External assessment 2024

Multiple choice question book

Chemistry

Paper 1

General instruction

- Work in this book will not be marked.

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Section 1

Instruction

- Respond to these questions in the question and response book.

QUESTIONS 1–2

Questions 1–2 refer to hydrated copper sulfate and its decomposition when heated.

Hydrated copper sulfate ($CuSO_4 \cdot H_2O$) decomposes to form copper sulfate ($CuSO_4$) and water when heated.

$$\text{heat} + CuSO_4 \cdot H_2O(s) \rightleftharpoons CuSO_4(s) + H_2O(g)$$

QUESTION 1

Which of the following is exchanged with the surrounding environment when $CuSO_4 \cdot H_2O(s)$ is heated in a closed system to establish dynamic equilibrium?

(A) heat

(B) $H_2O(g)$

(C) $CuSO_4(s) + H_2O(g)$

(D) $\text{heat} + CuSO_4 \cdot H_2O(s)$

QUESTION 2

Determine the oxidation number of sulfur (S) in $CuSO_4 \cdot H_2O$.

(A) +8

(B) +6

(C) −2

(D) −4

QUESTION 3

Identify which of the following is an essential component of an electrolytic cell.

(A) voltmeter

(B) salt bridge

(C) power supply

(D) standard hydrogen electrode (SHE)

QUESTION 4

Identify which polymer contains a carbonyl (C=O) group.

(A) polyester

(B) polyethene

(C) polypropene

(D) polytetrafluorethene

QUESTION 5

Titration is a volumetric analysis method used to

(A) measure the pH of an analyte.

(B) determine the volume of a titrant.

(C) calculate the concentration of an identified solution.

(D) prepare a standard solution of known concentration and volume.

QUESTION 6

The equivalence point of an acid–base titration occurs when the

(A) pH equals the pK_a.

(B) pH stops changing.

(C) indicator changes colour.

(D) titrant completely neutralises the analyte.

QUESTION 7

Which option is a principle of green chemistry?

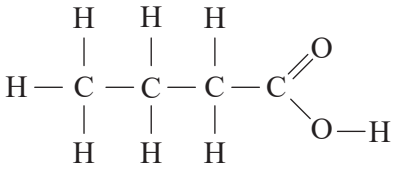
(A) avoid chemical derivatives

(B) decrease energy efficiency

(C) prevent catalytic reactions

(D) minimise atom economy

QUESTION 8



Determine the IUPAC name of the organic compound shown.

(A) butanoic acid

(B) butanone

(C) butanol

(D) butanal

QUESTION 9

Polytetrafluorethene (PTFE) has a higher melting point than polypropene (PP) due to the

(A) C–F bonds being non-reactive.

(B) fluorine atoms forming stable C–F covalent bonds.

(C) dispersion forces between closely packed fluorocarbon chains.

(D) dipole–dipole interaction between fluorine and carbon atoms within the fluorocarbon chain.

QUESTION 10

The acid dissociation constant (K_a) represents the

(A) pH of an acid solution.

(B) strength of an acid solution.

(C) concentration of an acid solution.

(D) conjugate acid–base pairs of an acid solution.

QUESTION 11

A Brønsted–Lowry acid

(A) accepts a proton to form its base.

(B) donates a proton to form its base.

(C) accepts a proton to form its conjugate base.

(D) donates a proton to form its conjugate base.

QUESTION 12

The following equilibrium law expression is given for a specific reaction.

$$K_c = \frac{[H_2O]^4[CO_2]^3}{[C_3H_8][O_2]^5}$$

Determine which of the following is a product of this reaction.

(A) $CO_2(g)$

(B) $C_3H_8(l)$

(C) $H_2O(l)$

(D) $O_2(g)$

QUESTIONS 13–14

Questions 13–14 refer to the reactions below.

