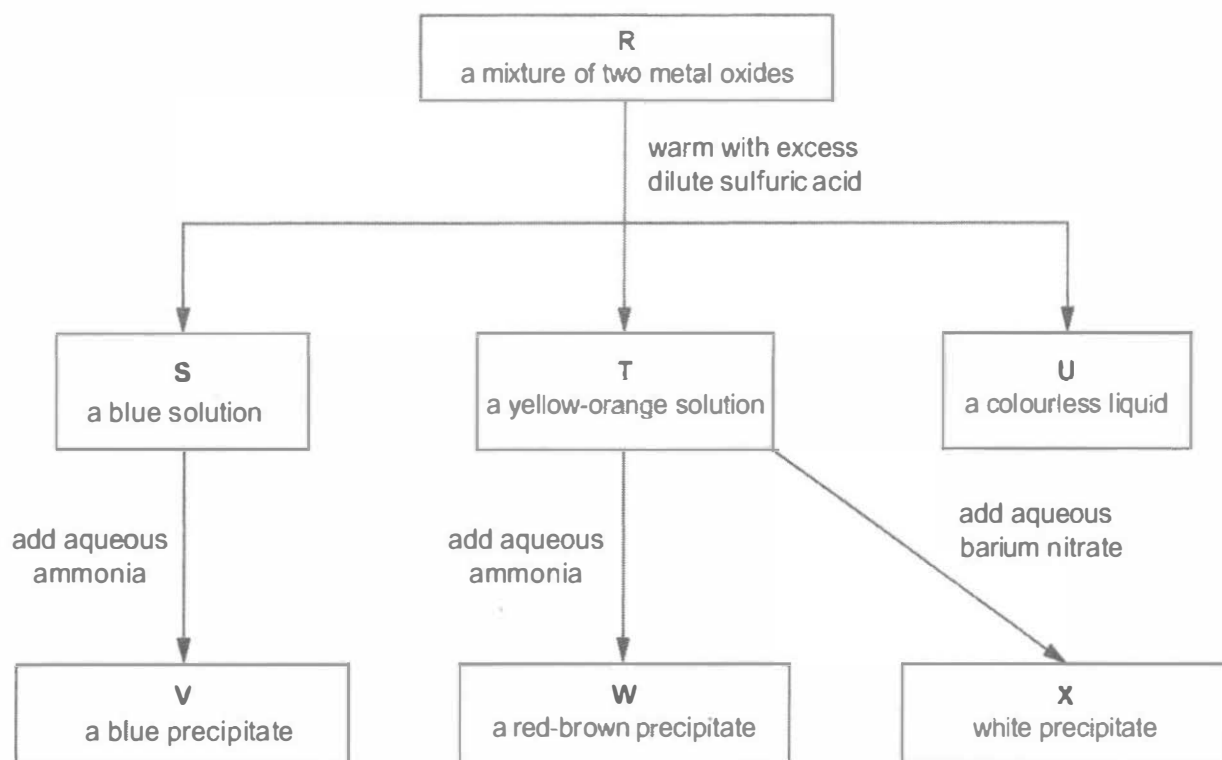


Fig. 6.1

- (a) Identify each of **S**, **T**, **U**, **V**, **W** and **X**.

S

T

U

V

W

X [6]

- (b) Write a balanced chemical equation, including state symbols, for any **one** of the reactions shown in Fig. 6.1.

..... [2]

[Total: 8]

- 7 (a)** Table 7.1 shows some information about the elements in Group 17 of the Periodic Table.

Table 7.1

element	atomic symbol	proton number	electronic configuration	melting point/°C
fluorine	F	9		-220
chlorine	Cl	17		-101
bromine	Br	35	2,8,18,7	-7.2
iodine	I	53	2,8,18,18,7	114

- (i)** State the name given to elements in Group 17 of the Periodic Table.

..... [1]

- (ii)** Complete Table 7.1 by filling in the electronic configuration of fluorine and chlorine.

Use the electronic configurations to explain why these two elements are placed in Group 17.

.....

 [2]

- (iii)** Describe the pattern shown by the melting points of the elements in Group 17.

.....
 [1]

- (iv) Use your knowledge of the kinetic particle theory and structure to help you explain the trend described in (a)(iii).

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

- (b) Chlorine displaces a halogen from each of the halide ions below it in Group 17.

- (i) Write a balanced ionic equation for any **one** of these displacements.

..... [1]

- (ii) Describe the observation when chlorine is bubbled into a solution of potassium bromide. Explain your observation.

observation.....

