TANZANIA HEADS OF ISLAMIC SCHOOLS COUNCIL

FORM SIX INTER ISLAMIC MOCK EXAMINATION

CHEMISTRY 1

(For Both School and Private Candidates)

132/1

TIME: 3 HOURS **Monday, 3rd March 2025 p.m.**

Instructions

1. This paper consists of sections **A** and **B** with a total of **ten (10)** questions.
2. Answer **all** questions in section **A** and **two (2)** questions from section **B.**
3. Mathematical tables and non-programmable calculators may be used.
4. Cellular phones and any unauthorized materials are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).
6. The following information may be used:
   - Universal gas constant R = 8.314 $Jmol^{-1}$ k^{-1} or 0.0821 $Latmmol^{-1}$ k^{-1}
   - Rydberg constant, $R_H = 1.09678 \times 10^7 m^{-1}$
   - Velocity of light $C = 3 \times 10^8$ m/s
   - Mass of electron = 9.11×10^{-31} kg
   - Planck's constant, $h = 6.63 \times 10^{-34}$ Js
   - Atomic masses H=1, C=12, O=16, N=14, Na=23, Cl=35.5, K=39, S=32, Cu=63.5, Br=80, Se = 78.8

SECTION A (70 Marks)

Answer **all** questions in this section

1. (a) Explain the following concepts:
   (i) Hydrogen spectrum has large number of lines despite the fact that it has only one electron.
   (ii) Magnesium gives three peaks in its spectrum.
   (iii) Line spectrum is regarded as a finger print of chemical element.

   (b) A chemistry teacher told his students "Dalton atomic theory is nothing but just primitive findings." Support teacher's statement by using four points.

   (c) (i) With the aid of diagrams, describe the shapes and orientations of ρ-orbitals.

   (ii) Suppose the location of an electron is determined with 0.53Å. Calculate the minimum uncertainty in its speed.

2. (a) Why alkynes do not exhibit geometrical isomerism while alkenes do?
   (b) Predict the major final product(s) for each of the following reactions:

   (i) $(CH_3)_2CHCH=CH_2 \xrightarrow[H_2O]{H_2SO_4} A$

   (ii) $CH_3CH_2CH=CH_2 \xrightarrow[THF]{Hg(OAc)_2} B \xrightarrow{NaBH_4} C$

   (iii) $(CH_3)_2CH - CH=CH_2 \xrightarrow[THF]{BH_3} D \xrightarrow[NaOH]{H_2O_2} E$

   (c) Explain briefly the preparation of acetylene by:
   (i) Pyrolysis of natural gas
   (ii) Action of water on calcium carbide

3. (a) State whether the following quantities are exothermic or endothermic and give reason for your answer.
   (i) Ionization energy for lithium
   (ii) Electron affinity for iodine
   (iii) Electron affinity for oxygen leading to O^- and O^{2-}

   (b) 1.5g of ammonium nitrate was added 35.0g of water in a plastic beaker and stirred until the salt dissolved. The temperature of solution dropped from 22.7℃ to 19.4℃. Basing on the given information respond to the following questions:
   (i) Is the process endothermic or exothermic? Explain
   (ii) Calculate the heat of ammonium nitrate solution in kJ/mol given that specific heat capacity of water = 4.1845J/g℃ and density of water 1g/ml.

   (c) The heat of combustion of methane, carbon and hydrogen are 890kJ/mol, 393kJ/mol and 285.8kJ/mol respectively. The heat of sublimation of carbon is 720kJ/mol and heat of dissociation of hydrogen molecule is 431kJ/mol. Calculate the C-H bond energy in methane.

4. (a) Give an account for the following observations:
   (i) Inflated weather balloons seem to violate Boyle's law.
   (ii) Bakery products like breads are fluffy.
   (iii) Aerated water bottles are kept underwater during summer.
   (iv) Throwing aerosol can into a fire may cause it to explode.

   (b) A 20.0L container is filled with helium at a pressure of 150 atm and the temperature of 30℃. How many 5.0L balloons can be filled when the temperature is 22℃ and atmospheric pressure is 755mmHg.

   (c) A container that is full of air has a volume of 275ml and contains 0.012mol of air. What will be the volume of the container after a piece of dry ice (solid CO_2) weighing 1.0g is added and allowed to sublime?

5. (a) (i) How does the equilibrium law differ from the Le-Chatelier's principle?
   (ii) Explain how catalyst affects the position of chemical equilibrium.

   (b) At 773k, the reaction between gaseous nitrogen and hydrogen to form ammonia gas has a Kc = $6.0 \times 10^{-2} dm^6 mol^{-2}$. Compute the value of K_p for this reaction.

   (c) A mixture of CO and steam consisting of 0.25mol each, is placed in 500ml flask and the mixture was heated was heated up to 900k. The reaction was
   $CO_{(g)} + H_2O_{(g)} \rightarrow H_{2(g)} + CO_{2(g)}$
   What is the composition of the equilibrium mixture if the Kc for this reaction is 1.56?

6. (a) Describe three (3) importance of dipole moment as applied in chemistry.

   (b) (i)Despite the fact that CO_2 and H_2O have two polar bonds, CO_2 exhibits non-polar while water is a polar molecule. Account for this observation.