Reaction 1: $CH_3CH_2OH \xrightarrow[\text{(heat/reflux)}]{H^+/Cr_2O_7^{2-}}$ compound X

Reaction 2: compound X + $CH_3NH_2 \xrightarrow[\text{(heat } >100\ ^oC)]{TiCl_4}$ compound Y

QUESTION 13

Determine the type of reaction that produced compound X.

(A) addition

(B) oxidation

(C) substitution

(D) esterification

QUESTION 14

Identify compound Y.

(A) CH_3CH_2CN

(B) $CH_3CONHCH_3$

(C) $CH_3CH_2CH_2NH_2$

(D) $H_2NCH(CH_3)COOH$

QUESTION 15

Identify the single displacement reaction.

(A) $2Cu(s) + O_2(g) \rightarrow 2CuO(s)$

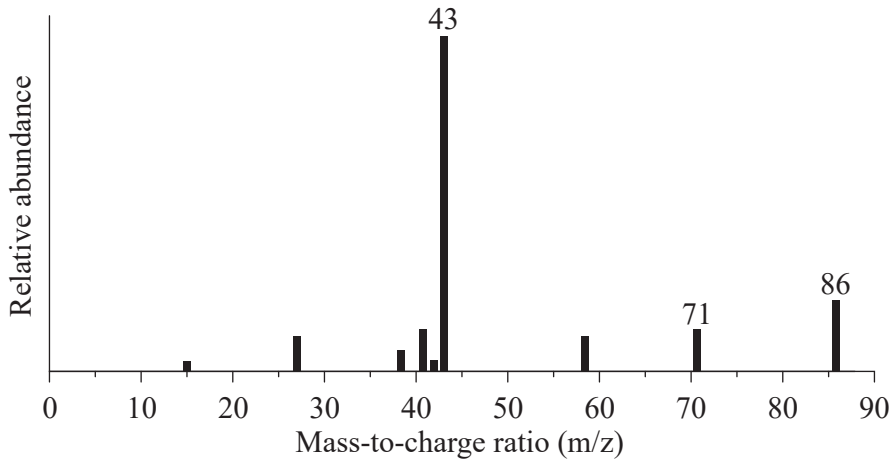
(B) $CuCl_2(aq) \rightarrow Cu^{2+}(aq) + 2Cl^-(aq)$

(C) $Cu(s) + 2AgNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2Ag(s)$

(D) $2AgNO_3(aq) + CuCl_2(aq) \rightarrow Cu(NO_3)_2(aq) + 2AgCl(s)$

QUESTION 16

The simplified mass spectrum for an organic compound C_5H_xO is shown.



Determine which compound the mass spectrum belongs to.

(A) pentan-2-one

(B) pentan-3-one

(C) pentan-1-ol

(D) pentanal

QUESTION 17

Identify the product produced at the cathode when a concentrated aqueous solution of NaCl undergoes electrolysis.

(A) $Cl_2(g)$

(B) Na(l)

(C) $O_2(g)$

(D) $H_2(g)$

QUESTION 18

The electrode and electrolyte solutions of four half-cells are shown.

Half-cell	Electrode	Electrolyte solution (1.0 M)
1	Cu	$CuNO_3(aq)$
2	Fe	$Fe(NO_3)_2(aq)$
3	Al	$Al(NO_3)_3(aq)$
4	Pt	$Fe(NO_3)_3(aq)$

Determine which two half-cells would produce the largest potential difference (V) under standard conditions when combined to construct a voltaic cell.

(A) 4 and 1

(B) 1 and 2

(C) 2 and 3

(D) 3 and 4

QUESTION 19

Esters undergo hydrolysis to form a carboxylic acid and

(A) water.

(B) an amine.

(C) an alcohol.

(D) an aldehyde.

QUESTION 20

Identify the polyprotic acid.

(A) $NH_3(aq)$

(B) $H_3PO_4(aq)$

(C) $(NH_4)_3PO_4(aq)$

(D) $CH_3COOH(aq)$

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