

TEMASEK JUNIOR COLLEGE
2024 JC2 PRELIMINARY EXAMINATION
Higher 1



CHEMISTRY

8873/01

Paper 1 Multiple Choice

12 September 2024

1 hour

Additional Materials: Multiple Choice Answer Sheet (OMS)
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.

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

Write your name & Civics Group on the Answer sheet. Shade your index number in the appropriate boxes.

1. Enter your NAME (as in NRIC). _____
2. Enter the SUBJECT TITLE. _____
3. Enter the TEST NAME. _____
4. Enter the CLASS. _____

Write your **name**
and **Civics Group**

5. Enter your CLASS NUMBER or INDEX NUMBER.
6. Now SHADE the corresponding lozenge in the grid for EACH DIGIT or LETTER

WRITE		SHADE APPROPRIATE BOXES									
I N D E X		0	1	2	3	4	5	6	7	8	9
		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
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		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
N U M B E R		0	1	2	3	4	5	6	7	8	9
		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
		0	1	2	3	4	5	6	7	8	9
		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
		A	B	C	D	E	F	G	H	I	
		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Index number
(refer to entry proof)

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

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

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 (OMS).

1 Which statement about the electrons in a ground state nitrogen atom is correct?

- A** There are more electrons in s orbitals than there are in p orbitals.
- B** Electrons are present in two different energy levels.
- C** There is a pair of electrons in one of the p orbitals.
- D** The occupied orbital of highest energy is spherical.

2 In an experiment, protons are deflected by an angle of $+10^\circ$.

In another experiment under identical conditions, particle X is deflected by an angle of -2.5° .

What could be the composition of particle X?

	protons	neutrons	electrons
A	4	4	5
B	2	2	3
C	2	2	1
D	1	2	2

3 Which compound is composed of cation and anion that has the same number of electrons as each other?

- | | | | | | | | |
|----------|-----------------------|----------|----------------|----------|-----------------------|----------|---------------|
| 1 | Na_2O | 2 | NaN_3 | 3 | NH_4F | 4 | NaCl |
|----------|-----------------------|----------|----------------|----------|-----------------------|----------|---------------|
- A** 1 and 3
 - B** 1 and 4
 - C** 2 and 3
 - D** 2 and 4

- 4 *Use of the Data Booklet is relevant to this question.*

The **sixth** ionisation energies of four different elements are shown below. The elements are arsenic, selenium, antimony and tellurium (though not necessarily in that order) from Groups 15 and 16.

Which of the following shows the sixth ionisation energy of antimony?

- A 12300 B 10400 C 7880 D 6820

- 5 Which feature is present in each of the ions CO_3^{2-} and SO_3^{2-} ?

- A All bond angles are 120°
B One dative covalent bond
C Three sigma bonds
D Eight lone pairs of electrons

- 6 Beryllium chloride, BeCl_2 , fully reacts with ammonia, NH_3 to form a compound. Which of the statements is **incorrect**?

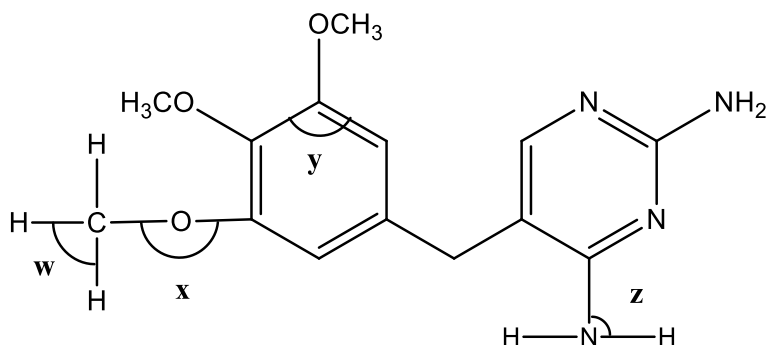
- A The compound is formed from 1 mole of BeCl_2 and 2 moles of NH_3 .
B The Be-N bond formed is chemically similar to a covalent bond.
C The beryllium atom in beryllium chloride is electron deficient.
D The compound is capable of forming only two hydrogen bonds per molecule.

- 7 In which of the following pairs of compounds would the first compound have a higher melting point than the second compound?

