HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2016

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. A flame test conducted for a sample gives a brick-red flame. The sample may contain

    A. chalk.
    B. quartz.
    C. graphite.
    D. rock salt.

2. Which of the following is the electron diagram (only electrons in the outermost shells are shown) of lithium sulphide ?

    A. $Li \overset{..}{\underset{..}{S}}$

    B. $[Li]^{+} [\overset{..}{\underset{..}{S}}]^{-}$

    C. $[Li]^{+} [\overset{..}{\underset{..}{S}}]^{2-} [Li]^{+}$

    D. $[\overset{..}{\underset{..}{Li}}]^{+} [\overset{..}{\underset{..}{S}}]^{2-} [\overset{..}{\underset{..}{Li}}]^{+}$
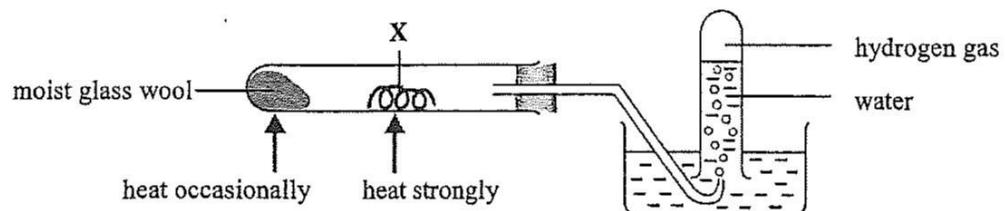
3. Consider the following information concerning metal **Y** :

    (1) **Y** reacts vigorously with water.
    (2) **Y** forms an oxide with chemical formula Y_2O.
    (3) An atom of **Y** has five occupied electron shells.

    Y may be
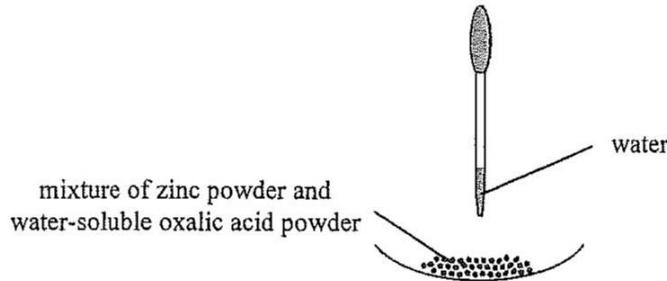
    A. silver (Ag).
    B. caesium (Cs).
    C. strontium (Sr).
    D. rubidium (Rb).

4. Consider the following experimental set-up :


    Which of the following would NOT be **X** ?

    A. iron
    B. zinc
    C. copper
    D. magnesium

5. Tin plating is used to prevent iron cans from rusting because

    A.   tin provides sacrificial protection to iron.
    B.   tin layer prevents iron from exposure to air.
    C.   tin is higher than iron in the metal reactivity series.
    D.   tin and iron form an alloy which does not corrode.

6. The pH of a sample of sulphuric acid is 2.6. 100 cm^3 of this sample is mixed with 100 cm^3 of water. What is the pH of the resulting mixture ?

    A.   5.8
    B.   2.9
    C.   2.6
    D.   1.3

7. Consider the following experimental set-up :

mixture of zinc powder and
water-soluble oxalic acid powder

water

A colourless gas is given out when water is dropped to the mixture. Which of the following statements is correct ?

    A.   Oxalic acid ionises in water to give hydrogen ions.
    B.   Zinc ionises in water to give zinc ions.
    C.   Water reacts with oxalic acid to give the colourless gas.
    D.   Water reacts with zinc to give the colourless gas.

8. Which of the following pairs of substances, when mixed together, can be used to prepare copper(II) sulphate crystals ?

    A. $CuO(s)$ and $H_2SO_4(aq)$
    B. $CuO(s)$ and $MgSO_4(aq)$
    C. $Cu(s)$ and $H_2SO_4(aq)$
    D. $Cu(s)$ and $MgSO_4(aq)$

9. 1 mol of a hydrocarbon requires 9 mol of oxygen for complete combustion. Which of the following may be this hydrocarbon ?

