HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2022

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)

- 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.

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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 statements concerning CO₂(g) is INCORRECT?
 - A. It can turn limewater milky.
 - B. It can be used to make dry ice.
 - C. It can be produced by adding marble to water.
 - D. It generally has a higher percentage in the air in urban areas than that in rural areas.
- 2. How many neutrons and electrons are there in a $_{23}^{51}X^{3+}$ ion?

	Number of neutrons	Number of electrons
A.	23	20
B.	28	23
C.	28	20
D.	51	23

- 3. Which of the following substances is an electrolyte?
 - A. sodium chloride
 - B. silicon dioxide
 - C. methanol
 - D. mercury
- 4. Which of the following is an INCORRECT procedure in titration?
 - A. Rinse the pipette with the solution to be delivered before titration.
 - B. Rinse the conical flask with the solution to be held before titration.
 - C. Take the burette readings with eyes on the same level as the meniscus.
 - D. Make sure that there are no air bubbles in the burette filled with the titrant.
- 5. Element X is one of the first twenty elements in the Periodic Table. X forms a stable XH₄⁺(aq) ion. Which group of the Periodic Table does X most likely belong to?
 - A. Group III
 - B. Group IV
 - C. Group V
 - D. Group VI
- 6. Copper(II) phosphate is insoluble in water. What is the number of moles of Cu²⁺(aq) ions remaining in the solution of the resulting mixture when 0.04 mol of CuCl₂(aq) is mixed with 0.02 mol of Na₃PO₄(aq)?
 - A. 0.00
 - B. 0.01
 - C. 0.02
 - D. 0.03

- 7. A white solid does NOT dissolve in both water and excess aqueous ammonia. Which of the following may this solid be?
 - A. $Pb(NO_3)_2$
 - B. $Zn(OH)_2$
 - C. MgSO₄
 - D. CaCO₃
- 8. The structure of a portion of a polymer is shown below:

Which of the following statements concerning the polymer is correct?

- A. It can be used as a substitute for glass.
- B. Its repeating unit is $\begin{bmatrix}
 H & Cl & H & H \\
 & & & & & \\
 C & -C & -C & -C \\
 & & & & & \\
 H & H & H & Cl
 \end{bmatrix}$
- C. It can be made from its monomer through addition polymerisation.
- D. It can decolourise bromine dissolved in an organic solvent quickly.
- 9. Consider the following three compounds:
 - X: CH₃CH₂CH₂CH₂OH
- Y: HOCH2CH2OH
- Z: CH₃COOCH₃

Which of the following shows the decreasing order of their solubilities in water?

- A. X > Y > Z
- B. Z>Y>X
- C. Y > Z > X
- $D. \qquad Y > X > Z$
- 10. 6.54 g of zinc granules are added to 100.0 cm³ of 1.0 M AgNO₃(aq). After the reaction has completed, which of the following statements is correct?

(Relative atomic masses : Zn = 65.4, Ag = 107.9)

- A. Some zinc granules have reacted and no silver ions remain in the solution.
- B. All the zinc granules have reacted and no silver ions remain in the solution.
- C. All the zinc granules have reacted and some silver ions remain in the solution.
- D. The mass of the zinc granules reacted is equal to the mass of the solid product formed.

11. In the electrolysis of 1.0 M CuSO₄(aq), copper cathode and carbon anode are used. Which of the following combinations is correct?

	Cathode	Anode
A.	Copper dissolves	Oxygen is formed
В.	Copper dissolves	Sulphur dioxide is formed
C.	Copper is deposited	Oxygen is formed
D.	Copper is deposited	Sulphur dioxide is formed

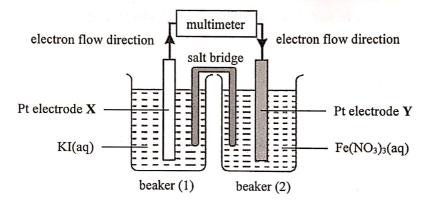
12. Consider the following chemical equation:

$$xNH_3(g) + yO_2(g) \rightarrow xNO(g) + zH_2O(g)$$

Which of the following combinations is correct?

	\boldsymbol{x}	y	Z
A.	2	3	3
В.	2	3	6
C.	4	5	4
D.	4	5	6

13. Consider the following chemical cell:



Which of the following statements is correct?

