HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2023

CHEMISTRY PAPER 1

8:30 am – 11:00 am (2 hours 30 minutes)

This paper must be answered in English

GENERAL INSTRUCTIONS

1. There are **TWO** sections, A and B, in this Paper. You are advised to finish Section A in about 45 minutes.

2. Section A consists of multiple-choice questions in this question paper, while Section B contains conventional questions printed separately in Question-Answer Book **B**.

3. Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book **B**. **The Answer Sheet for Section A and the Question-Answer Book for Section B will be collected separately at the end of the examination.**

4. A Periodic Table is printed on page 20 of Question-Answer Book **B**. Atomic numbers and relative atomic masses of elements can be obtained from the Periodic Table.

INSTRUCTIONS FOR SECTION A (MULTIPLE-CHOICE QUESTIONS)

1. Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first stick a barcode label and insert the information required in the spaces provided. No extra time will be given for sticking on the barcode label after the 'Time is up' announcement.

2. When told to open this book, you should check that all the questions are there. Look for the words **'END OF SECTION A'** after the last question.

3. All questions carry equal marks.

4. **ANSWER ALL QUESTIONS.** You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.

5. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

6. No marks will be deducted for wrong answers.

Not to be taken away before the end of the examination session

This section consists of two parts. There are 24 questions in PART I and 12 questions in PART II.

Choose the best answer for each question.

Candidates may refer to the Periodic Table printed on page 20 of Question-Answer Book B.

PART I

1. Which of the following mixtures can be separated by filtration ?

   A. a mixture of oil and water
   B. a mixture of ethanol and water
   C. a mixture of silver chloride and water
   D. a mixture of sodium chloride and water

2. Which of the following gases can cause acid rain ?

   A. $CH_4(g)$
   B. $CO(g)$
   C. $N_2(g)$
   D. $SO_2(g)$

3. Solid **W** dissolves in water to form an alkaline solution. What is **W** ?

   A. calcium oxide
   B. calcium chloride
   C. copper(II) oxide
   D. copper(II) chloride

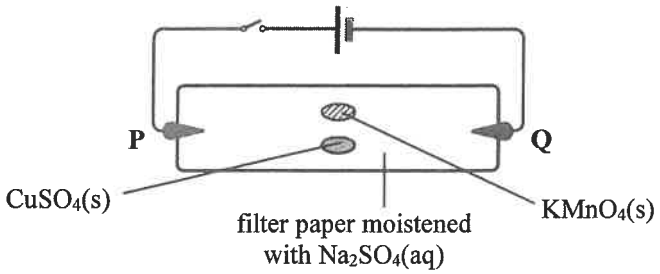
4. The table below shows the molar masses of four fertilisers. Which of the following fertilisers has the highest percentage by mass of nitrogen ?

Fertiliser	Molar mass / g
$(NH_2)_2CO$	60.0
NH_4NO_3	80.0
$NaNO_3$	85.0
$(NH_4)_2SO_4$	132.1

(Relative atomic mass : N = 14.0)

   A. $(NH_2)_2CO$
   B. NH_4NO_3
   C. $NaNO_3$
   D. $(NH_4)_2SO_4$

5. Consider the following experimental set-up :



What can be observed after the circuit is closed for a period of time ?

A. A purple patch and a blue patch migrate towards **P**.
B. A purple patch and a blue patch migrate towards **Q**.
C. A purple patch migrates towards **P** while a blue patch migrates towards **Q**.
D. A purple patch migrates towards **Q** while a blue patch migrates towards **P**.

6. Metal **X** is less reactive than silver. 2.21 g of an oxide of **X** is heated strongly until no further reaction. The mass of the solid remaining is 1.97 g. What is the chemical formula of this oxide ?

