



**TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS**

CANDIDATE
NAME

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CLASS

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INDEX
NUMBER

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SCIENCE (CHEMISTRY)

5086/01 & 5088/01

Paper 1 Multiple Choice

22 August 2025

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Write your name, index number on the Answer Sheet.

There are **forty** questions in 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 9.

A copy of the Periodic Table is printed on page 10.

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

- 1 A student intends to measure the rate of reaction between a volume of hydrochloric acid and a lump of zinc carbonate.



Which piece of apparatus is required to perform the experiment?

- A distillation flask
B gas syringe
C test-tube
D thermometer
- 2 Which statement explains why carbon dioxide and oxygen can be separated from air by fractional distillation?
- A Carbon dioxide has a larger molecular mass than oxygen.
B Carbon dioxide is a triatomic molecule while oxygen is a diatomic molecule.
C Carbon dioxide and oxygen have different boiling points.
D Carbon dioxide is less soluble in water than oxygen.
- 3 An element **G** forms a compound with nitrogen with a chemical formula of **GN**. Given that **G** has 56 particles in the nucleus, which row shows the correct composition of an ion of **G**?

	number of protons	number of neutrons	number of electrons
A	26	30	23
B	26	30	26
C	30	26	26
D	30	26	23

- 4 Which element burns in excess oxygen to form a neutral oxide?
- A carbon
B hydrogen
C magnesium
D sulfur

- 5 Helium is represented by ${}_{10}^{20}\text{Ne}$.

What can be deduced about neon?

- A It exists as diatomic molecules.
- B It forms a positive ion.
- C It has 10 protons and 10 neutrons.
- D It has a nucleon mass of 30.

- 6 Which substance has the typical properties of a covalent compound?

	melting point / °C	boiling point / °C	electrical conductivity at room temperature
A	-39	361	conductor
B	-21	105	non-conductor
C	636	1300	conductor
D	3727	4829	non-conductor

- 7 Steel is widely used in construction because of its strength and hardness as compared to pure iron.

Which statement explains why steel is used over pure iron?

- A Carbon atoms form covalent bonds with iron atoms.
- B Carbon atoms disrupt the regular arrangement of iron atoms.
- C Steel has lower density than iron.
- D Carbon anions form strong electrostatic forces of attraction with iron cations.

8 A metallic element, **M**, has the following properties:

- less dense than water
- easily cut by a knife
- melts below 100 °C
- **M** reacts with water to form a soluble hydroxide.

What is **M**?

- A** barium
- B** copper
- C** magnesium
- D** potassium

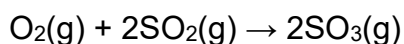
9 Excess aqueous sodium hydroxide is added to salt **P** and the solution is heated. A gas is given off which turns red litmus blue.

When this reaction is complete, aluminium foil is added to the solution. A gas is again given off which also turns red litmus blue.

What is salt **P**?

- A** ammonium nitrate
- B** ammonium sulfate
- C** zinc nitrate
- D** zinc sulfate

10 40 cm³ of oxygen was reacted with 20 cm³ of sulfur dioxide to form sulfur trioxide.



What are the volume of gases remaining at the end of reaction at room temperature and pressure?

	Volume of oxygen / cm ³	Volume of sulfur dioxide / cm ³	Volume of sulfur trioxide / cm ³
A	10	0	20
B	10	0	40
C	30	0	20
D	30	0	40

11 Which substance contains the same number of atoms as 18 g of H₂O?

- A 1 g of H₂ gas
- B 12 g of Mg
- C 44 g of CO₂**
- D 28 g of N₂

12 The table gives information about the reactivity of three metals **S**, **T** and **U**.

metal	reaction with Fe ²⁺ (aq)	reaction with Cu ²⁺ (aq)
S	solution remains green	solution turns colourless
T	solution remains green	solution remains blue
U	solution turns colourless	solution turns colourless

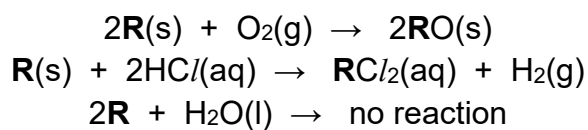
What is the order of reactivity of the metals?

	most reactive → least reactive				
A	S	Fe	T	Cu	U
B	T	Fe	S	Cu	U
C	U	Fe	S	T	Cu
D	U	Fe	S	Cu	T

