AGA KHAN UNIVERSITY EXAMINATION BOARD

HIGHER SECONDARY SCHOOL CERTIFICATE

CLASS XI

ANNUAL EXAMINATIONS (THEORY) 2023

Chemistry Paper II

Time: 1 hour 30 minutes Marks: 35

INSTRUCTIONS

Please read the following instructions carefully.

1. Check your name and school information. Sign if it is accurate.

I agree that this is my name and school. **Candidate's Signature**

RUBRIC

2. There are EIGHT questions. Answer ALL questions. Questions 7 & 8 each offer TWO choices. Attempt any ONE choice from each.

3. When answering the questions:

   Read each question carefully.
   Use a black pointer to write your answers. DO NOT write your answers in pencil.
   Use a black pencil for diagrams. DO NOT use coloured pencils.
   DO NOT use staples, paper clips, glue correcting fluid, or ink erasers.
   Complete your answer in the allocated space only. DO NOT write outside the answer box.

4. The marks for the questions are shown in brackets ( ).

5. You may use a scientific calculator if you wish.

Q.1. (Total 4 Marks)

Describe the properties of cathode rays with reference to the given attributes.

a. Effect of an electric field (1 Mark)

b. Fluorescence (1 Mark)

c. Momentum (1 Mark)

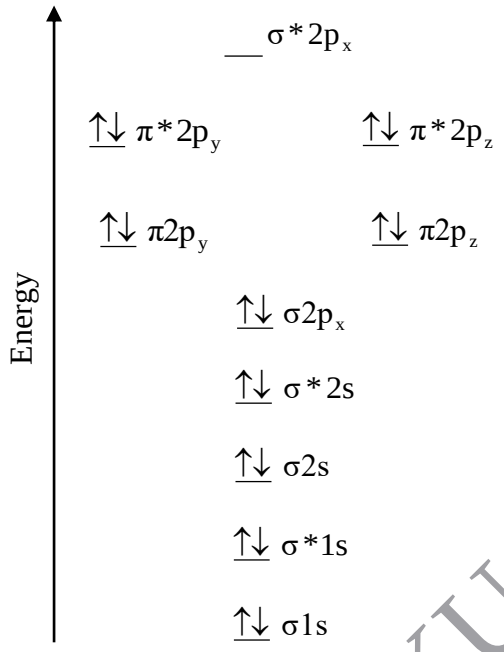
d. Charge to mass ratio (1 Mark)

Q.2. (Total 2 Marks)

Identify the nature of bond in a molecule of CCl_4 as directional or non-directional. Give a reason to support your answer.

Q.3. (Total 3 Marks)

The molecular orbital diagram for the diatomic fluorine molecule (F_2) is as follows:



With the help of the given diagram, determine

a. the bond order of fluorine molecule. (1 Mark)

b. whether fluorine molecule is diamagnetic or paramagnetic. Give a reason for your answer. (2 Marks)

Q.4. (Total 4 Marks)

Given is an example of a reversible reaction at equilibrium.

$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$

The K_C for this reaction is $K_c = \frac{4x^2}{V(a-x)}$.

Why is the factor of volume written in the denominator in the K_C expression? With reference to the change in pressure, describe the effect of volume on equilibrium state and the value of K_C.

Q.5. (Total 4 Marks)

Following are the observations of a student while working in the laboratory. Explain each of his/ her observations with reference to chemical kinetics.

a. Magnesium reacts very slowly with cold water, but extremely vigorously with steam. (2 Marks)

b. Chlorine can be made by reacting potassium manganate(VII) with concentrated hydrochloric acid, but the reaction is very slow in the presence of dilute hydrochloric acid. (2 Marks)

Q.6. (Total 4 Marks)

Calculate the change in internal energy for the given reaction at T = 273 K and R = 8.314 J K^{-1} mol^{-1}.

$$C_2H_{6(g)} + \frac{7}{2}O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)} \qquad \Delta H = -1560 \text{ kJ mol}^{-1}$$

Q.7. (Total 7 Marks)

EITHER

a. The analysis of a hydrocarbon shows that it consists of 81.8% carbon. The relative molecular mass of the hydrocarbon is 44 g mol^{-1}.

i. Calculate the empirical formula of the compound. (5 Marks)

ii. Determine its molecular formula. (2 Marks)

(**Note**:

- Molar mass of C = 12 g mol^{-1} and H = 1 g mol^{-1}
- Show the complete steps of working.)

OR

b. The given equation shows a reaction that takes place in a basic medium. Balance this equation using the half reaction method. (7 Marks)

Equation: $MnO^-_{4(aq)} + NO^-_{2(aq)} \rightarrow MnO_{2(s)} + NO^-_{3(aq)}$

Reduction half reaction: $MnO^-_{4(aq)} \rightarrow MnO_{2(s)}$

Oxidation half reaction: $NO^-_{2(aq)} \rightarrow NO^-_{3(aq)}$

(**Note**: Show all the steps of balancing in sequence.)

Q.8. (Total 7 Marks)

EITHER

a. Calculate the molarity of 500 cm^3 sulphuric acid solution neutralised by 18 g of 6 dm^3 of sodium hydroxide solution. (7 Marks)

(**Note**:

- $^{23}_{11}Na$, $^{1}_{1}H$, $^{16}_{8}O$ and $^{32}_{16}S$
- Show the complete steps of working.)

OR

b. The boiling point of a solution containing 5 g of an organic solid in 45 g of diethyl ether is 39°C. The molal boiling point constant of diethyl ether is 2.16°C/m and its boiling point in pure state is 34.6°C. The empirical formula of the organic solid is CH_2O.

i. For the given organic solid, calculate its

I. relative molar mass. (4 Marks)

II. molecular formula. (2 Marks)

ii. Why is the boiling point of the solution higher than that of pure diethyl ether? (1 Mark)

(**Note**: Show the complete steps of working.)

END OF PAPER

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