.....

explanation

.....

.....

.....

..... [3]

[Total: 10]

Section B

Answer any **one** question from this section.
Write your answers in the spaces provided.

8 Magnesium reacts with dilute nitric acid to form hydrogen gas.

- (a) In an experiment, 0.500 g of magnesium is reacted with 25.0 cm³ of dilute nitric acid.

The total volume of hydrogen produced every 1 minute is measured.

Fig. 8.1 shows a graph of the results.

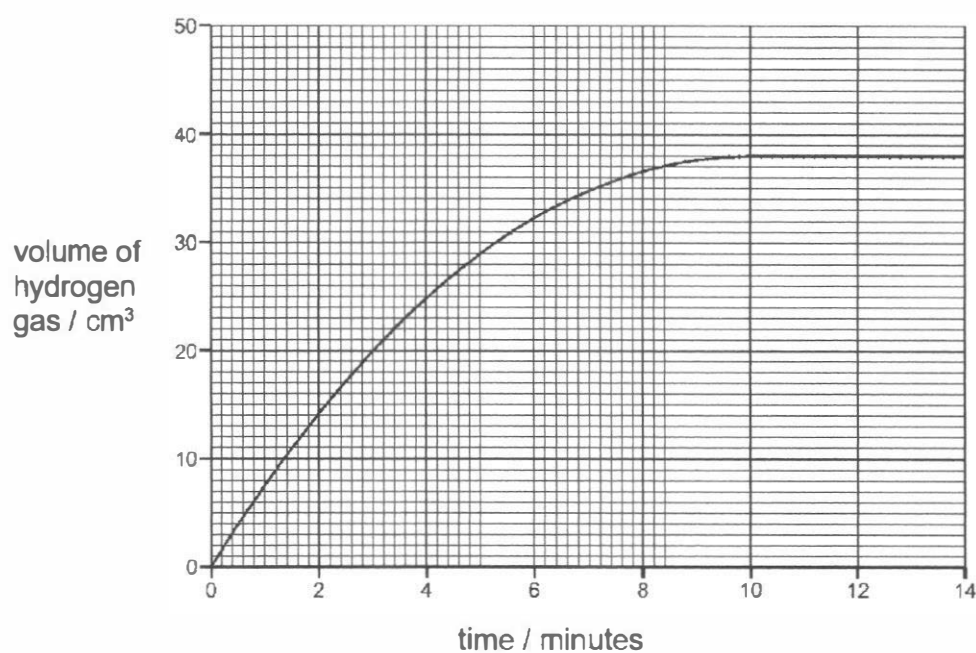


Fig. 8.1

- (i) State the time when the magnesium and the nitric acid first stop reacting.

..... min [1]

- (ii) Complete a labelled diagram showing the set up of apparatus that can be used to collect and measure the volume of gas produced in the experiment.

One apparatus has been drawn for you.



[2]

- (iii) The experiment is repeated using a **decreased** temperature of acid. The quantities of the reactants used are the same.

Draw a curve on Fig. 8.1 to show the results of this experiment. Label this curve X.

[2]

- (iv) The experiment is repeated a second time. This time the concentration of the nitric acid is **increased**.

Explain why the initial rate of the reaction increases.

.....

 [2]

- (b) In a different experiment, 1.00 g of excess magnesium is reacted with 40 cm³ of 0.500 mol/dm³ nitric acid.



- (i) Calculate the number of moles of nitric acid, HNO₃, that reacted.

number of moles = mol [1]

- (ii) Calculate the number of moles of hydrogen, H_2 , formed.

number of moles = mol [1]

- (iii) Calculate the volume of hydrogen formed at room temperature and pressure.

volume = dm^3 [1]

[Total: 10]

9 Iron and aluminium are two essential metals with many practical uses.

(a) Define the term alloy.

..... [1]

(b) Name an alloy and list two of its constituents.

alloy

constituent 1

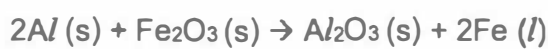
constituent 2

[1]

(c) Machine parts made of iron are usually coated with oil to prevent rusting. Explain how applying the layer of oil helps prevent rusting.

.....
 [1]

(d) In a thermit reaction, aluminium reacts with iron(III) oxide in the following reaction.



(i) In terms of the reactivity of metals, explain why the reaction occurs.

.....

