

UEC TRIAL EXAMINATION (2011)
Senior Middle Level
CHEMISTRY

Date: 22nd.september
Time Limit: 2 hours

Name: [] [] [] Seat no: () Student number: _____
Class: Sc ()

INSTRUCTIONS:

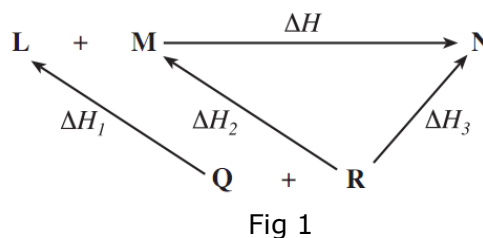
1. This paper comprises two papers:
Paper 1: Multiple-choice questions (40%)
Paper 2: Written questions (60%)
2. Attempt all the 20 questions in Paper 1. For each question, select the best answer.
3. Paper 2 consists of two sections:
Section A: compulsory questions (24%)
Section B: Elective question (36%)
4. Non- programmable electronic calculators may be used.
5. These papers consist of 6 printed pages.

PAPER 1 MULTIPLE-CHOICE QUESTIONS

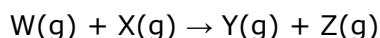
1. When 0.30 mol of X₂ gas and 0.40 mol of Y₂ gas are allowed to react until equilibrium is established, the equilibrium mixture is found to contain 0.20 mol of XY gas.
The equation for the reaction is: X₂ (g) + Y₂ (g) \rightleftharpoons 2 XY (g)
What is the value for the equilibrium constant K_c ?
A. 10/3 B. 2 C. 5/3 D. 2/3
2. Which of the following is a non-polar molecule?
A. PCl₃ B. H₂S C. BeCl₂ D. CFCI₃
3. Cr(OH)₃ (s) \rightleftharpoons Cr³⁺ (aq) + 3OH⁻ (aq) K_{sp} = [Cr³⁺] [OH⁻]³
Which of the following factors would affect the solubility product, K_{sp} of Cr(OH)₃ is ...
I change in temperature II addition of NaOH
III addition of HCl IV filtration
A. I, II, III B. I, III C. II, IV D. I
4. The standard enthalpies of combustion of methanal, HCHO(g), and methanoic acid, HCOOH(l), are -563 and -270 kJ/mol respectively. What is ΔH° for the following reaction?
HCHO(g) + 1/2 O₂(g) → HCOOH(l)
A. -833 kJ/mol B. -293 kJ/mol C. 293 kJ/mol D. 833 kJ/mol
5. Which of the following statements about the percentage ionization of weak acids in water is/are correct?
I The percentage ionization increases as the ionization constant of the acid becomes larger.
II The percentage ionization increases as the concentration of the acid becomes smaller.
A. I only B. II only C. Both I and II D. Neither I nor II
6. The electronic configuration of four elements are given. Which of these elements has the highest first ionisation energy?
A. 1s²2s²2p³ B. 1s²2s²2p⁴ C. 1s²2s²2p⁶3s¹ D. 1s²2s²2p⁶3s²3p³
7. What occurs when an aqueous solution of Na₂SO₄ containing several drops of phenolphthalein is electrolyzed between Pt electrodes?
A. The colorless solution turns pink at the anode but remains colorless at the cathode.
B. The colorless solution turns pink at the cathode but remains colorless at the anode.
C. The pink solution becomes colorless at the anode but remains pink at the cathode.
D. The pink solution becomes colorless at the cathode but remains pink at the anode.

8. Use the energy cycle in Fig.1 to answer the question that follows. State which one of the following is a correct application of Hess's law.

- A. $\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3$
 B. $\Delta H = \Delta H_1 + \Delta H_2 - \Delta H_3$
 C. $\Delta H = \Delta H_3 - \Delta H_1 - \Delta H_2$
 D. $\Delta H = \Delta H_3 + \Delta H_1 - \Delta H_2$

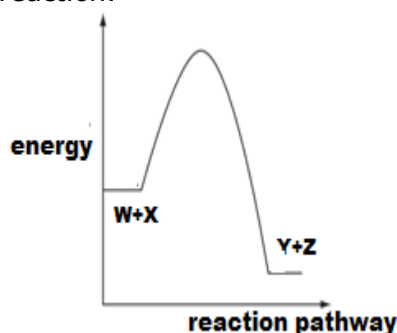


9. The diagram represents the reaction pathway for the following reaction.



What statement can be made about the reverse reaction, $Y(g) + Z(g) \rightarrow W(g) + X(g)$?