(Relative atomic masses : O = 16.0, **X** = 197.0)

A. **X**O
B. $\mathbf{X}O_2$
C. $\mathbf{X}_2O$
D. $\mathbf{X}_2O_3$

7. Which of the following statements concerning aqueous ammonia is INCORRECT ?

A. Aqueous ammonia is a weak alkali.
B. Concentrated aqueous ammonia is corrosive.
C. Aqueous ammonia can be used to distinguish between $Pb(NO_3)_2(aq)$ and $Al(NO_3)_3(aq)$.
D. When aqueous ammonia is added to $CuSO_4(aq)$ until in excess, a deep blue solution is formed.

8. Which of the following is endothermic ?

A. dilution of concentrated sulphuric acid with water
B. thermal decomposition of limestone
C. reaction of quicklime with water
D. combustion of ethanol

9. Which of the following equations can represent a possible reaction for the cracking of $C_{16}H_{34}$ to give propene and other organic products ?

A. $C_{16}H_{34} \rightarrow C_2H_4 + C_7H_{14} + C_7H_{16}$
B. $C_{16}H_{34} \rightarrow C_3H_6 + C_6H_{12} + C_7H_{14}$
C. $C_{16}H_{34} \rightarrow C_3H_6 + C_6H_{14} + C_7H_{14}$
D. $C_{16}H_{34} \rightarrow C_3H_8 + C_5H_{10} + C_8H_{16}$

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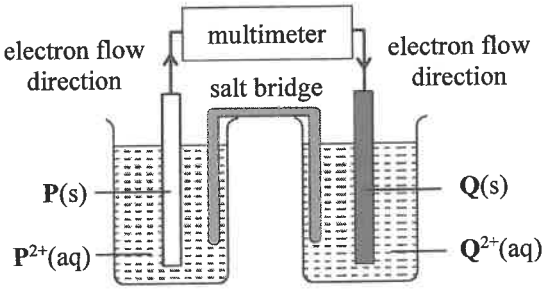
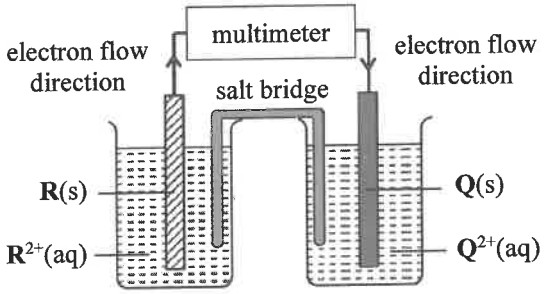
10. Petroleum can be separated into different fractions by fractional distillation in a fractionating tower. Fraction **U** is obtained from the upper part of the fractionating tower and fraction **L** is obtained from the lower part of the fractionating tower. Which of the following statements is correct ?

A. Fraction **U** has a higher boiling range and a higher viscosity than fraction **L**.
B. Fraction **U** has a higher boiling range and a lower viscosity than fraction **L**.
C. Fraction **U** has a lower boiling range and a higher viscosity than fraction **L**.
D. Fraction **U** has a lower boiling range and a lower viscosity than fraction **L**.

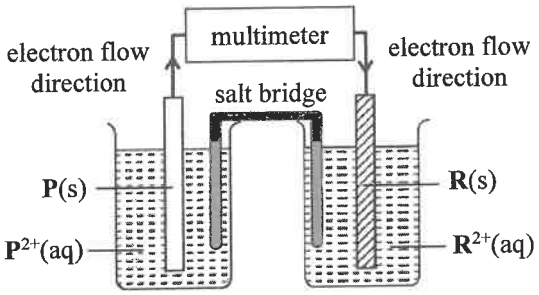
11. Consider the following three chemical cells :



Chemical cell (1)



Chemical cell (2)



Chemical cell (3)

Which of the following correctly shows the descending order of reactivity of the three metals **P**, **Q** and **R** ?

A. **P > Q > R**
B. **P > R > Q**
C. **R > P > Q**
D. **Q > R > P**

12. When 40 cm^3 of 0.5 M hydrochloric acid is mixed with 40 cm^3 of 0.5 M sodium hydroxide solution, there is a temperature rise of ΔT. What would be the temperature rise if 60 cm^3 of 1.0 M hydrochloric acid is mixed with 60 cm^3 of 0.5 M sodium hydroxide solution ?