    A. C_6H_6
    B. C_6H_{10}
   C. C_6H_{12}
    D. C_6H_{14}
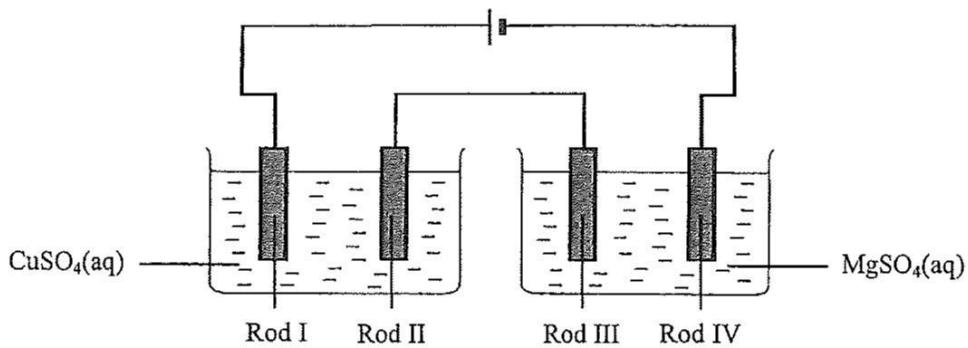
10. Which of the following CANNOT be converted into substances that are less harmful when passed through a catalytic converter ?

      A.   nitrogen oxides
      B.   sulphur dioxide
      C.   carbon monoxide
      D.   unburnt hydrocarbons

11. In which of the following compounds does nitrogen have the highest oxidation number ?

      A. NF_3
      B. N_2H_4
      C. $NaNH_2$
      D. $HONH_2$
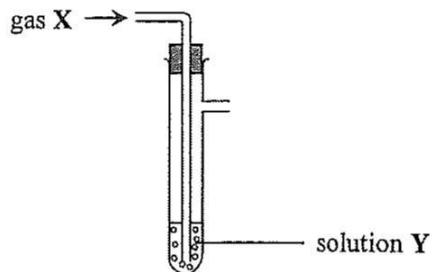
12. The diagram below shows the set-up used in an electroplating experiment involving four iron rods :

On which of the following iron rods would a metal be plated ?

      A.   Rod I
      B.   Rod II
      C.   Rod III
      D.   Rod IV

13. Gas **X** is bubbled steadily into solution **Y** as shown in the diagram below :
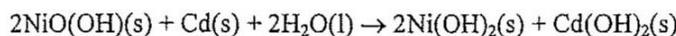
In which of the following combinations would NOT have a visible change in solution **Y** ?

	gas **X**	solution **Y**
A.	$Cl_2(g)$	$KI(aq)$
B.	$O_2(g)$	$FeSO_4(aq)$
C.	$CO_2(g)$	acidified $KMnO_4(aq)$
D.	$SO_2(g)$	acidified $Na_2Cr_2O_7(aq)$

14. Which of the following is NOT a redox reaction ?

    A. $2AgBr(s) \rightarrow 2Ag(s) + Br_2(g)$
    B. $SO_2(g) + 2H_2S(g) \rightarrow 3S(s) + 2H_2O(l)$
    C. $2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$
    D. $Ca(HCO_3)_2(aq) \rightarrow CaCO_3(s) + H_2O(l) + CO_2(g)$

15. The following equation shows the reaction when a secondary cell is discharging :

$$2NiO(OH)(s) + Cd(s) + 2H_2O(l) \rightarrow 2Ni(OH)_2(s) + Cd(OH)_2(s)$$

Which of the following half equations shows the change at the negative electrode when the cell is being recharged ?

    A. $Cd(s) + 2OH^-(aq) \rightarrow Cd(OH)_2(s) + 2e^-$
    B. $Cd(OH)_2(s) + 2e^- \rightarrow Cd(s) + 2OH^-(aq)$
    C. $Ni(OH)_2(s) + OH^-(aq) \rightarrow NiO(OH)(s) + H_2O(l) + e^-$
    D. $NiO(OH)(s) + H_2O(l) + e^- \rightarrow Ni(OH)_2(s) + OH^-(aq)$

16. Which of the following compounds has the highest boiling point ?

    A.   HF
    B.   HCl
    C. PH_3
    D. H_2Se

17. Which of the following statements concerning petroleum is / are correct ?
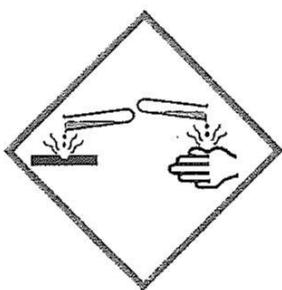
    (1)   It is a source of aliphatic hydrocarbons.
    (2)   It can be separated into liquids of different viscosity by a separating funnel.
    (3)   It is a fossil fuel derived from ancient marine organisms.