 [2]

(ii) Describe in terms of kinetic particle theory, the changes in motion and arrangement of aluminium atoms when a sample of solid aluminium changes into aluminium liquid.

.....

 [2]

- (iii) Calculate the maximum mass of iron that can be made from 4 tonnes of iron(III) oxide.

[1 tonne = 1 000 000 g]

Maximum mass of iron = kg [3]

[Total: 10]

---End of Paper---

2024 4E Science Chem Prelim Paper 1**Suggested Answers**

1	D	11	C
2	A	12	C
3	B	13	B
4	A	14	C
5	D	15	C
6	D	16	D
7	C	17	D
8	A	18	D
9	A	19	B
10	C	20	B

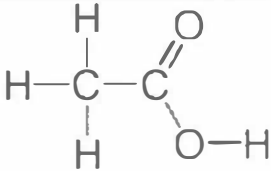
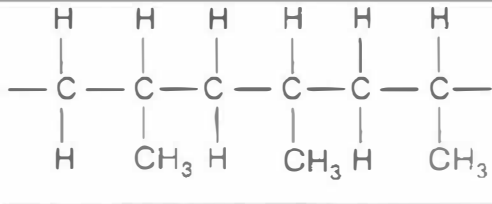
Secondary 4E Prelim Examination

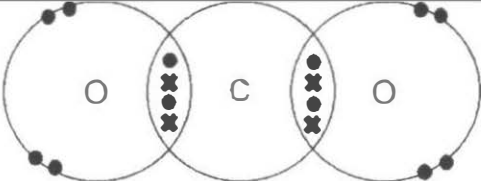
Science Chemistry (5086/5088)

Suggested Answers

Section A:

1	(a)		Helium	1												
	(b)		aluminium oxide	1												
	(c)		Calcium hydroxide	1												
	(e)		Bromine	1												
				[4]												
2	(a)		<table><tr><th>description</th><th>name of reaction</th></tr><tr><td>many monomers forming a polymer</td><td>polymerisation</td></tr><tr><td>changing long-chain hydrocarbons into short-chain hydrocarbons</td><td>cracking</td></tr><tr><td>gives out energy, often in the form of heat, to the surroundings</td><td>exothermic</td></tr><tr><td>two solutions react to form an insoluble salt</td><td>precipitation</td></tr><tr><td>the oxidation state of an element decreases</td><td>reduction</td></tr></table>	description	name of reaction	many monomers forming a polymer	polymerisation	changing long-chain hydrocarbons into short-chain hydrocarbons	cracking	gives out energy, often in the form of heat, to the surroundings	exothermic	two solutions react to form an insoluble salt	precipitation	the oxidation state of an element decreases	reduction	4
description	name of reaction															
many monomers forming a polymer	polymerisation															
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gives out energy, often in the form of heat, to the surroundings	exothermic															
two solutions react to form an insoluble salt	precipitation															
the oxidation state of an element decreases	reduction															
	(b)	(i)	A potassium atom has an <u>electronic configuration of 2, 8, 8, 1</u> and it <u>loses 1 valence electron to form a potassium ion</u> with an electronic configuration of <u>2, 8, 8</u> .	1												
		(ii)	Potassium oxide exists as a <u>giant ionic lattice</u> . [✓] The potassium and oxide <u>ions are held in fixed positions</u> . [✓] There are <u>no mobile ions to act as mobile charged carriers</u> [✓] to conduct electricity. 1- 2 [✓] – 1 mark 3 [✓] – 2 marks	2												
		(iii)	18 electrons, 19 protons, 22 neutrons 1-2 correct – 1 mark; 3 correct – 2 mark	2												
				[9]												
3	(a)	(i)	Condition 1: maintain temperature at 37 °C Reason: enzymes in yeast work best at 37°C/ At a higher temperature than 37°C, enzyme would denature / below this temperature, enzyme is deactivated	2												