A. 0.75 ΔT
B. ΔT
C. 1.5 ΔT
D. 2 ΔT

13. Which of the following combinations concerning the electrolysis of copper(II) sulphate solution is correct ?

	Anode	Cathode	Observation
A.	graphite	graphite	A reddish brown solid is deposited on the anode.
B.	graphite	copper	The mass of the cathode decreases.
C.	copper	copper	The blue colour of the solution fades out.
D.	copper	graphite	The mass of the anode decreases.

14. 0.729 g of magnesium ribbon reacts with 50.0 cm^3 of 0.50 M sulphuric acid. What is the mass of magnesium ribbon remained after the reaction has completed ?

(Relative atomic mass : Mg = 24.3)

A. 0.122 g
B. 0.243 g
C. 0.425 g
D. 0.608 g

15. Argon is a gas at room temperature and pressure because

A. the outermost electron shell of an argon atom has an octet structure.
B. the attractive force between argon atoms is weak.
C. argon molecules are monoatomic.
D. argon is chemically inert.

16. Consider the following reaction :

$$Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$$

Which of the following statements concerning the oxidising agent in this reaction is correct ?

A. It loses electrons and is reduced.
B. It gains electrons and is reduced.
C. It loses electrons and is oxidised.
D. It gains electrons and is oxidised.

17. Which of the following statements concerning ice and water is / are correct ?

(1) Ice has an open structure but water does not.
(2) The number of hydrogen bonds formed between H_2O molecules in ice is double that in water.
(3) The shape of a H_2O molecule in ice is tetrahedral while the shape of a H_2O molecule in water is V-shaped.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

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18. **X** and **Z** are two elements. The table below shows some physical properties of two bromides, **X**Br and **Z**Br.

	Melting point / °C	Boiling point / °C	Solubility in water
XBr	459	1 325	soluble
ZBr	32	105	insoluble

Which of the following statements is / are correct ?

(1) **X**Br is a hard but brittle solid at room temperature.
(2) **Z**Br has a giant covalent structure.
(3) **X** is a metal and **Z** is a non-metal.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

19. Members of the homologous series of alkenes have the same

(1) structural formula.
(2) empirical formula.
(3) general formula.

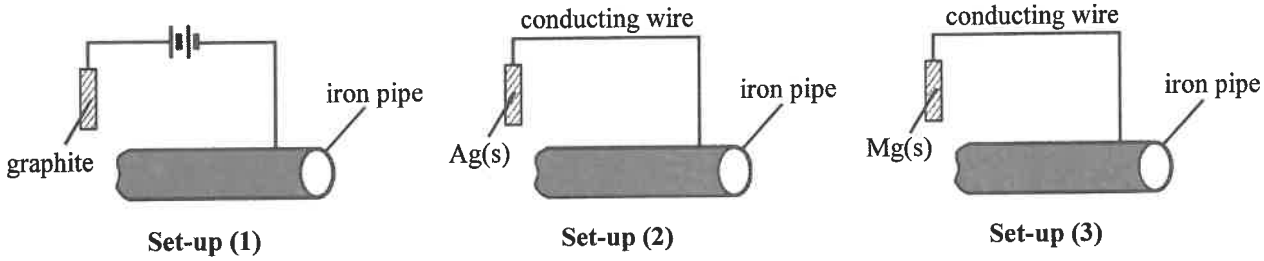
A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

20. Which of the following statements is / are correct ?

(1) The standard enthalpy change of formation of liquid nitrogen is not equal to zero.
(2) The standard enthalpy change of formation of a compound must be a negative value.
(3) The standard enthalpy change of formation of CO(g) can be determined directly from experiment.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

21. Which of the following set-ups can be used to prevent an underground iron pipe from rusting ?



A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

22. Consider the following two solutions :

Solution **A** : 100 cm^3 of 1.0 M nitric acid
Solution **B** : 100 cm^3 of 0.5 M sulphuric acid

Which of the following statements are correct ?