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

18. Which of the following statements concerning vinegar is / are correct ?

    (1) The process of forming hydrogen ions in vinegar is reversible.
    (2) Neutralisation occurs when sugar is added to vinegar.
    (3) The pH of vinegar used in kitchen is around 1.

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

19. The hazard warning label below is displayed on a bottle containing chemical **Z** :

    Which of the following chemicals may **Z** be ?

    (1) sodium
    (2) trichloromethane
    (3) concentrated aqueous ammonia

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

20. Pb is an element in Group IV of the Periodic Table and can form Pb^{2+} ion. Which of the following statements are correct ?

    (1) The change from Pb^{2+} ion to Pb atom is a reduction.
    (2) Both Pb atom and Pb^{2+} ion have the same number of protons.
    (3) Both Pb atom and Pb^{2+} ion have the same number of occupied electron shells.

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

21. Which of the following molecules have a similar shape ?

    (1) BCl_3
    (2) NH_3
    (3) PF_3

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

22. Which of the following processes are exothermic ?

    (1)   placing calcium oxide in water
    (2)   placing a zinc strip in a copper(II) sulphate solution
    (3)   passing hydrogen chloride gas into a sodium hydroxide solution

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

Directions : Each question below (Questions 23 and 24) consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following table :

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.

|	**1st statement**	**2nd statement**
23.	During anodisation, the aluminium oxide on the surface of aluminium is reduced to metal.	The corrosion resistance of aluminium can be enhanced by anodisation.
24.	The standard enthalpy change of formation of a compound must be a negative value.	Under standard conditions, a compound must be energetically more stable than its constituent elements.
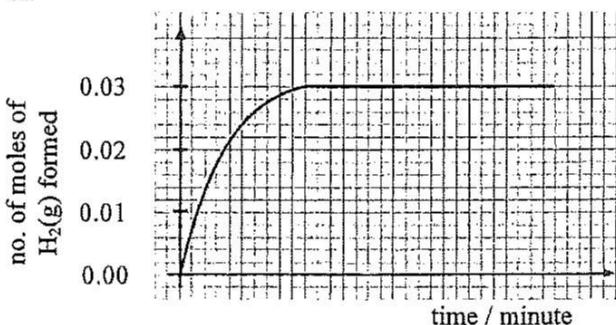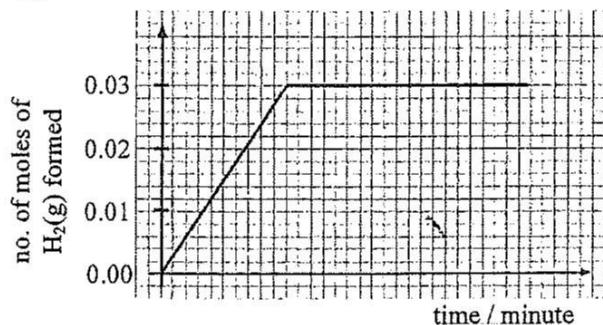
PART II

25. In an experiment, 0.03 mol of Mg(s) is allowed to react with 20.0 cm^3 of 1.0 M HCl(aq). Which of the following graphs best represents the results of the experiment ?
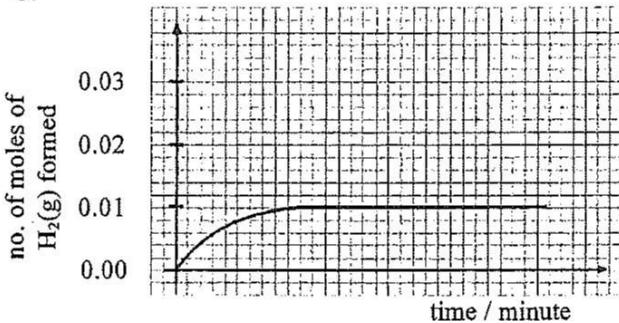
A.
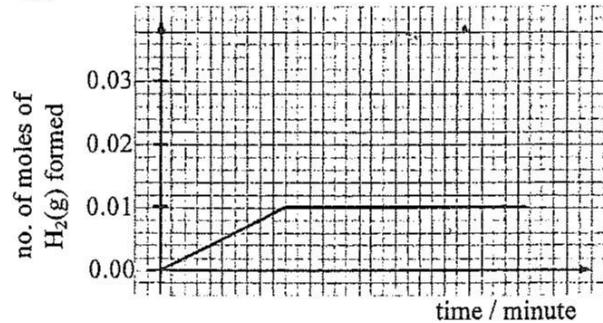
B.
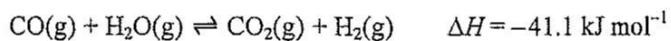
C.