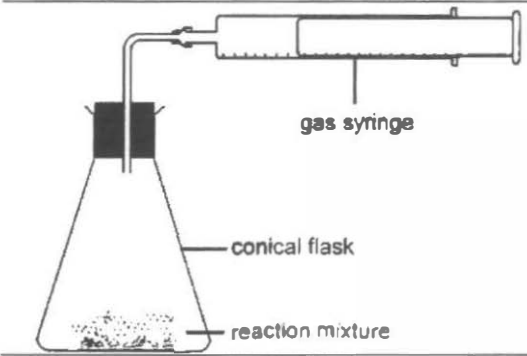
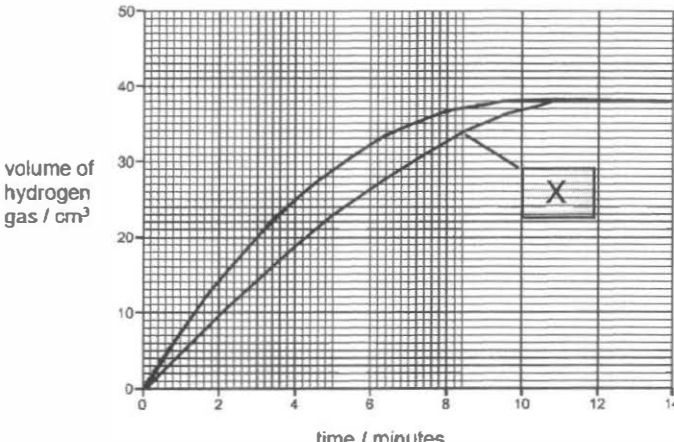
		Condition 2: absence of oxygen Reason: ethanol produced in the reaction would be oxidised in the presence of oxygen. Every correct condition with correct reason – 1 m	
	(ii)	$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$	1
	(iii)		1
(b)	(i)	Propene contains a carbon-carbon double bond.	1
	(ii)	Test: Bubble propene into a test-tube containing bromine solution. [1] Observation: The reddish-brown bromine solution will turn colourless when propene is bubbled in. [1]	2
	(iii)	 1 mark for 3 repeating units, 1 mark for single bonds formed from double bonds	2
	(iv)	physical method: melting small pieces of poly(ethene) waste chemical method: cracking of plastic waste into fuel	2
			[11]
4	(a)	Nitric acid	1
	(b)	It is to speed up the rate of reaction / It is to ensure that the acid has fully reacted.	1
	(c)	Filtration	1
	(d) (i)	Mr of $Zn(NO_3)_2 = 64 + 2(14+48) = 188$ Moles of $Zn(NO_3)_2 = 1 / 188 = 0.005319 \text{ mol}$	1
	(ii)	Mr of $Na_2CO_3 = 2(23) + 12 + 3(16) = 106$ Moles of $Na_2CO_3 = 1 / 106 = 0.009433 \text{ mol}$	1

		(iii)	Mole ratio $\text{Zn}(\text{NO}_3)_2 : \text{Na}_2\text{CO}_3 = 1 : 1$ $0.005319 \text{ mol } \text{Zn}(\text{NO}_3)_2$ needs 0.005319 mol of Na_2CO_3. However, there is $0.009433 \text{ mol } \text{Na}_2\text{CO}_3$, Na_2CO_3 is in excess and $\text{Zn}(\text{NO}_3)_2$ is the limiting reactant. – 1m mass of zinc carbonate = $0.005319 \times (64 + 12 + 48) - 1\text{m}$ = $0.660 \text{ g} - 1\text{m}$ Identify limiting reagent correctly with proper reasoning – 1m Calculate number of mass of zinc carbonate correctly – 1m Allow ecf from (i) – maximum 2 marks	2
				[7]
5	(a)		Source: produced from the burning/combustion of fossil fuels OR from Volcanic eruptions Effect: It causes eye and lung irritation / inflammation of the lungs and breathing difficulties/ acid rain that results in damage to buildings or plants or marine life	1
	(b)	(i)	reduction: <u>nitrogen monoxide is reduced</u> when the <u>oxidation state of nitrogen decreases from +2 in NO to 0 in N_2</u>. [1] OR <u>nitrogen monoxide is reduced</u> as it <u>loses oxygen</u> to <u>form N_2</u>. Oxidation: <u>carbon monoxide is oxidised</u> when the <u>oxidation state of carbon increases from +2 in CO to +4 in CO_2</u>. [1] OR <u>Carbon monoxide is oxidised</u> as it <u>gains oxygen</u> to <u>form CO_2</u>.	2
		(ii)	 ●- electron of O ×- electron of C correctly drawn shared electrons – 1 mark correctly drawn non-bonding electrons – 1 mark	2
		(iii)	<u>Carbon dioxide</u> is produced in the catalytic converter, which is a greenhouse gas that <u>causes global warming</u>.	1
				[6]
6	(a)		S: copper(II) sulfate, CuSO_4	6

