

External assessment 2022

Multiple choice question book

# Chemistry

## Paper 1

### General instruction

- Work in this book will not be marked.

## Section 1

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### QUESTION 1

Identify the type of reaction that occurs when ethene undergoes polymerisation to form polyethene.

- (A) addition
- (B) elimination
- (C) substitution
- (D) condensation

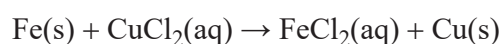
### QUESTION 2

Structural isomers are compounds with the same molecular formula but a different

- (A) molar mass.
- (B) molecular mass.
- (C) empirical formula.
- (D) arrangement of atoms.

### QUESTION 3

Which option is true for the redox equation?



- (A) Fe is oxidised and Cu is the oxidising agent
- (B) Fe is oxidised and  $\text{Cu}^{2+}$  is the oxidising agent
- (C)  $\text{Fe}^{2+}$  is oxidised and Cu is the oxidising agent
- (D)  $\text{Fe}^{2+}$  is oxidised and  $\text{Cu}^{2+}$  is the oxidising agent

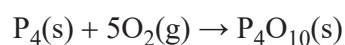
#### QUESTION 4

Which pair of reagents would react to form a glycosidic bond?

- (A) lysine and aniline
- (B) glucose and galactose
- (C) methanol and butanoic acid
- (D) glycerol and sodium hydroxide

#### QUESTION 5

Phosphorus pentoxide is prepared by burning phosphorus in oxygen.

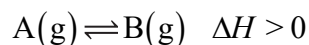


Calculate the percentage yield if 10.0 g of  $\text{P}_4\text{O}_{10}$  is produced when 0.200 mol of  $\text{P}_4$  and 0.200 mol of  $\text{O}_2$  are reacted.

- (A) 2.0%
- (B) 3.5%
- (C) 17.6%
- (D) 88.0%

#### QUESTION 6

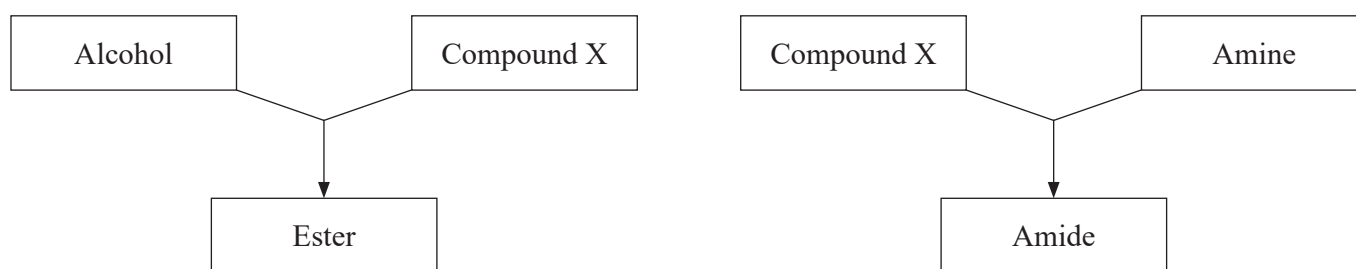
The equilibrium concentration of A is  $2.8 \times 10^{-4}$  M and B is  $1.2 \times 10^{-4}$  M.



Which option represents the ratio of molecules present in a sample of the gaseous mixture when the temperature is decreased and a new equilibrium established?

- (A) 8 molecules of A and 2 molecules of B
- (B) 5 molecules of A and 5 molecules of B
- (C) 3 molecules of A and 7 molecules of B
- (D) 2 molecules of A and 8 molecules of B

### QUESTION 7

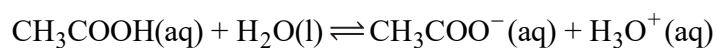


Compound X in these reaction pathways is

- (A) a ketone.
- (B) an alkene.
- (C) an aldehyde.
- (D) a carboxylic acid.

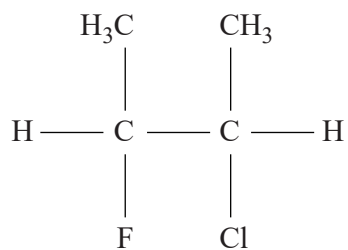
### QUESTION 8

Predict how the system shown will respond when a small amount of aqueous sodium hydroxide is added.



- (A) Equilibrium shifts to the left and the pH decreases.
- (B) Equilibrium shifts to the right and the pH increases.
- (C) Equilibrium shifts to the left and the pH remains the same.
- (D) Equilibrium shifts to the right and the pH remains the same.

### QUESTION 9



The IUPAC name for this molecule is

- (A) 2-chloro-3-fluorobutane.
- (B) 2-fluoro-3-chlorobutane.
- (C) 2-dimethyl-1-chloro-2-fluoroethane.
- (D) 1,2-dimethyl-1-fluoro-2-chloroethane.