D.

26. The following reaction has attained equilibrium in a fixed volume container :

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g) \qquad \Delta H = -41.1 \text{ kJ mol}^{-1}$$

Which of the following is correct if the temperature of the system is increased ?
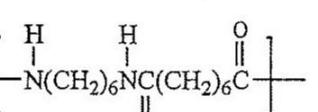
    A.   The pressure of the system remains unchanged.
    B.   Both the rates of forward and backward reaction increase.
    C.   The equilibrium constant of the reaction remains unchanged.
    D.   The respective yields of $CO_2(g)$ and $H_2(g)$ increase to the same extent.

27. Consider the following equilibrium system :

$$Br_2(aq) + H_2O(l) \rightleftharpoons HOBr(aq) + H^+(aq) + Br^-(aq)$$
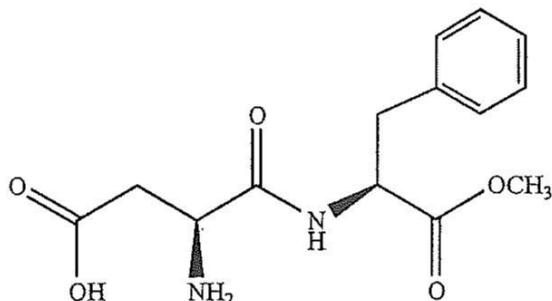
Which of the following can turn the colour of the system paler ?

    A.   passing HCl(g) into the system
    B.   passing HBr(g) into the system
    C.   adding NaBr(s) to the system
    D.   adding NaOH(s) to the system

28. Which of the following statements concerning but-1-ene and butan-1-ol is INCORRECT ?

      A.   Both of them can decolourise acidified $KMnO_4(aq)$.
      B.   Butan-1-ol can react with $PBr_3(l)$ while but-1-ene cannot.
      C.   Both of them can react with $H_2(g)$ in the presence of platinum.
      D.   But-1-ene can be obtained from heating butan-1-ol with $Al_2O_3(s)$.

29. The molecular formula of compound **X** is $C_4H_4O_4$. It has two —COOH groups. How many isomers may **X** have ?

      A.   5
      B.   4
      C.   3
      D.   2

30. Which of the following trends involving Na, Mg and Al is INCORRECT ?

      A.   Melting point of metal :   Al > Mg > Na
      B.   Electronegativity of metal :   Al > Mg > Na
      C.   Metal reactivity with water :   Na > Mg > Al
      D.   Base strength of metal oxide : $Al_2O_3 > MgO > Na_2O$

31. Which of the following statements concerning nylon-6,6 is / are correct ?

      (1)   It can be used to make ropes.
      (2)   The polymerisation in forming it is a hydrolysis process.

      (3)   Its repeating unit is $\left[\begin{array}{c} \overset{\displaystyle H}{|} \quad \overset{\displaystyle H}{|} \quad \overset{\displaystyle O}{\|} \\ {-}N(CH_2)_6NC(CH_2)_6C{-} \\ \underset{\displaystyle O}{\|} \end{array} \right]$.

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

32. Aspartame is an artificial sweetener. The structure of it is shown below :

Which of the following statements concerning an aspartame molecule is / are correct ?

(1) It has two ester groups.
(2) It has two chiral centres.
(3) It has two amide groups.
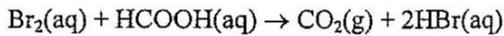
   A. (1) only
   B. (2) only
   C. (1) and (3) only
   D. (2) and (3) only

33. Which of the following statements are correct ?

(1) Magnesium oxide dissolves faster in 1 M HCl(aq) than in 1 M CH_3CO_2H(aq).
(2) Powdered marble dissolves faster in 1 M HCl(aq) than granular marble does.
(3) H_2O_2(aq) decomposes faster in the presence of MnO_2(s) than without MnO_2(s).