- 1 Na_2O , K_2O
2 AlF_3 , AlCl_3
3 MgO , MgCl_2

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

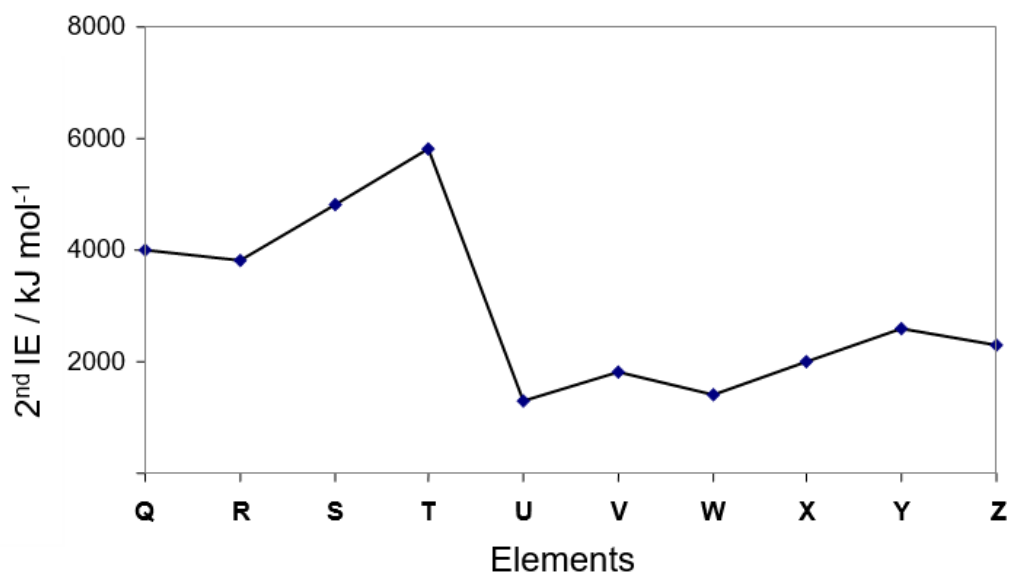
- 8 Trimethoprim (TMP) is used for the treatment of urinary tract infections. It has the following structure:



Which are the correct bond angles **w**, **x**, **y** and **z**?

- | | w | x | y | z |
|----------|----------|----------|----------|----------|
| A | 90° | 180° | 120° | 90° |
| B | 90° | 105° | 118° | 107° |
| C | 109.5° | 105° | 120° | 107° |
| D | 109.5° | 180° | 118° | 120° |
- 9 *Use of the Data Booklet is relevant to this question.*
A solution containing 25 cm³ of 0.1 mol dm⁻³ VO₂⁺ reacts completely with 0.245 g of zinc. Which of the following can be the vanadium-containing species in the product?
- | | | | | | | | |
|----------|------------------------------|----------|-------------------------------|----------|-----------------|----------|-----------------|
| A | VO ₃ ⁻ | B | VO ₂ ²⁺ | C | V ³⁺ | D | V ²⁺ |
|----------|------------------------------|----------|-------------------------------|----------|-----------------|----------|-----------------|
- 10 Which oxide does **not** react with dilute sodium hydroxide to produce a salt?
- | | | | | | | | |
|----------|--------------------------------|----------|--------------------------------|----------|-----------------|----------|------------------|
| A | Al ₂ O ₃ | B | P ₄ O ₁₀ | C | SO ₂ | D | SiO ₂ |
|----------|--------------------------------|----------|--------------------------------|----------|-----------------|----------|------------------|
- 11 When phosphoryl chloride, POCl₃, dissolves in water, it gives a mixture of phosphoric acid and hydrochloric acid. How many moles of sodium hydroxide would be needed to neutralise the solution formed by adding one mole of POCl₃ to excess water?
- | | | | | | | | |
|----------|---|----------|---|----------|---|----------|---|
| A | 3 | B | 4 | C | 5 | D | 6 |
|----------|---|----------|---|----------|---|----------|---|

- 12 The graph below shows the variation in the **second** ionisation energies for the consecutive elements **Q** to **Z** in the Periodic Table, all with proton number below 20.



What can be deduced from the above?

- 1 T has a smaller atomic radius than U.
 - 2 Effervescence is observed when a magnesium strip is dipped into the aqueous solution containing the chloride of element W.
 - 3 When the oxide of U is mixed with water, an alkaline solution is formed.
- A** 1, 2 and 3 **B** 1 and 2 **C** 2 and 3 **D** 3 only

- 13 Which sample contains the same number of the named species as the number of molecules in 1 g of hydrogen?