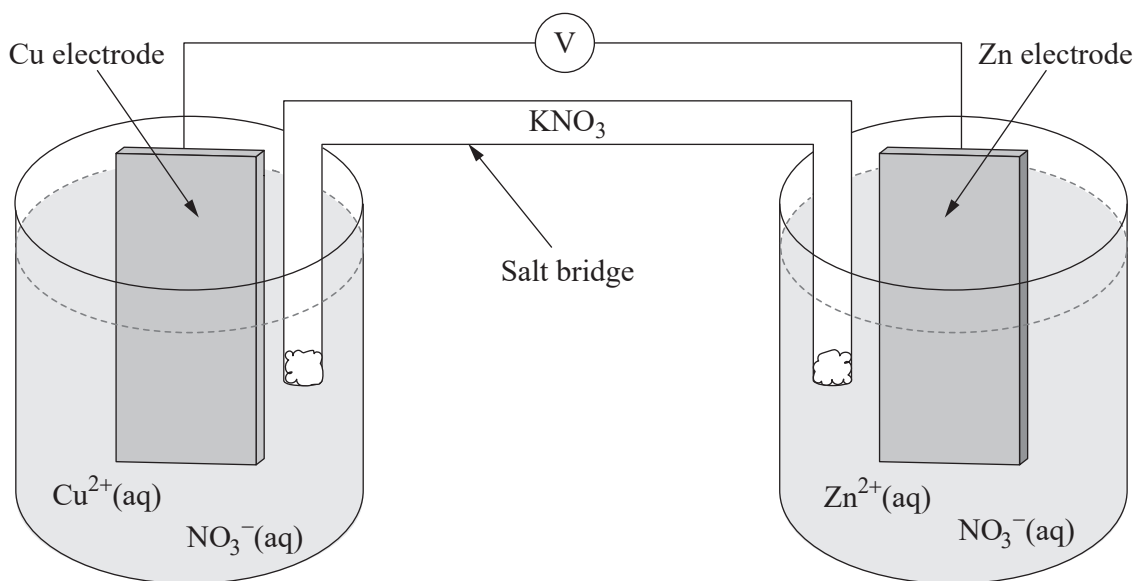
### QUESTION 10

The midpoint of the colour change of a weak acid indicator occurs when

- (A)  $[\text{In}^-] = [\text{H}^+]$
- (B)  $[\text{In}^-] = [\text{HIn}]$
- (C)  $[\text{H}^+] = [\text{OH}^-]$
- (D)  $[\text{HIn}] = [\text{OH}^-]$

## QUESTIONS 11–12

These questions refer to the diagram shown.



### QUESTION 11

Determine the species that travels through the salt bridge towards the reduction half-cell in the electrochemical cell at standard conditions.

- (A) zinc ions
- (B) nitrate ions
- (C) copper ions
- (D) potassium ions

### QUESTION 12

The zinc electrode

- (A) gains electrons and acts as the anode.
- (B) acts as the cathode and has a positive charge.
- (C) undergoes reduction and has a negative charge.
- (D) is oxidised and donates electrons to the copper ions.

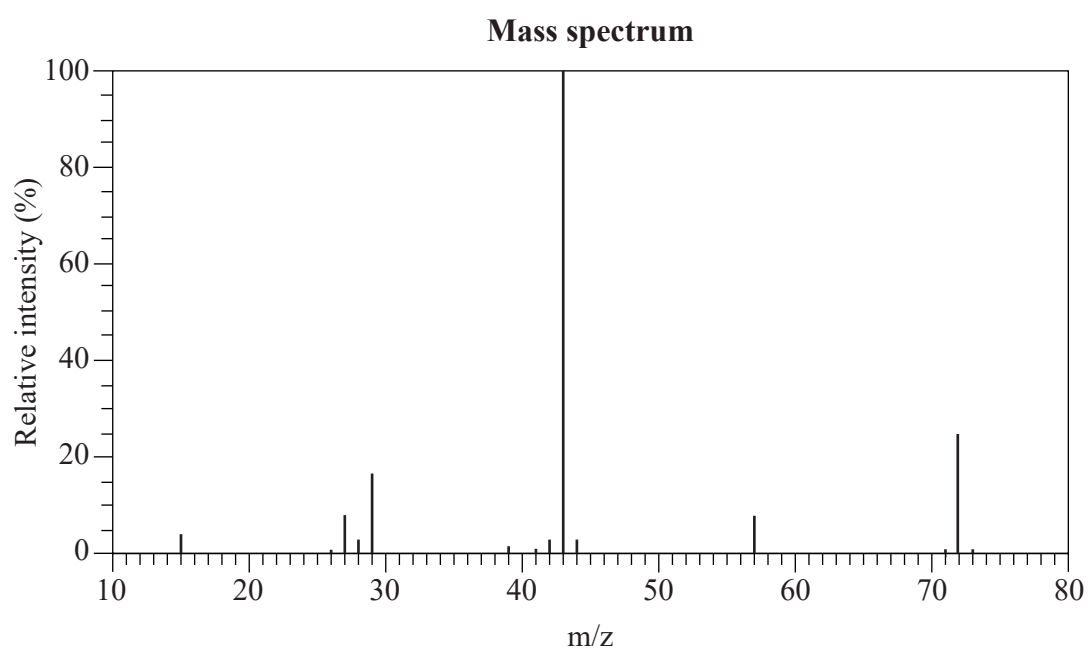
### QUESTION 13

Determine the  $K_a$  of an unknown weak acid (HA) with an aqueous concentration of 0.12 M and a pH of 3.2.