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

34. Consider the following reaction :

Br_2(aq) + HCOOH(aq) → CO_2(g) + 2HBr(aq)

Which of the following can be measured in order to follow the progress of the reaction ?

(1) the volume of gas formed
(2) the turbidity of the reaction mixture
(3) the colour intensity of the reaction mixture

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

35. Soap can

    (1)   be made from fats.
    (2)   emulsify oily particles.
    (3)   increase the surface tension of water.

Which of the following combinations is correct ?

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

Directions : Question 36 consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following table :

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.

1st statement	**2nd statement**
36. $P_4O_{10}(s)$ can react with NaOH(aq).	$P_4O_{10}(s)$ is an acidic oxide.

END OF SECTION A

B

Candidate Number

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2016

CHEMISTRY PAPER 1

SECTION B: Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS FOR SECTION B

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5, 7 and 9.

(2) Refer to the general instructions on the cover of the Question Paper for Section A.

(3) This section consists of TWO parts, Parts I and II.

(4) Answer ALL questions in both Parts I and II. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) An asterisk (*) has been put next to the questions where one mark will be awarded for effective communication.

(6) Supplementary answer sheets will be provided on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string INSIDE this Question-Answer Book.

(7) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

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Provided by dse.life

PART I

Answer **ALL** questions. Write your answers in the spaces provided.

1. Refer to the following information of phosphorus (P) and chlorine (Cl).

	P	Cl
Atomic number	15	17
Relative atomic mass	31.0	35.5

(a) State the electronic arrangement of a phosphorus atom.

(1 mark)

(b) All chlorine atoms have the same atomic number. Explain why some chlorine atoms have different mass numbers.

(1 mark)

(c) A compound of phosphorus and chlorine has a relative molecular mass smaller than 250. It contains 22.6% of phosphorus by mass.

   (i) Deduce the molecular formula of the compound.
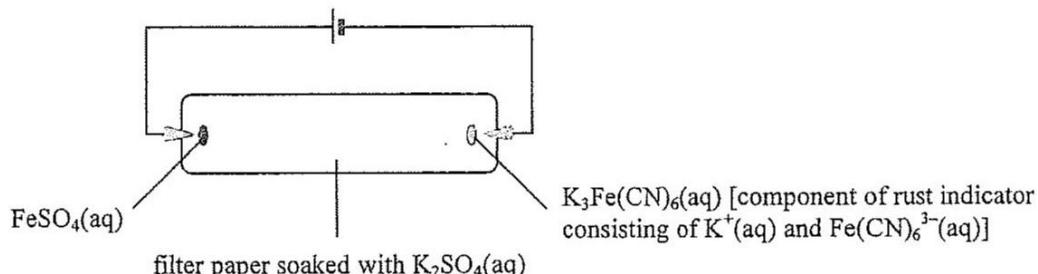
   (ii) Draw the electron diagram for the compound, *showing electrons in the outermost shells only.*

(3 marks)

2. The set-up of an experiment for studying the movement of ions is shown below.

$FeSO_4(aq)$

filter paper soaked with $K_2SO_4(aq)$

$K_3Fe(CN)_6(aq)$ [component of rust indicator consisting of $K^+(aq)$ and $Fe(CN)_6^{3-}(aq)$]

(a) Explain why the filter paper is soaked with $K_2SO_4(aq)$ instead of water.

(1 mark)

(b) State the colour of $FeSO_4(aq)$.

(1 mark)
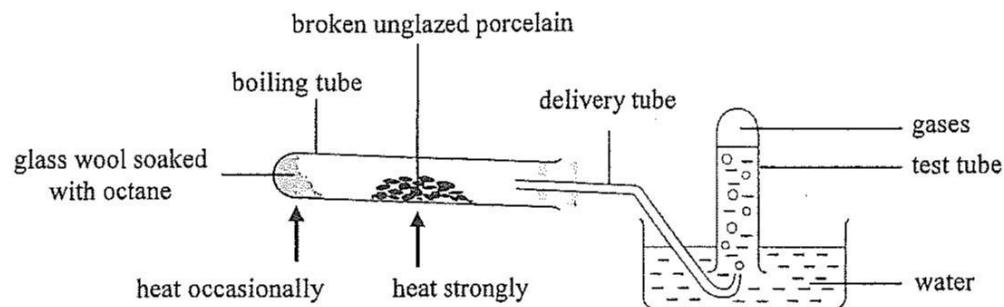
(c) Explain what would be observed around the middle of the filter paper when the circuit is closed for a period of time.