   (ii)Why do NH_3, H_2O and HF have higher boiling points than those of PH_3, H_2S and HBr?

   (c) Pre-form five students became surprised after being told that chemical bonds are further categorized into sigma and Pi. By using four key points keep on informing them on how the bonds above are differentiated.

7. (a) Suppose you are invited to educate form one students about the importance of ozone layer in atmosphere, with the aid of equations (where necessary) briefly explain formation of ozone layer, primary cause of ozone layer depletion and three effects of ozone layer depletion.

   (b) A certain soil sample was analysed in the laboratory and found to contain the following ions in meq/100g of oven dry soil. $K^+ = 0.28$, $Mg^{2+} = 0.12$, $Ca^{2+}=1.00$, $Na^+=0.03$ and $H^+=10.00$. If cation exchange capacity (CEC) of soil is 3.83 meq/100g of oven dry soil, calculate percentage base saturation (PBS) and give comment on fertility status of the soil.

(c) A 21g of the soil sample was dried in soil and lost its weight by 1g. The soil was analysed and found to contain 0.0015g of Ca^{2+}. Calculate concentration in meq/100g of oven dry soil of calcium in soil sample

SECTION B (30 Marks)

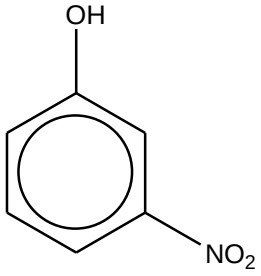
Answer **two (2)** questions in this section

8. (a) (i) By using the chemical equation explain why tertiary halo alkane cannot undergo S_{N2} reaction mechanism.

(ii) Benzene is more reactive than nitrobenzene while methyl is more reactive than benzene. Explain this observation.

(b) Explain which substituent entered in the benzene ring first

(i)



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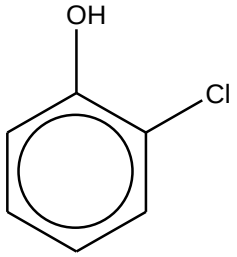

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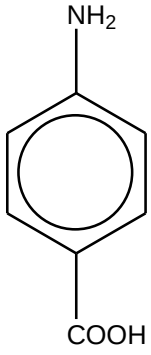
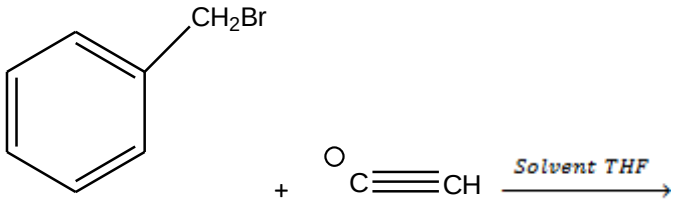
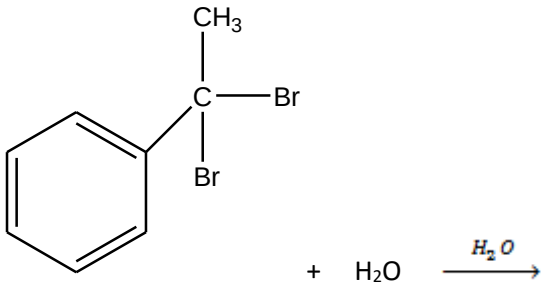
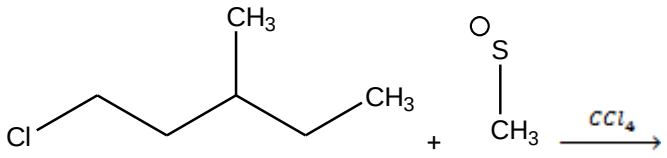


(c) Convert ethane to benzoic acid.

(d) Predict whether the following reactions will undergo S_N2 or S_N1 mechanism and give reasons for your answer.

(i) 

(ii) 

(iii) 

9. (a) With aid of chemical equation if applicable explain the following phenomena.
   (i) Aluminium is said to be amphoteric
   (ii) Iron (III) carbonate never exists.
   (iii) $MgCl_2.6H_2O$ when heated can never give out anhydrous $MgCl_2$.
   (iv) $CuCl_2$ solution is acidic to litmus paper
   (v) Fe_3O_4 is called mixed oxide

   (b) Form five students argued that metal nitrates are not useful in our life and studying metal nitrates is just wastage of time. As chemistry expert show how would you correct them by giving five points.

10. (a) (i) Arrange the following aqueous solutions in order of their increasing boiling points and give reasons for your answer
0.001M NaCl, 0.001M urea, 0.001M $MgCl_2$, 0.01M NaCl

(ii) Why is glycol-water mixture used in a car radiator during driving through a colder region having subzero temperature?

(b) The molar freezing point depression constant of benzene (C_6H_6) is 4.90 kg mol^{-1}. selenium is known to exist as polymer Se_x. When 3.26g of selenium is dissolved in 226g of benzene, the freezing point is 0.112°C lower than that of pure benzene. Deduce the molecular formula of selenium.

(c) (i) State Vant Hoff's law of osmotic pressure.

(ii) Calculate the osmotic pressure of aqueous solution $BaCl_2$ at 298k containing 0.39g in 60ml. The degree of dissociation of salt is 60% (Ba=137, Cl 35.5).

Wabillah Tawfiq