- A. Electrode X is the cathode.
- B. The solution in beaker (1) gradually turns brown.
- C. The solution in beaker (2) gradually changes from pale green to yellow.
- D. Fe(NO₃)₃(aq) acts as a reducing agent.
- 14. The enthalpy changes of formation of some substances under certain conditions are shown below:

Substance	Enthalpy change of formation / kJ mol-1
$H_2O(l)$	-286
$Na_2O(s)$	-414
NaOH(s)	-425

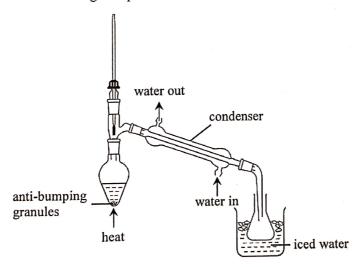
What is the enthalpy change of the following reaction under the same conditions?

$$Na_2O(s) + H_2O(l) \rightarrow 2NaOH(s)$$

- P, Q and R are three different metals. When dilute HCl(aq) is added to these metals separately, only Q and R give a colourless gas. When zinc is added to aqueous solutions of their chlorides separately, only the chloride of R shows no observable change. Which of the following shows the increasing order of the reducing power of the metals?
 - A. R < Q < P
 - B. Q < P < R
 - $C. \qquad P < Q < R$
 - $D. \qquad P < R < Q$
- 16. The molecular formula of compound X is C_4H_7Br and it has one carbon-carbon double bond. It can react with Br_2 (dissolved in an organic solvent) to give the following organic product:

Which of the following is / are the possible structure(s) of X?

- (1) CH₂BrCH₂CH=CH₂
- (2) $H_2C=CHCHBrCH_3$
- (3) CH₃CH=CHCH₂Br
 - A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
- 17. Refer to the following set-up:



Which of the following processes can be performed by using the above set-up?

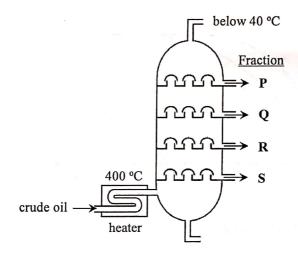
- (1) obtaining pure water from sea water
- (2) obtaining propane from diesel oil
- (3) obtaining oxygen from liquefied air
 - A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only

- 18. Which of the following pairs of substances, when mixed, would release hydrogen gas?
 - (1) copper and concentrated HCl(aq)
 - (2) iron and H₂SO₄(aq)
 - (3) calcium and NaOH(aq)
 - A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
- 19. Consider the following two compounds:

Which of the following statements is / are correct?

- (1) They belong to the same homologous series.
- (2) They have the same molecular formula.
- (3) They are insoluble in water.
 - A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
- 20. A small piece of sodium is added to water containing a few drops of universal indicator. Which of the following statements is / are correct?
 - (1) Sodium moves quickly on the water surface.
 - (2) The resulting solution shows a red colour.
 - (3) This reaction is exothermic.
 - A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
- 21. Which of the following statements are correct?
 - (1) The standard enthalpy change of formation of graphite is zero.
 - (2) The standard enthalpy change of combustion of carbon monoxide is a negative value.
 - (3) The standard enthalpy change of formation of carbon monoxide is equal to the standard enthalpy change of combustion of graphite.
 - A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)

- 22. Both A and B are monobasic acids. The pH of 0.10 M A(aq) is 1.0 and the pH of 0.10 M B(aq) is 3.0. Which of the following statements are correct?
 - (1) A is a stronger acid than B.
 - (2) Some B molecules are present in B(aq).
 - (3) Complete neutralisation of 25.0 cm³ of 0.10 M A(aq) and complete neutralisation of 25.0 cm³ of 0.10 M B(aq) require the same number of moles of NaOH(aq).
 - A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)
- 23. The simplified diagram below shows how different petroleum fractions can be obtained from a fractionating tower.



Which of the following statements are correct?

- (1) Fraction S has a darker colour than fraction Q.
- (2) Fraction \mathbf{R} has a higher viscosity than fraction \mathbf{P} .
- (3) Fraction Q is more flammable than fraction P.
 - 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:

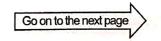
1st statement

2nd statement

Ethene and but-1-ene have the same standard enthalpy change of combustion.

Ethene and but-1-ene have the same empirical 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.

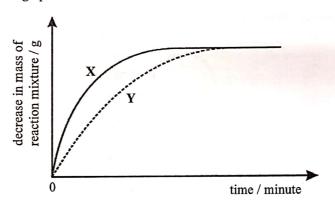


PART II

25. A mixture consists of methane and ethane. 50 cm³ of this mixture completely burns in oxygen to form 80 cm³ of carbon dioxide at room conditions. What is the volume of methane in this mixture at room conditions?