(2 marks)

(d) The experiment is repeated, but the two poles of the cell have been reversed at the very beginning. Explain what would be observed around the middle of the filter paper when the circuit is closed for a period of time.

(2 marks)

Provided by dse.life

3. The diagram below shows an experimental set-up in which the glass wool soaked with octane is heated occasionally and the broken unglazed porcelain is heated strongly. Some gases are collected in the test tube over water.

(a) Name the type of reaction that occurs in the boiling tube. Suggest one importance of this type of reaction in industry.

(2 marks)

(b) Explain why, instead of a large piece of unglazed porcelain, broken unglazed porcelain is used in this experiment.

(1 mark)

(c) Suppose that during the experiment, octane changes to ethane gas and propene gas only and they can be collected in the test tube.

(i) Write the balanced equation for the reaction of changing octane to ethane and propene.

3. (c) (ii) The gases collected in the test tube are shaken thoroughly with a few drops of Br_2(in CH_3CCl_3) solution.

(1) State the expected observation.

(2) Draw the structure of the product formed from the reaction between propene and Br_2.

(3 marks)

(d) When no more gas can be collected, what should be done to end the experiment for safety consideration ? Explain your answer.

(2 marks)

Answers written in the margins will not be marked.

Provided by dse.life

4. Consider the molecules CO_2, CS_2 and CH_2Br_2.

(a) For each of the following molecules, draw its three-dimensional structure.

(i) CS_2

(ii) CH_2Br_2

(2 marks)

(b) Identify, with explanation, the polar bond(s) in CH_2Br_2.

(2 marks)

(c) Suggest why, under room temperature and pressure, CO_2 is a gas but CS_2 is a liquid.
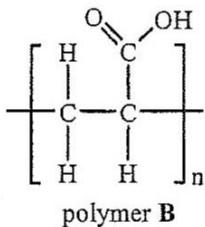
(2 marks)

5. Polymer **B** shown below can be used as water absorbing material in diapers. It can be formed from the polymerisation of compound **A**.

polymer **B**

(a) Draw the structure of compound **A** and state its systematic name.

(2 marks)

(b) State the type of polymerisation for the formation of **B** from **A**.

(1 mark)

(c) Suggest why the relative molecular mass of **B** is expressed using a range of values instead of a single fixed value.
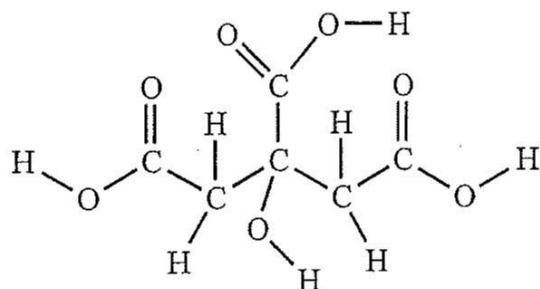
(1 mark)

(d) It is known that the reaction of polymer **B** with NaOH(aq) forms polymer **C** which can absorb water better. Draw the structure of **C**.

(1 mark)

Go on to the next page

6. Citric acid is a tribasic acid found in lemon. It is a white solid and soluble in water.

(a) In the structure of citric acid shown below, circle ALL ionisable hydrogen atom(s) making it a tribasic acid.

(1 mark)

(b) A solid sample contained citric acid and other soluble inert substances. 1.65 g of the sample was dissolved in deionised water and diluted to 250.0 cm³ in apparatus **X**. After that, 25.00 cm³ of the diluted solution was withdrawn and titrated with 0.123 M NaOH(aq) using phenolphthalein as an indicator. 18.45 cm³ of the NaOH(aq) was required to reach the end point.
(Molar mass of citric acid = 192.0 g)

(i) What is apparatus **X** ?

(ii) Calculate the percentage by mass of citric acid in the solid sample.

(4 marks)

6. (c)   A few drops of lemon juice are added to sodium hydrogencarbonate powder.

(i)   State the expected observation.

(ii)   Write the ionic equation for the reaction involved.