- (A)  $5.2 \times 10^{-3}$
- (B)  $6.3 \times 10^{-4}$
- (C)  $3.3 \times 10^{-6}$
- (D)  $4.0 \times 10^{-7}$

### QUESTION 14

The mass spectrum for Compound X is found to have signals at the following  $m/z$  values.

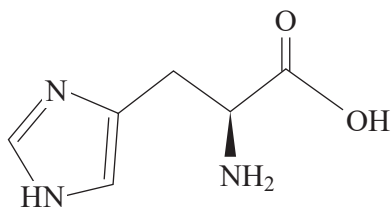


Compound X is

- (A) butanal.
- (B) butanol.
- (C) butanone.
- (D) butanoic acid.

### QUESTION 15

The structure of an amino acid is shown.



This molecule contains an amine group and a

- (A) carboxyl group.
- (B) hydroxy group.
- (C) methyl group.
- (D) ketone group.

### QUESTION 16

Determine the oxidation state of manganese in  $\text{MnO}_4^-$ .

- (A) +1
- (B) +2
- (C) +7
- (D) +8

### QUESTION 17

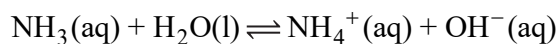
Identify the redox reaction.

- (A)  $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
- (B)  $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{s})$
- (C)  $\text{Cl}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{HCl}(\text{aq}) + \text{HClO}(\text{aq})$
- (D)  $\text{NaOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$



### QUESTION 18

Determine the  $K_b$  expression for the weak base shown in the equilibrium equation.



(A)  $K_b = \frac{[\text{NH}_3][\text{H}_2\text{O}]}{[\text{NH}_4^+]}$

(B)  $K_b = \frac{[\text{NH}_3][\text{H}_2\text{O}]}{[\text{OH}^-]}$

(C)  $K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]}$

(D)  $K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{H}_2\text{O}]}$

### QUESTION 19

Three voltaic cells are constructed with metal Q as one electrode and metals R, S or T as the other electrode. The potential differences for the cells are shown in the table.

Voltaic cell	Half-cell	Half-cell	Potential difference (V)
1	Q(s) / Q <sup>2+</sup> (aq)	R <sup>+</sup> (aq) / R(s)	1.18
2	Q(s) / Q <sup>2+</sup> (aq)	S <sup>2+</sup> (aq) / S(s)	0.72
3	T(s) / T <sup>3+</sup> (aq)	Q <sup>2+</sup> (aq) / Q(s)	0.95

The relative strength of the reducing agents from strongest to weakest is

- (A) T > Q > S > R
- (B) S > Q > T > R
- (C) R > Q > S > T
- (D) Q > R > T > S

## QUESTION 20

<b>1</b>	$\left( \text{CH}_2 - \underset{\text{CH}_3}{\underset{ }{\text{CH}}} - \text{CH}_2 - \overset{\text{CH}_3}{\overset{ }{\text{CH}}} - \text{CH}_2 - \underset{\text{CH}_3}{\underset{ }{\text{CH}}} - \text{CH}_2 - \overset{\text{CH}_3}{\overset{ }{\text{CH}}} - \text{CH}_2 - \underset{\text{CH}_3}{\underset{ }{\text{CH}}} \right)$
<b>2</b>	$\left( \text{CH}_2 - \overset{\text{CH}_3}{\overset{ }{\text{CH}}} - \text{CH}_2 - \overset{\text{CH}_3}{\overset{ }{\text{CH}}} - \text{CH}_2 - \underset{\text{CH}_3}{\underset{ }{\text{CH}}} - \text{CH}_2 - \overset{\text{CH}_3}{\overset{ }{\text{CH}}} - \text{CH}_2 - \underset{\text{CH}_3}{\underset{ }{\text{CH}}} \right)$

The two forms of polypropene shown are

	<b>1</b>	<b>2</b>
(A)	syntactic	atactic
(B)	isotactic	atactic
(C)	isotactic	syntactic
(D)	atactic	syntactic

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## References

### Question 14

Mass spectrum (electron ionization), <https://webbook.nist.gov/cgi/cbook.cgi?ID=C78933&Mask=200#Mass-Spec>, © 2021 by the U.S. Secretary of Commerce on behalf of the United States of America. All rights reserved.



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