(Molar volume of gas at room conditions = 24 dm³)

- A. 10 cm³
- B. 20 cm³
- C. 30 cm³
- D. 40 cm^3
- 26. 50 cm³ of 0.10 M HCl(aq) reacts with excess calcium carbonate powder in an open conical flask giving curve X in the graph below.



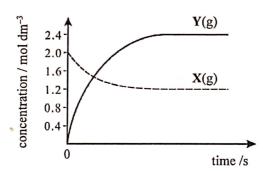
Which of the following changes may give curve Y?

- A. Increase the temperature by 10 °C.
- B. Use 25 cm³ of 0.10 M HCl(aq) instead of 50 cm³ of 0.10 M HCl(aq).
- C. Use 50 cm³ of 0.05 M HCl(aq) instead of 50 cm³ of 0.10 M HCl(aq).
- D. Use the same mass of calcium carbonate granules instead of calcium carbonate powder.
- 27. The structure of an organic compound is shown below:

Which of the following combinations concerning whether *cis-trans* isomerism and enantiomerism can occur in the compound is correct?

	cis-trans isomerism	enantiomerism
A.	No	No
В.	Yes	Yes
C.	Yes	No
D.	No	Yes

When chemical equilibrium is attained in a certain reversible reaction, only X(g) and Y(g) are present in a closed container of fixed volume. The following graph shows the variation in concentrations of X(g) and Y(g) with time:



Which of the following equations can represent the reversible reaction?

- A. $X(g) \rightleftharpoons 2Y(g)$
- B. $X(g) \rightleftharpoons 3Y(g)$
- C. $2X(g) \rightleftharpoons Y(g)$
- D. $2X(g) \rightleftharpoons 3Y(g)$
- 29. The structure of an organic compound is shown below:

When it is heated with excess NaOH(aq), followed by the addition of excess HCl(aq), a major organic product **Z** is formed. Which of the following is **Z**?

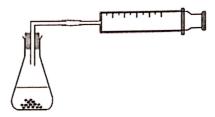
- A. $_{\text{HO}}$ $^{\text{NH}_3\text{Cl}}$
- B. O NH₃Cl
- C. NaO NH₃Cl
- D. O NH₂
- 30. When 0.40 mol of $SO_2(g)$ and 0.60 mol of $O_2(g)$ are placed in a 1.0 dm³ evacuated flask, the following reaction occurs.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

When chemical equilibrium is attained at a certain temperature, the flask is found to contain 0.30 mol of $SO_3(g)$. What is the equilibrium constant K_c for the reaction at this temperature?

- A. 20 mol⁻¹ dm³
- B. $6.7 \text{ mol}^{-1} \text{ dm}^3$
- C. $2.0 \text{ mol}^{-1} \text{ dm}^3$
- D. $0.050 \text{ mol}^{-1} \text{ dm}^3$

31. Consider the experimental set-up shown below:



Under room conditions, which of the following pairs of reactants can the progress of their reaction be followed by the above set-up?

- (1) $Zn(OH)_2(s)$ and $HNO_3(aq)$
- (2) Mg(s) and HCl(aq)
- (3) KBr(s) and $Cl_2(aq)$
 - A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
- 32. Consider the following equilibrium system:

$$2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O(l)$$

Which of the following statements can demonstrate that chromium exhibits the characteristic(s) of transition metals?

- (1) $Cr_2O_7^{2-}(aq)$ ions are orange in colour.
- (2) Adding HCl(aq) would shift the equilibrium position to the right.
- (3) The oxidation states of chromium in CrO_4^{2-} and $Cr_2O_7^{2-}$ are the same.
 - A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
- 33. The structure of aspirin is shown below:

Which of the following statements about aspirin are correct?

- (1) It has an ester group.
- (2) It can reduce inflammation.
- (3) It has a higher solubility in Na₂CO₃(aq) than in pure water.
 - A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)

- 34. Which of the following compounds can be used as a monomer for condensation polymerisation?
 - (1) $H_2C=CHCH_2CH=CH_2$
 - (2) HOOCCH₂CH₂CH₂CH₂COOH
 - (3) HOCH₂CH₂CH₂CH₂CH₂CH₂OH
 - A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)
- 35. The structure of a detergent is shown below:

Which of the following statements concerning this detergent are correct?

- (1) It is a soapless detergent.
- (2) It can act as an emulsifying agent.
- (3) It can increase the surface tension of water.
 - 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

At chemical equilibrium, the concentration of reactants must be equal to the concentration of products.

2nd statement

At chemical equilibrium, both forward reaction rate and backward reaction rate are equal to zero.

- 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