(2 marks)

Go on to the next page

7. The enthalpy change of formation of $MgCO_3(s)$ can be obtained using an indirect method. Firstly, the enthalpy change for the reaction of $MgCO_3(s)$ with $H_2SO_4(aq)$, and that of $Mg(s)$ with $H_2SO_4(aq)$ are respectively determined experimentally. After that, the enthalpy change of formation of $MgCO_3(s)$ can be obtained through calculation with given enthalpy changes of formation of $CO_2(g)$ and $H_2O(l)$.

(a) According to definition, under which condition could the 'heat change' of a reaction be regarded as the 'enthalpy change' ?

(1 mark)

(b) Explain why, instead of a direct method, an indirect method is used to obtain the enthalpy change of formation of $MgCO_3(s)$.

(1 mark)

(c) In order to determine experimentally the enthalpy change for the reaction of $MgCO_3(s)$ with $H_2SO_4(aq)$, an accurate mass of $MgCO_3(s)$ was firstly allowed to react with excess $H_2SO_4(aq)$ in a polystyrene foam cup. The maximum rise in temperature of the mixture was then found. After calculation, the enthalpy change for the reaction can be obtained.

(i) Suggest one possible error for the above experimental procedure.

(ii) Explain whether the enthalpy change for the reaction of $CaCO_3(s)$ with $H_2SO_4(aq)$ can be obtained using a similar experimental procedure.

(2 marks)

7. (d) Using the information given below, calculate the standard enthalpy change of formation of $MgCO_3(s)$.
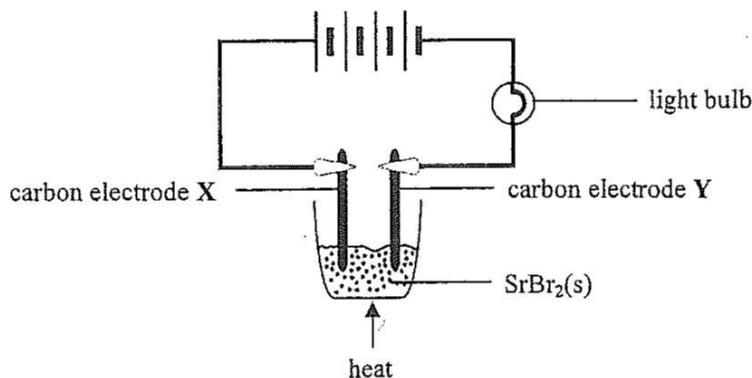
Standard enthalpy change for the reaction of $MgCO_3(s)$ with $H_2SO_4(aq)$	$= -50 \text{ kJ mol}^{-1}$
Standard enthalpy change for the reaction of $Mg(s)$ with $H_2SO_4(aq)$	$= -467 \text{ kJ mol}^{-1}$
Standard enthalpy change of formation of $CO_2(g)$	$= -394 \text{ kJ mol}^{-1}$
Standard enthalpy change of formation of $H_2O(l)$	$= -286 \text{ kJ mol}^{-1}$

(3 marks)

11

Go on to the next page

8.   Consider the experimental set-up shown below :

(a)   In the above experiment, the bulb lights up when the $SrBr_2(s)$ becomes molten.
       (Atomic number of Sr = 38)

       (i)   State the observation at carbon electrode **X**.

(2 marks)

(b)   Explain why the experiment should be performed in a fume cupboard.
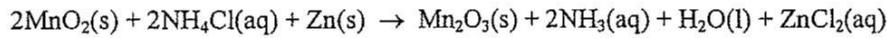
(1 mark)

       (ii)   Write a half equation for the change that occurs at carbon electrode **Y**.

(c)   Zinc-carbon cells are used in the above experiment. The equation below shows the reaction that occurs in the zinc-carbon cells when the bulb lights up.

       $2MnO_2(s) + 2NH_4Cl(aq) + Zn(s) \rightarrow Mn_2O_3(s) + 2NH_3(aq) + H_2O(l) + ZnCl_2(aq)$
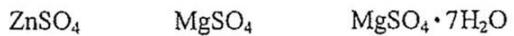
       (i)   Deduce, in terms of change in oxidation number, the oxidising agent in a zinc-carbon cell.

       (ii)   Write a half equation for the change that occurs at the cathode in a zinc-carbon cell.

(3 marks)

Answers written in the margins will not be marked.

Three unlabelled reagent bottles each contains one of the white solids listed below :

$$ZnSO_4 \qquad MgSO_4 \qquad MgSO_4 \cdot 7H_2O$$

Outline how you would carry out tests to distinguish these three solids.