13 In an endothermic reaction, what happens to the bonds in the reactants compared to the products?

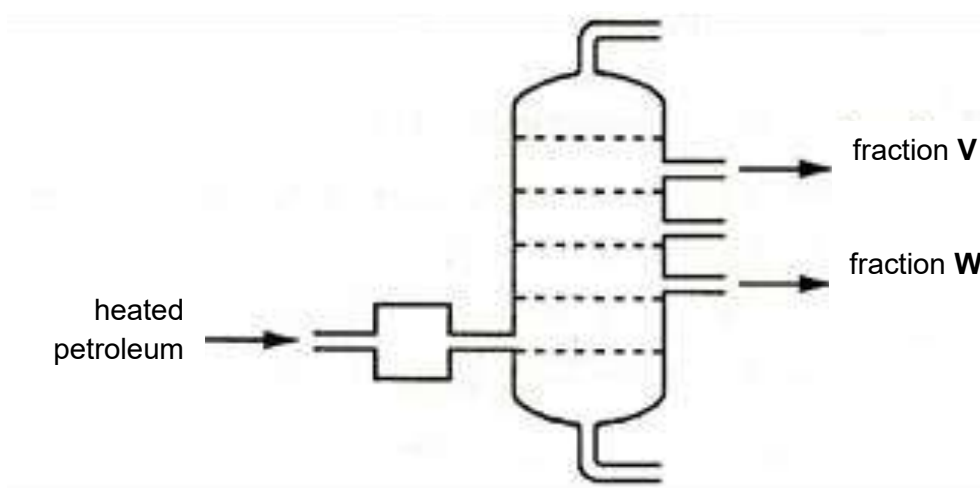
- A Energy is released when stronger bonds form in the products.
- B Energy is absorbed when weaker bonds form in the products.
- C Energy is absorbed to break bonds in the reactants.**
- D Energy is released to break bonds in the reactants.

- 14 An element **R** reacts in the following ways.



Which one of the following could be **R**?

- A calcium
 - B copper
 - C sodium
 - D zinc**
- 15 The diagram below shows the fractional distillation of petroleum.



Which statement about fractions **V** and **W** is correct?

- A Fraction **V** combusts less easily than fraction **W**.
- B Fraction **V** has a higher density than fraction **W**.
- C Fraction V has a lower boiling point than fraction W.**
- D Fraction **V** is more viscous than fraction **W**.

16 How can margarine be made from vegetable oils?

- A addition of hydrogen to a saturated oil in the presence of nickel catalyst
- B addition of hydrogen to an unsaturated oil in the presence of nickel catalyst**
- C addition of steam to a saturated oil in the presence of nickel catalyst
- D addition of steam to an unsaturated oil in the presence of nickel catalyst

17 The following are three reactions of hydrocarbons.



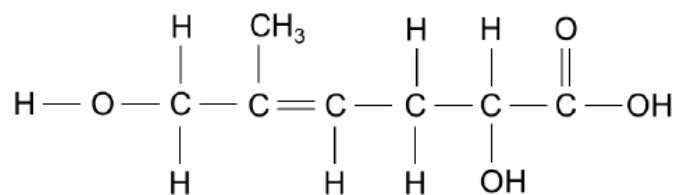
Which row describes the three reactions correctly?

	Reaction 1	Reaction 2	Reaction 3
A	combustion	addition	cracking
B	substitution	cracking	combustion
C	addition	combustion	cracking
D	reduction	addition	combustion

18 Which environmental problem is associated with non-biodegradable plastics?

- A increased soil fertility
- B ocean acidification
- C pollution in landfills and marine environments**
- D depletion of mineral resources

19 The structure of an organic compound is shown.



Which statement about the above compound is correct?

- 1 It decolourises aqueous bromine.
- 2 It can undergo addition polymerisation.
- 3 It can undergo oxidation with acidified potassium manganate(VII).
- 4 It can react with metal carbonates.

- A** 1 and 2 only
B 1 and 3 only
C 2, 3 and 4 only
D All of the above

20 A forested region was cleared, and the trees were burned to make way for development. Which combination of effects on the carbon cycle is *most likely* to occur as a **long-term** consequence?

- A** increase in photosynthesis and decrease in ocean uptake
B decrease in photosynthesis and increase in atmospheric carbon dioxide
C increase in combustion and increase in photosynthesis
D decrease in combustion and increase in oxygen production