- A. It will have a larger activation energy and a positive ΔH .
 B. It will have a larger activation energy and a negative ΔH .
 C. It will have a smaller activation energy and a positive ΔH .
 D. It will have a smaller activation energy and a negative ΔH .



10. A mixture of gases containing 0.20 mol of SO_2 and 0.20 mol of O_2 in a 4.0L vessel reacts to form SO_3 as shown in equation: $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

If the temperature is $25^\circ C$, what is the pressure in the vessel after reaction is complete?

[$R=0.0821 \text{ atm.Lmol}^{-1}\text{K}^{-1}$]

- A. $\frac{0.4 \times 0.0821 \times 298}{4} \text{ atm}$ B. $\frac{0.2 \times 0.0821 \times 298}{4} \text{ atm}$
 C. $\frac{0.3 \times 0.0821 \times 298}{4} \text{ atm}$ D. $\frac{0.3 \times 0.0821 \times 25}{4} \text{ atm}$

11. Consider an alcohol P: $CH_3CH_2CH=CHCH_2CH_2OH$

Which two compounds will be formed when P is oxidised using hot, concentrated manganate(VII) ions?

- A. CH_3CO_2H and $HOCH_2CH_2CH_2CO_2H$ B. CH_3CO_2H and $HO_2CCH_2CH_2CO_2H$
 C. $CH_3CH_2CO_2H$ and $HO_2CCH_2CO_2H$ D. $CH_3CH_2CO_2H$ and $HOCH_2CH_2CO_2H$

12. In which of the following alternatives are the three compounds listed in order of increasing boiling point?

- A. Pentane, butan-1-ol, propanoic acid B. Propanoic acid, butan-1-ol, pentane
 C. Propanoic acid, pentane, butan-1-ol D. Butan-1-ol, propanoic acid, pentane

13. The product of the reaction between propanone and hydrogen cyanide is hydrolysed under acid conditions.

What is the formula of the final product?

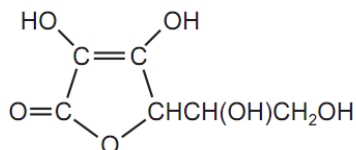
- A. $CH_3CH(OH)CO_2H$ B. $CH_3CH_2CH_2CO_2H$ C. $CH_3\overset{CH_3}{\underset{|}{C}}CONH_2$ D. $CH_3-\overset{CH_3}{\underset{OH}{|}{C}}-COOH$

14. Which statements about alkenes are correct?

- I. They are formed when higher alkanes are cracked.
 II. They are used as monomers for polymerisation.
 III. They are less reactive than alkanes towards electrophiles.

- A. I, II, III B. I, II C. II, III D. I

15. The structure of the antioxidant vitamin C is shown in the diagram.



On the basis of this structure, which properties is vitamin C likely to have?

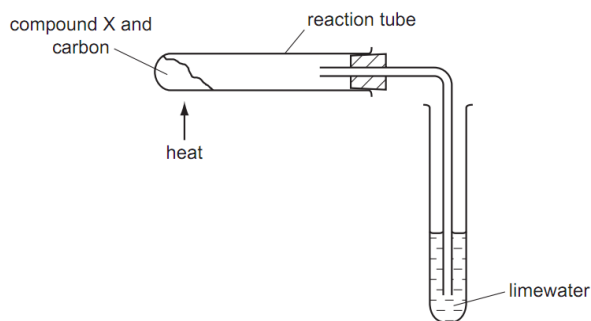
- I. It is soluble in water.
 II. It decolourises aqueous bromine rapidly.
 III. It reduces Fehling's reagent.
- A. I, II, III B. I, II C. II, III D. I

16. Which oxide, when mixed with water, will produce the most acidic solution?
 A. CO B. CO₂ C. SiO₂ D. P₂O₅

17. Compound X is heated with carbon using apparatus shown.

A brown solid is formed in the reaction tube and the limewater turns cloudy.
 What is compound X?