			T: iron(III) sulfate, $\text{Fe}_2(\text{SO}_4)_3$ U: water, H_2O V: copper(II) hydroxide, $\text{Cu}(\text{OH})_2$ W: iron(III) hydroxide, $\text{Fe}(\text{OH})_3$ X: barium sulfate, BaSO_4	
	(b)		Any one $\text{CuO}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CuSO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l})$ $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 3\text{H}_2\text{O}(\text{l})$ $\text{Fe}_2(\text{SO}_4)_3(\text{aq}) + 3\text{Ba}(\text{NO}_3)_2(\text{aq}) \rightarrow 3\text{BaSO}_4(\text{s}) + 2\text{Fe}(\text{NO}_3)_3(\text{aq})$ 1 mark – correct chemical formulae and correctly balanced 1 mark – correct state symbols	2
				[8]
7	(a)	(i)	halogen	1
		(ii)	Electronic structure of fluorine: 2, 7 Electronic structure of chlorine: 2, 8, 7 Both electronic structures given. [1] Since they both have <u>7 valence electrons</u>, they are placed in Group 17. [1]	2
		(iii)	The melting point increases as the elements go down the Group 17.	1
		(iv)	The melting point of the halogen increases as the relative molecular mass of the element increases down the group. With the <u>increase in relative molecular mass / increase in size of halogen</u>, the <u>intermolecular forces of attraction between the molecules increases</u>. [1] This results in <u>an increase in the energy required to overcome the intermolecular forces of attraction</u> [1] between the molecules and hence, an increase in the melting point.	2
	(b)	(i)	$\text{Cl}_2 + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Cl}^-$	1
		(ii)	Observation: The <u>colourless</u> solution turns <u>reddish brown</u> . [1]	3

			Explanation: <u>Chlorine is a more reactive halogen than bromine.</u> [1] Thus, it will <u>displace bromine/bromide ions</u> from potassium bromide to produce bromine solution. [1]	
				[10]

Section B:

8	(a)	(i)	9.6 – 10.0 min	1
		(ii)	 Gas syringe (labelled) – 1m Rubber stopper with delivery tube (labelled) – 1m No labels (minus 1 mark overall)	2
		(iii)	 Graph with initial gradient less steep than original and ending at the same volume of gas – 1 m Labelled graph with 'X' – 1m	2
		(iv)	When the <u>concentration of acid increases</u> , the number of H^+ ions <u>per unit volume increases</u> . [1] Hence the <u>frequency of effective collisions between</u> the H^+ ions and magnesium atom/ the <u>reactant particles increases</u> , therefore the <u>rate of reaction increases</u> . [1]	2

	(b)	(i)	No of mole of HNO_3 reacted = $0.500 \times (40/1000) = 0.0200 \text{ mol}$	1
		(ii)	Mole ratio of $\text{HNO}_3 : \text{H}_2$ is 2:1 No of mole of $\text{H}_2 = 0.02/2 = 0.0100 \text{ mol}$	1
		(iii)	Volume of H_2 gas = $0.0100 \times 24\text{dm}^3 = 0.240\text{dm}^3$	1
				[10]
9	(a)		An alloy is a mixture of a metal with another metal or non-metal.	1
	(b)		Stainless steel Iron and carbon 1 mark for an alloy <u>and</u> correctly named constituents of the named alloy	1
	(c)		The layer of oil coats the iron surface/ acts as a <u>protective barrier</u> and <u>prevents iron from coming into contact with oxygen and water.</u>	1
	(d)	(i)	Aluminium is a more reactive metal than iron. [1] It will displace iron metal from iron(III) oxide. [1]	2
		(ii)	Movement: The particles in <u>solid aluminium</u> changed from <u>vibrating about fixed positions</u> to <u>sliding over one another freely/moving freely</u> in the <u>liquid aluminium</u> . [1] Arrangement: The particles in <u>solid aluminium</u> changed from <u>orderly-arranged and closely packed</u> to <u>randomly arranged and close together</u> in <u>liquid aluminium</u> . [1]	2
		(iii)	Mr of iron(III) oxide = $56 \times 2 + 16 \times 3 = 160$ Moles of iron(III) oxide = $4000\ 000 / 160 = 25000 \text{ mol}$ [1] Mole ratio $\text{Fe}_2\text{O}_3 : \text{Fe} = 1 : 2$ Number of moles of Fe = $25000 \times 2 = 50\ 000 \text{ mol}$ [1] Maximum mass of Fe = $50\ 000 \times 56$ = $2800\ 000 \text{ g}$ = 2800 kg [1] Never convert g to kg, minus 1 mark.	3
				[10]