MCQ No.	Answer	Explanation
1	B	Since carbon dioxide gas is produced , the rate of reaction can be measured by collecting and measuring the volume of gas evolved over time . A gas syringe is the most suitable apparatus for this purpose.
2	C	Fractional distillation separates components of a mixture based on their boiling points . The difference in boiling points between carbon dioxide and oxygen allows them to be separated through this process. The other options are true facts but are not the reason fractional distillation works.
3		Element G has 56 particles in its nucleus (that means protons + neutrons = 56). It forms a compound with nitrogen, with the formula GN . You are given 4 options showing different numbers of protons, neutrons, and electrons. Your task is to pick the correct one.
	A	Step 1: Check nucleus particles (protons + neutrons) All 4 options add up to 56, so we can't eliminate any just yet.
		Step 2: Figure out the charge of G in GN - The formula is GN - Nitrogen usually forms N³⁻ (gains 3 electrons) - To balance that, G must be G³⁺ (loses 3 electrons) So we want an atom where: Protons – Electrons = 3
4	B	When hydrogen burns in oxygen, it forms water (H ₂ O). Water is considered a neutral oxide because it doesn't behave as an acid or a base in water—it's basically neutral. Magnesium, on the other hand, forms magnesium oxide (MgO) when it burns, which is a basic oxide because it reacts with water to form a base (magnesium hydroxide). Carbon burns to form carbon dioxide (CO ₂), which is an acidic oxide since it forms carbonic acid when dissolved in water. Sulfur forms sulfur dioxide (SO ₂), another acidic oxide because it forms sulfurous acid in water. So, only hydrogen burns in excess oxygen to form a neutral oxide, which is water.
5	C	- The subscript 10 = number of protons = atomic number. - The superscript 20 = nucleon (mass) number = protons + neutrons.

		From this: - Protons = 10 - Nucleon mass = 20 - Therefore, neutrons = $20 - 10 = 10$ Now, check the options: A. It exists as diatomic molecules. Neon is a noble gas, existing as single atoms, not diatomic molecules. So, this is false. B. It forms a positive ion. Neon is very stable and unreactive; it rarely forms ions. So, this is unlikely. C. It has 10 protons and 10 neutrons. Yes, exactly as deduced above. D. It has a nucleon mass of 30. The nucleon mass is 20, not 30. Correct answer: C. It has 10 protons and 10 neutrons.
6	B	Let's break down what typical covalent compounds are like: - Usually low melting and boiling points (because of weak intermolecular forces). Do not conduct electricity in solid or liquid state (no free ions or electrons). Now, let's look at the options: A: melting point -39°C, boiling point 361°C, conductor - Low melting point fits covalent, but conductor? Most covalent compounds are non-conductors. B: melting point -21°C, boiling point 105°C, non-conductor - Low melting and boiling points and non-conductive — fits covalent properties well. C: melting point 636°C, boiling point 1300°C, conductor - High melting/boiling points and conductor — more like metals or ionic compounds. D: melting point 3727°C, boiling point 4829°C, non-conductor - Very high melting/boiling points — typical of giant covalent solids (like diamond) which are non-conductors, but the melting point is extremely high compared to usual covalent molecular compounds.

		Since the question says typical properties (implying molecular covalent compounds, not giant covalent solids), Option B fits best.
7	B	Steel is an alloy of iron and carbon. The small carbon atoms fit into the spaces between iron atoms, disrupting the regular arrangement of layers of atoms of pure iron. This disruption makes it harder for the layers of iron atoms to slide past each other, increasing strength and hardness. - Option A is incorrect because carbon does not form covalent bonds with iron in steel. - Option C is incorrect because steel generally has a similar or slightly higher density, not lower. - Option D is incorrect because carbon in steel is not present as carbon anions forming electrostatic bonds.
8	D	- The metal is lighter than water, so it floats. - It's soft enough to be cut with a knife. - It melts below 100°C (so it melts easily). - It reacts with water to make a solution that dissolves (a soluble hydroxide). Out of the choices, potassium is soft, floats on water, melts at about 63°C (below 100°C), and reacts quickly with water to form potassium hydroxide, which dissolves in water. So, the metal is potassium.
9	A	When sodium hydroxide is added and heated, the salt gives off ammonia gas (which turns red litmus paper blue). This means the salt has ammonium in it. When aluminium foil is added afterward, it reacts with any nitrate in the salt and makes more ammonia gas. Only ammonium nitrate has both ammonium and nitrate ions, so it fits both parts of the test.
10	C	$2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ The reaction requires 2 parts sulfur dioxide (SO₂) for every 1 part oxygen (O₂). Given 20 cm³ SO₂ and 40 cm³ O₂. To react with 20 cm³ SO₂, only 10 cm³ O₂ is needed.