- A. calcium oxide
 B. copper(II) oxide
 C. magnesium oxide
 D. sodium oxide



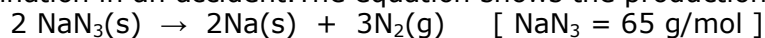
18. The table below summarises the reaction of a certain unknown solution when treated with NaOH and NH₃ solution.

Sample	Reagent	Results
I	NaOH(aq)	White precipitate is formed. The precipitate dissolves in excess reagent.
II	NH ₃ (aq)	White precipitate is formed. The precipitate does not dissolve in excess reagent.

Which of the following metallic ions could be present in the unknown solution?

- A. Ca²⁺ (aq) B. Zn²⁺ (aq) C. Al³⁺ (aq) D. Ag⁺ (aq)

19. Sodium azide is used in automobile airbags to provide a source of nitrogen gas for rapid inflation in an accident. The equation shows the production of nitrogen gas from sodium azide.



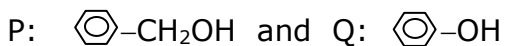
What mass of sodium azide will produce 40 L of N₂ at rtp conditions?

- A. 70 g B. 72.2 g C. 108.3 g D. 162.5 g
20. What changes will take place when sulphur dioxide is passed into concentrated nitric acid.
 I. brown gas is observed II. Sulphuric acid is formed
 III. sulphur IV. The solution turn red
 A. I, II B. II, III C. I, II, III D. I, II, III, IV

Paper 2 WRITTEN QUESTIONS (60%)
Section B Elective Questions (36%)

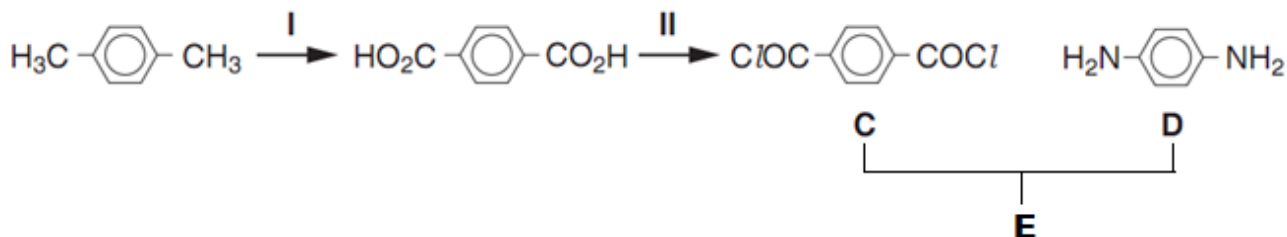
- ① Attempt any three, but not more than three from the six questions in this section.
 ② **Begin each answer on a fresh new page.**

1. a. Suggest a simple chemical test you could carry out to distinguish between compound P and Q.



You should state the reagent used, observation with each compound and relevant chemical equation. [3%]

- b. Kevlar is a tough polyamide used in bullet-proof vests and high-specification bicycle tyres. It can be manufactured by the following process. It is represented with symbol E.



(i) Suggest reagents and conditions for Reaction I and reaction II. [2%x2]

(ii) Draw the structural formula of one repeat unit of Kevlar. [2%]

c. Select **one** of the following synthesis. Write two chemical equations to show the conversion. [3%]

(i) propanol → propene → propane-1,2-diol

(ii) ethyl ethanoate → ethanol → chloroethane

2. The structural formulae of six different compounds, A – F, are given below.

A: $\text{CH}_3\text{CH}=\text{CHCH}_3$

B: $\text{CH}_3\text{CH}_2\text{COCH}_3$

C: $\text{CH}_2=\text{CHCH}_2\text{CH}_3$

D: $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$

E: $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

F: $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$

a. What is the empirical formula of compound E? [1%]

b. State the type of isomerism shown by compound A. [1%]

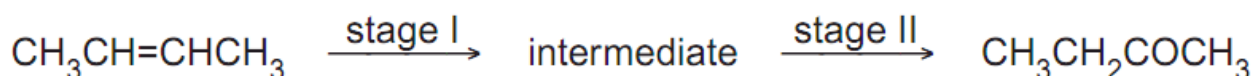
c. Compound D may be converted into compound C.