(1) Both solution **A** and solution **B** can react with iron.
(2) Complete neutralisation of solution **A** and complete neutralisation of solution **B** require the same volume of 1.0 M potassium hydroxide solution.
(3) When 0.05 mol of $CaCO_3(s)$ is separately added to solution **A** and to solution **B**, the same number of moles of gas is evolved in both cases.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

23. Which of the following statements concerning ethanoic acid are correct ?

(1) Ethanoic acid is present in vinegar.
(2) Ethanoic acid changes phenolphthalein indicator from colourless to pink.
(3) Ethanoic acid is an alkanoic acid.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

24. Consider the following statements and choose the best answer :

1st statement	**2nd statement**
Butane and methylpropane have the same physical properties.	Butane and methylpropane have the same molecular formula.

A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
C. The 1st statement is false but the 2nd statement is true.
D. Both statements are false.

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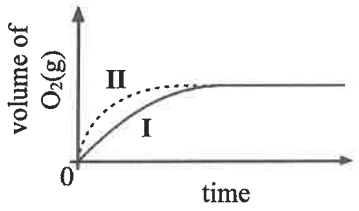
PART II

25. In order to investigate the decomposition of $H_2O_2(aq)$ to form $O_2(g)$, two experiments were carried out with $H_2O_2(aq)$ in the presence of the same amount of a suitable catalyst at room conditions. The concentrations and volumes of $H_2O_2(aq)$ used are shown below :

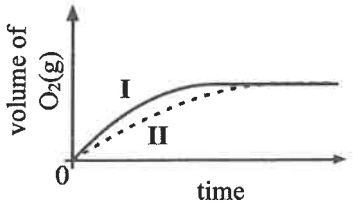
Experiment	Concentration of $H_2O_2(aq)$ / M	Volume of $H_2O_2(aq)$ / cm^3
I	1.0	25
II	0.5	50

Which of the following graphs correctly shows the variation in the volume of $O_2(g)$ evolved with time in the above two experiments ?

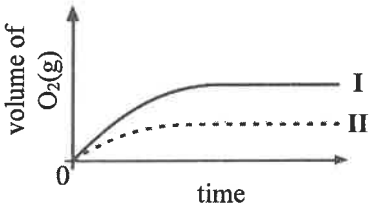
A.



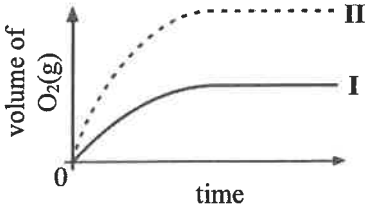
B.



C.



D.



26. Consider the following reaction :

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$$

If 100 cm^3 of $C_3H_8(g)$ burns in 600 cm^3 of $O_2(g)$, what would be the volume of the resulting gaseous mixture at room conditions ?

(Molar volume of gas at room conditions = 24 dm^3)

A. 800 cm^3
B. 700 cm^3
C. 400 cm^3
D. 300 cm^3

27. Consider the following equilibrium system at room conditions :

$$Fe^{3+}(aq) + SCN^-(aq) \rightleftharpoons Fe(SCN)^{2+}(aq)$$

A small amount of $Fe(NO_3)_3(s)$ is added to the equilibrium mixture, and a new equilibrium is finally attained at the same conditions. In comparison with the original equilibrium, which of the following combinations concerning this new equilibrium is correct ?