(6 marks)

13 Go on to the next page →

Answer **ALL** questions. Write your answers in the spaces provided.

10. In an experiment, 2.0 mol of $SO_2(g)$ and 2.0 mol of $O_2(g)$ are allowed to react in a closed container maintained at 950 K. The chemical equation for the reaction is shown below :

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad\qquad \Delta H = -198 \text{ kJ mol}^{-1}$$

When the reaction attains dynamic equilibrium, 1.8 mol of $SO_3(g)$ is obtained.

(a) What is meant by the term 'dynamic equilibrium' ?

(1 mark)

(b) At 950 K, the equilibrium constant K_c for the above reaction is 878 dm^3 mol^{-1}. Calculate the volume of the container.

(3 marks)

10. (c) If the above equilibrium mixture is subjected to each of the following changes, will the number of moles of $SO_3(g)$ obtained increase, decrease or remain unchanged ? Explain your answer in each case.

(i) increasing the temperature

(ii) adding a suitable catalyst

(2 marks)

Provided by dse.life

11. Under certain conditions, a pink compound **X** reacts with NaOH(aq) to give a colourless product. Three trials of an experiment were conducted to study the kinetics of the reaction. Firstly, three NaOH(aq) solutions were prepared by mixing different volumes of 2.0 M NaOH(aq) and $H_2O(l)$ at 25°C. After that, one drop of **X** was added to each of them and the time needed for the pink colour to disappear was recorded. The relevant data is shown below :

	Volume of 2.0 M NaOH(aq) used / cm³	Volume of $H_2O(l)$ used / cm³	Time needed for the pink colour to disappear / s
Trial 1	5.0	0	61
Trial 2	4.0	1.0	76
Trial 3	3.0	2.0	101

(a) Why is it necessary to make the total volume of the reaction mixtures the same for the trials ?

(1 mark)

(b) Given that at 25°C, $[H^+(aq)] [OH^-(aq)] = 1.0 \times 10^{-14}$ mol² dm⁻⁶, calculate the pH of the NaOH(aq) solution prepared in Trial 2.

(3 marks)
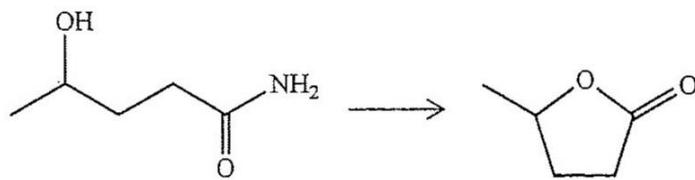
(c) Based on the information provided, deduce one factor which affects the rate of this reaction.

(2 marks)

Provided by dse.life

11. (d) Detection of colour change using naked eye is not accurate enough. Suggest an instrumental method that can be used to more accurately detect the colour change.

(1 mark)

12. Outline a synthetic route, with *no more than three steps*, to accomplish the following conversion. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.
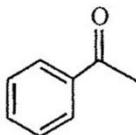
(3 marks)

13.   The structure of acetophenone is shown below :

Heating a mixture of acetophenone and $NaBH_4$ in methanol solvent under reflux can give two isomeric compounds **P** and **Q**. **P** and **Q** have the same melting point and same solubility in methanol.

(a)   Draw a labelled diagram of the set-up for heating the mixture under reflux.

(2 marks)

(b)   Suggest another reagent that can also react with acetophenone in a suitable solvent to give **P** and **Q**.

(1 mark)

(c)   What kind of isomers are **P** and **Q** ?

(1 mark)

(d)   State one different physical property between **P** and **Q**.

(1 mark)

(e)   Suggest a chemical test to show how acetophenone and **P** can be distinguished.

(2 marks)

*14. Arrange sodium, aluminium, silicon and sulphur in decreasing order of electrical conductivity at room conditions, and explain your answer in terms of bonding and structure.

(5 marks)

END OF SECTION B

END OF PAPER

PERIODIC TABLE　周期表

GROUP 族

atomic number　原子序

relative atomic mass　相對原子質量

1	H
	1.0

I	II												III	IV	V	VI	VII	0
																		2 He 4.0
3 Li 6.9	4 Be 9.0												5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3												13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 40.0
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4		31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4		49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 * La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6		81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 ** Ac (227)	104 Rf (261)	105 Db (262)														

*

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0

**

90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)