(i) What type of reaction is this? [1%]

(ii) What reagent would you use for this reaction? [1%]

(iii) What is formed when compound E undergoes the same reaction using an excess of the same reagent? [1%]

d. Compound A may be converted into compound B in a two-stage reaction.



(i) Write the structural formula of the intermediate compound. [1%]

(ii) Write chemical equation to show how stage I may be carried out to give this intermediate compound. Your answer should include the reaction conditions required. [2%]

(iii) What reagent would be used for stage II? [1%]

e. Compounds D and F are isomers. What type of isomerism do they show? [1%]

f. When compound C reacts with HBr, write the **displayed formula** of the product formed. [2%]

3. a.

The graph shows changes in pH for the titrations of **equal volumes** of solutions of two monoprotic acids, Acid 1 and Acid 2 with KOH.

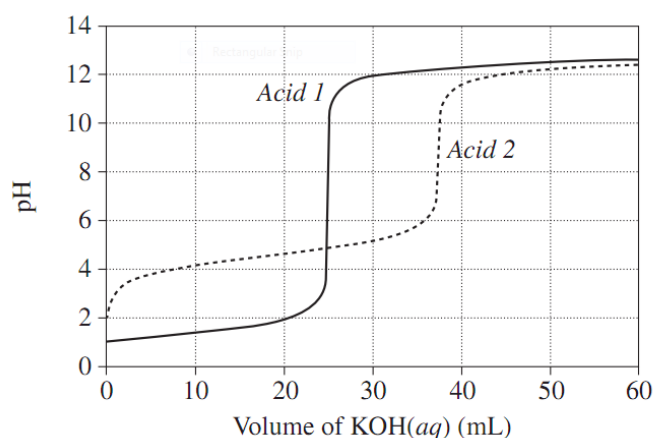
Using the graph to answer the following questions.

(i) Which acid is a strong acid? Explain. [1%x2]

(ii) Which acid has higher concentration? Give your reasoning. [1%x2]

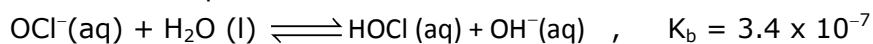
(iii) Calculate the concentration of hydrogen ions when 20 mL of KOH(aq) has been added to Acid 1. [2%]

(iv) **Select** a suitable indicator for both titration from the list. [1%]



Indicator	pH at which color changes
Methyl violet	0-1
Methyl orange	3-4
Bromothymol blue	6-7

b. A solution of NaOCl of 1.2 mol/L is prepared. The reaction of water and chlorate(I) ion, OCl⁻ ion is shown in equation below.

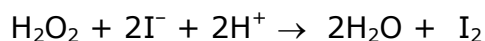


(i) Write the expression for the base dissociation constant, K_b . [1%]

(ii) Calculate the value of [OH⁻] in the 1.2 mol/L NaOCl solution at 25°C. [2%]

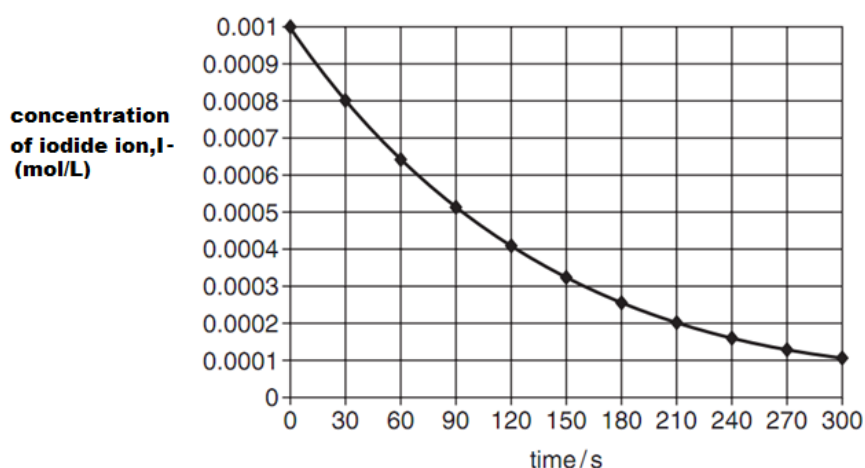
(iii) Calculate pH value of the solution at 25°C. [2%]

4. The rate of the reaction between hydrogen peroxide and iodide ions in acidic solution is



a. Suggest how the appearance of the solution might change as the reaction takes place. [2%]

b. A study was carried out in which both [H₂O₂] and [H⁺] were kept constant at 0.05 mol/L , and [I⁻] was plotted against time. The following curve was obtained.