	Rate of *backward* reaction	**Concentration of $Fe(SCN)^{2+}(aq)$**
A.	decreased	unchanged
B.	decreased	increased
C.	increased	unchanged
D.	increased	increased

28. Which of the following chemical reactions is the fastest at room conditions ?

A. $AgNO_3(aq) + NaCl(aq) \longrightarrow AgCl(s) + NaNO_3(aq)$

B. $Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$

C. $4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$

D. $CH_4(g) + Br_2(\text{in organic solvent}) \xrightarrow{\text{light}} CH_3Br(g) + HBr(g)$

29. Consider the information below :

Chemical reaction	Equilibrium constant at 500°C
$HI(g) \rightleftharpoons \frac{1}{2}H_2(g) + \frac{1}{2}I_2(g)$	K_1
$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$	K_2

Which of the following mathematical relationships concerning K_1 and K_2 is correct ?

A. $K_1 = \frac{1}{K_2}$

B. $K_1 = \frac{1}{K_2^{\,2}}$

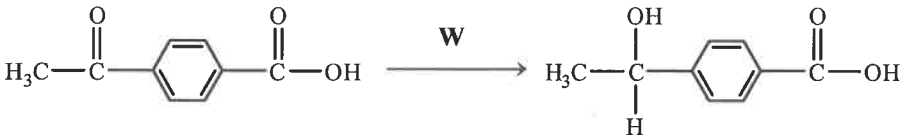
C. $K_2 = \frac{1}{2K_1}$

D. $K_2 = \frac{1}{K_1^{\,2}}$

30. Which of the following pairs of substances would NOT react with each other ?

A. ethene and hydrogen chloride
B. propan-1-ol and phosphorus trichloride
C. propene and hydrogen in the presence of platinum
D. methylpropan-2-ol and acidified potassium dichromate solution

31. What is **W** in the following conversion ?



A. $LiAlH_4$, dry ether; then $H^+(aq)$
B. concentrated H_2SO_4
C. $NaBH_4(aq)$
D. $KOH(aq)$

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32. Consider the following reversible reaction :

$$\mathbf{X}(aq) \rightleftharpoons \mathbf{Y}(aq)$$

At a fixed temperature, the system initially contains a small amount of **X**(aq) only. When the system attains chemical equilibrium, the mole ratio of **X** to **Y** in the mixture is 1 : 3. Which of the following statements is / are correct ?

(1) The reaction quotient Q_c of the system at any moment before equilibrium is greater than the equilibrium constant K_c for the reaction.
(2) If the experiment is repeated at the same temperature with the system initially containing a small amount of **Y**(aq) only, the mole ratio of **X** to **Y** in the equilibrium mixture is 1 : 3.
(3) At equilibrium, the rate of backward reaction is 3 times the rate of forward reaction.

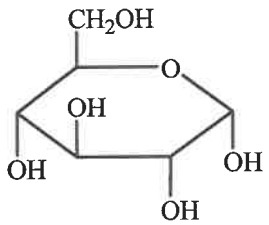
A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

33. Which of the following statements concerning the elements across the second period of the Periodic Table going from left to right is / are correct ?

(1) The melting point of carbon is the highest among these elements.
(2) The electrical conductivity of lithium is the highest among these elements.
(3) The bond type of these elements changes from ionic bonding to covalent bonding.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

34. An organic compound has the following structure :



Which of the following statements concerning this compound is / are correct ?

(1) It is soluble in water.
(2) It has an ester group.
(3) Its empirical formula is CH_2O.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

35. **P** and **Q** are polyesters made from the same monomers. The average number of repeating units in **P** is 5 000 and that in **Q** is 80 000. Which of the following statements are correct ?

(1) **Q** melts at a higher temperature than **P**.
(2) The average molecular mass of **Q** is greater than that of **P**.
(3) The number of carbon atoms in a repeating unit of **Q** is greater than that of **P**.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

36. Consider the following statements and choose the best answer :

1st statement	**2nd statement**
$CH_3CH_2CH_2CH_2COO^-Na^+$ is a soap.	$CH_3CH_2CH_2CH_2COO^-Na^+$ contains a hydrophilic $-COO^-$ group.

A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
C. The 1st statement is false but the 2nd statement is true.
D. Both statements are false.

END OF SECTION A