- A** Electrons in 1 g of helium
B Atoms in 23.0 g of sodium
C Ions in 26.5 g of sodium carbonate
D Molecules in 44 g of carbon dioxide

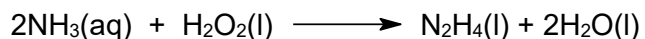
- 14 Use of the Data Booklet is relevant to this question.

A sample of glass is composed of 50% SiO₂, 38% CaO and 12% Al₂O₃ by mass.

What is the Si / Al molar ratio in the glass sample?

- A** 0.28 **B** 2.08 **C** 3.54 **D** 7.08

- 15** Hydrazine, N_2H_4 , was used as fuel for the Apollo space mission, and it can be synthesised in an environmentally friendly manner according to the following reaction.



substance	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$
$\text{H}_2\text{O}(\text{l})$	-286
$\text{N}_2\text{H}_4(\text{l})$	+51
$\text{NH}_3(\text{aq})$	-80
$\text{H}_2\text{O}_2(\text{l})$	-174

Given the above enthalpy changes of formation, what is the enthalpy change of the above reaction in kJ mol^{-1} ?

- A** -187 **B** -19 **C** +19 **D** +187

- 16** When 25 cm^3 of 1.0 mol dm^{-3} sodium hydroxide was neutralised with an equal volume of 0.5 mol dm^{-3} sulfuric acid, the temperature of the mixture rose by 7.0°C .

What would be the temperature change if 50 cm^3 of 0.5 mol dm^{-3} sodium hydroxide is neutralised with an equal volume of 0.25 mol dm^{-3} sulfuric acid?

(Assume negligible heat loss in each case.)

- A** 1.8°C **B** 3.5°C **C** 7.0°C **D** 14°C

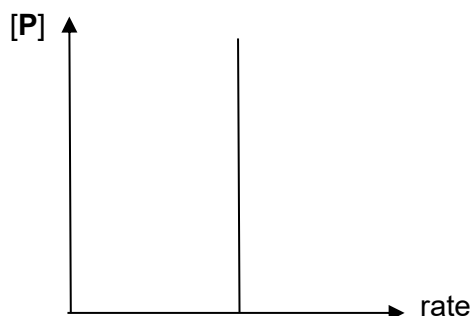
- 17** After the closure of a chemical plant in Switzerland, a substitution reaction between **R** and hydrogen sulfide ions is found to take place

initial concentration of R / mol dm ⁻³	initial concentration of hydrogen sulfide ions / mol dm ⁻³	initial rate of reaction / mol dm ⁻³ s ⁻¹
0.1	0.1	1.5 x 10 ⁻⁵
0.2	0.1	3.0 x 10 ⁻⁵
0.1	0.2	3.0 x 10 ⁻⁵
0.3	<i>x</i>	1.125 x 10 ⁻⁵

What conclusion can be drawn about the reaction?

- A** The reaction is zero order with respect to the concentration of hydrogen sulfide ions.
- B** The overall order of reaction is one.
- C** The value of the rate constant is 1.5 x 10⁻⁴.
- D** The value of *x* is 0.025.
- 18** Enzymes are biological catalysts, and many enzymes show specificity. An example is lipase which hydrolyses triglyceride molecules into glycerol and fatty acids.
- What does specificity mean in this context?
- A** Lipase only works well over a narrow range of temperatures.
- B** Lipase only works well over a narrow pH range.
- C** Lipase only produces glycerol and fatty acids.
- D** Lipase only hydrolyses triglycerides.

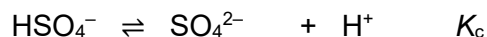
- 19 The kinetics of a reaction $P \rightarrow Q$ were investigated under different conditions. The following graph was obtained.



Which of the following statements about the reaction is correct?

- A The unit of the rate constant is s^{-1} .
 - B A curve is obtained when $[P]$ is plotted against time.
 - C The same graph is obtained when the $[P]$ is plotted against rate constant.
 - D The rate constant remained unchanged when reaction is repeated at a higher temperature.
- 20 An enzyme, found in the stomach, operates at maximum efficiency when in an aqueous solution buffered at pH 5.
- Which of the following combinations of substances would give the necessary buffer solution?
- A 2 mol of HCl and 1 mol of CH_3CO_2H
 - B 2 mol of $NaOH$ and 1 mol of CH_3CO_2H
 - C 2 mol of HCl and 1 mol of CH_3CO_2Na
 - D 2 mol of CH_3CO_2H and 1 mol of $NaOH$

- 21 In aqueous solution, sulfuric acid dissociates as shown.