		Since $40 \text{ cm}^3 \text{ O}_2$ is available, oxygen is in excess. All the SO_2 reacts, producing 20 cm^3 sulfur trioxide (SO_3). Oxygen left unreacted: $40 \text{ cm}^3 - 10 \text{ cm}^3 = 30 \text{ cm}^3$. Sulfur dioxide left: 0 cm^3. Final volumes: 30 cm^3 oxygen, 0 cm^3 sulfur dioxide, 20 cm^3 sulfur trioxide.
11	C	• 18 g of water has 1 mole of water molecules. • Each water molecule has 3 atoms, so 18 g of water has 3 moles of atoms. Now look at the options: • 1 g hydrogen gas has fewer atoms than water. • 12 g magnesium has fewer atoms than water. • 44 g carbon dioxide has 1 mole of molecules, and each molecule has 3 atoms — same number of atoms as water. • 28 g nitrogen gas has fewer atoms than water. So, 44 g of carbon dioxide has the same number of atoms as 18 g of water.
12	D	Metal U reacts with both Fe^{2+} and Cu^{2+} solutions (they turn colourless), so U is the most reactive. Metal S reacts only with Cu^{2+} but not with Fe^{2+}, so S is less reactive than Fe but more reactive than Cu. Metal T doesn't react with either, so it's the least reactive. Fe is in the middle. So the order from most to least reactive is: $\text{U} > \text{Fe} > \text{S} > \text{Cu} > \text{T}$
13	C	In an endothermic reaction, energy is taken in (absorbed) from the surroundings to break the bonds in the reactants. Breaking bonds requires energy input. The products often have weaker bonds or the overall process results in net energy absorption.

		- Option A is incorrect because energy release happens when bonds form, but endothermic reactions absorb energy overall. - Option B is incorrect because forming weaker bonds releases less energy, but energy is absorbed to break bonds first. - Option D is incorrect because breaking bonds requires energy input, not energy release. So, energy absorption occurs to break bonds in the reactants in endothermic reactions.
14	D	- The element R makes a compound RO when it reacts with oxygen, meaning it forms an oxide with a +2 charge. - It reacts with acid to give RCl_2 and hydrogen gas, so it's a metal that can replace hydrogen. - It doesn't react with water. Looking at the choices: - Calcium and sodium react with water, so they're out. - Copper doesn't react with acid to make hydrogen gas. - Zinc fits perfectly: it forms ZnO, reacts with acids to make hydrogen, and doesn't react with water. So, the element is zinc.
15	C	Fractions collected at the top (like V) are lighter hydrocarbons: lower boiling points, less viscous, lower density, and easier to combust. Fractions collected at the bottom (like W) are heavier hydrocarbons: higher boiling points, more viscous, higher density, and harder to combust.
16	B	Margarine is made by hydrogenating vegetable oils, which are mostly unsaturated. Hydrogen is added to the double bonds of unsaturated fats to convert them into saturated fats, making the oil more solid at room temperature. This process uses a nickel catalyst.

		- Option A is incorrect because saturated oils do not have double bonds to hydrogenate. - Options C and D are incorrect because steam addition is not involved in making margarine. So, hydrogenation of unsaturated oils with hydrogen and nickel catalyst is the correct process.
17	B	Reaction 1: A chlorine atom replaces a hydrogen in methane — this is called substitution. Reaction 2: A big hydrocarbon breaks into smaller ones — this is called cracking. Reaction 3: A hydrocarbon burns in oxygen to make carbon dioxide and water — this is combustion. So the correct order is substitution, cracking, combustion — answer B.
18	C	Non-biodegradable plastics do not break down easily and accumulate in the environment, causing pollution on land (landfills) and in oceans, harming wildlife and ecosystems. - Option A is incorrect because plastics do not increase soil fertility. - Option B (ocean acidification) is caused mainly by increased CO₂, not plastics. - Option D relates to mining and resource use, not plastics. So, pollution from plastic waste is the main issue.
19	D	1. It decolourises aqueous bromine. True — The alkene group reacts with bromine water in an addition reaction, removing the reddish-brown colour. 2. It can undergo addition polymerisation. True — The alkene group allows the compound to take part in addition polymerisation. 3. It can undergo oxidation with acidified potassium manganate(VII).

		True — The alcohol group (-OH) can be oxidised to a carboxylic acid or ketone using acidified KMnO_4. 4. It can react with metal carbonates. True — The carboxylic acid group (-COOH) reacts with metal carbonates to form salt, carbon dioxide, and water.
20	B	• Burning trees releases carbon dioxide into the atmosphere $\rightarrow$ increase in atmospheric CO_2 • Fewer trees means less photosynthesis, so less CO_2 is removed from the air $\rightarrow$ decrease in photosynthesis This combination leads to a carbon imbalance, contributing to global warming. Why the other options are incorrect: • A: Increase in photosynthesis is wrong — fewer trees mean less photosynthesis. • C: Combustion increases temporarily, but photosynthesis decreases long term. • D: Combustion decreases is incorrect — it increases when trees are burned, and oxygen production falls due to fewer trees.

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red brown
zinc hydroxide	white