(i) Calculate the rate of this reaction and state its units. [1% \times 2]

(ii) Using the graph, find the half-life of this reaction. [1%]

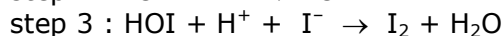
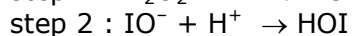
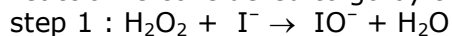
(iii) From answer in b(ii), deduce the order of reaction with respect to [I⁻]. [1%].

c. Use the following data to deduce the orders with respect to [H₂O₂] and [H⁺], explaining your reasoning. [2% \times 2]

Experiment	[H ₂ O ₂] (mol/L)	[H ⁺] (mol/L)	Initial rate of formation of I ₂ (molL ⁻¹ sec ⁻¹)
1	0.05	0.05	1.0
2	0.07	0.05	1.4
3	0.09	0.07	1.8

d. Using results from b(iii) & (C), write a rate equation for this reaction. [1%]

e. This reaction is considered to go by the following steps.



From your results ,deduce which of the three steps is the rate determining step. [1%]

5.

a. The nitrogen content of bread was determined using the following procedure:

- A sample of bread weighing 2.80 g was analysed.
- The nitrogen in the sample was converted into ammonia.
- The ammonia was collected in 50.0 mL of 0.125 mol/L hydrochloric acid. All of the ammonia was neutralised, leaving an excess of hydrochloric acid.
- The excess hydrochloric acid was titrated with 23.30 mL of 0.116 mol/L NaOH solution.

(i). Write balanced equations for the TWO reactions involving hydrochloric acid. [2%]

(ii). Calculate the moles of excess hydrochloric acid. [1%]

(iii). Calculate the moles of ammonia. [2%]

(iv). Calculate the percentage by mass of nitrogen in the bread. [N=14][2%]

b. Describe what you would observe when hydrogen sulphide is passed into a gas jar filled with KMnO_4 solution. Explain the changes with the aid of a balanced chemical equation for the reaction. [4%]

c. Complete and balance the equation: $\text{SO}_2 + \text{H}_2\text{S} \rightarrow$ [1%]

6.

a. 4.07 g of a chloride of iron was formed by reacting 1.40 g of iron with an excess of chlorine. Determine the empirical formula of the chloride. [Fe=56, Cl=35.5] [2%]

b. Copper reacts with concentrated nitric acid to give a brown gas. When the gas is cooled to 0°C , it turns to a yellow liquid. Briefly explain the changes and write balanced chemical equations of the reactions that take place. [4%]

c. An experiment as shown in Fig. 2 is carried out.

Manganese(IV) oxide, MnO_2 , when heated with hydrochloric acid, reacts according to the following equation.



(i) Explain why this can be classified as a redox reaction. [2%]

(ii) **Describe what you would see**, if solution B is

- ① Litmus solution [1%]
- ② potassium iodide solution. [1%]
- ③ iron (II) sulphate solution and then an excess amount of aqueous sodium hydroxide is added. [2%]

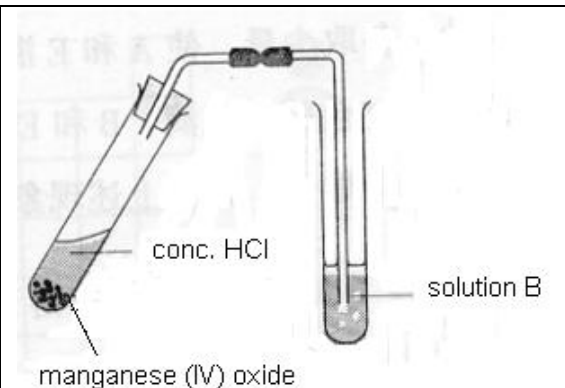


Fig. 2