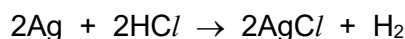


2.00 mol dm⁻³ of aqueous H₂SO₄ produced 1.988 mol dm⁻³ of aqueous HSO₄⁻ at equilibrium.

What is the value of K_c ?

- | | | | |
|----------|-----------------------|----------|-----------------------|
| A | 7.24×10^{-5} | B | 1.21×10^{-2} |
| C | 82.3 | D | 1.38×10^5 |

- 22 Silver foil does not react when added to a beaker of dilute hydrochloric acid. However, silver nanoparticles do react with dilute hydrochloric acid.



Which statement could explain why silver nanoparticles are more reactive than silver foil?

- A** They act as catalysts for the reaction.
- B** They contain a much greater concentration of silver.
- C** They have a very high surface area to volume ratio.
- D** They do not have an unreactive oxide layer.

- 23 Which of the following is a pair of constitutional isomers?

- A** (CH₃)₃CCO₂H and CH₃CH(CH₃)CO₂H
- B** CH₂C(CH₃)CO₂H and CH₃CHCHCO₂H
- C** (CH₃)₂CHCO₂H and CH₃CH(CO₂H)CH₃
- D** CH₃CH₂CO₂CH₃ and CH₃OCOCH₂CH₃

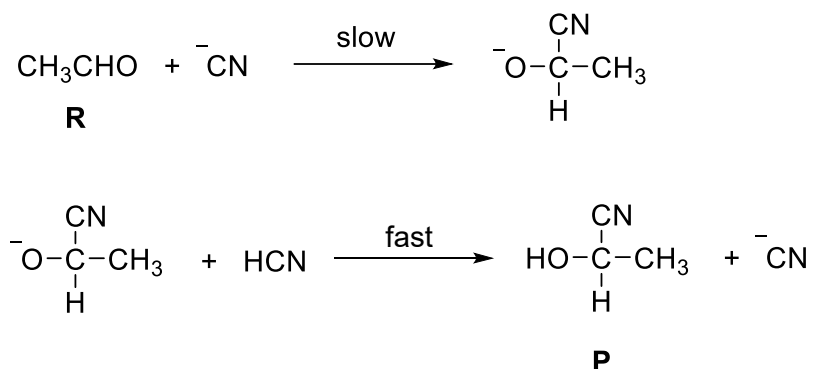
- 24 Compound **X**, C₄H₈, reacts with bromine via an addition reaction.

What is the maximum number of isomers of compound **X**, considering both constitutional isomerism and cis-trans isomerism?

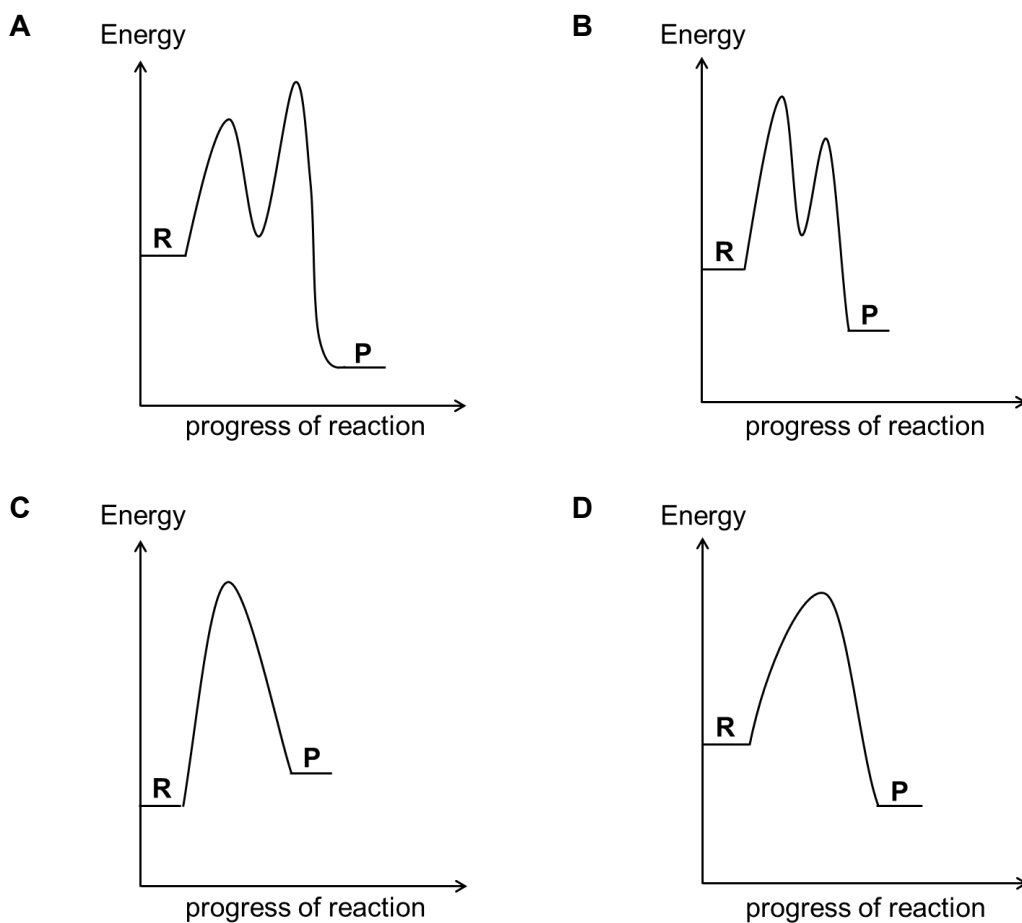
- | | | | | | | | |
|----------|---|----------|---|----------|---|----------|---|
| A | 1 | B | 3 | C | 4 | D | 5 |
|----------|---|----------|---|----------|---|----------|---|

- 25 The use of the *Data Booklet* is relevant to this question.

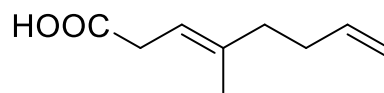
Ethanal, **R**, undergoes addition reaction with HCN in the presence of CN^- ions to form a cyanohydrin, **P**, via a two-step reaction.



Which of the energy profile diagrams best describes the reaction from **R** to **P**?



- 26 The structure of compound **X** is shown.



compound **X**

Which of the following are true about compound **X**?

- 1 The molecular formula of **X** is $C_9H_{14}O_2$.
- 2 **X** has 2 π bonds.
- 3 **X** can decolourise bromine water.

A 1, 2 and 3

B 1 and 2

C 2 and 3

D 1 and 3

- 27 How much water must be added to 2 dm³ of HCl of pH 2.0 to increase the pH to 3.0?

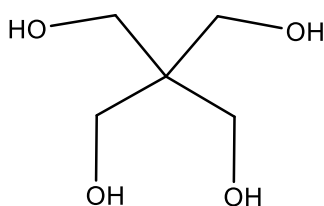
A 1.0 dm³

B 10 dm³

C 18 dm³

D 20 dm³

- 28 Pentaerythritol is an intermediate in the production of paint.



pentaerythritol

Which of the following statements about pentaerythritol are correct?

- 1 It decolourises hot acidified potassium manganate(VII).
- 2 It reacts with propanoic acid to form a sweet-smelling compound.
- 3 It can react with excess hot concentrated sulfuric acid to form alkene.

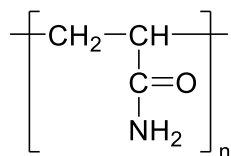
A 1, 2 and 3

B 1 and 2 only

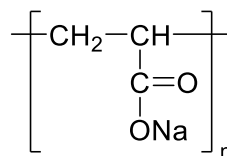
C 2 and 3 only

D 1 only

- 29 Poly(acrylamide) and sodium poly(acrylate) are super absorbent polymers (SAP) used in various hygienic products like diapers.



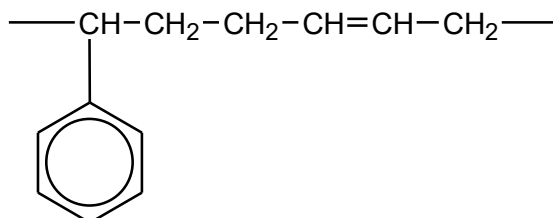
poly(acrylamide)



sodium poly(acrylate)

Which statement is correct for these SAP?

- A Both are condensation polymers.
 - B Both are non-biodegradable polymers.
 - C Poly(acrylamide) is formed between $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ and NH_3 in the presence of DCC.
 - D Sodium poly(acrylate) can form hydrogen bonding between two polymer chains.
- 30 A polymer has the repeat unit:



Which statement about this polymer is **incorrect**?

- A It can be hydrolysed by heating with dilute aqueous sulfuric acid.
- B $\text{CH}_2=\text{CHCH}=\text{CH}_2$ is one of the monomers.
- C It is a copolymer made up of two different monomers.
- D It is capable of forming a thermosetting polymer.