MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR
FIRST YEAR FIRST SEMESTER

SCHOOL OF PURE APPLIED AND HEALTH SCIENCES
BACHELOR OF SCIENCE IN CHEMISTRY

COURSE CODE: CHE 1105-1

COURSE TITLE: BASIC CHEMISTRY

DATE: 8TH APRIL, 2022   **TIME: 0830-1030**

INSTRUCTIONS TO CANDIDATES

1. Answer Question **ONE** and any other **TWO** questions.
2. All Examination Rules Apply
3. Avogadro's number, $L = 6.02 \times 10^{23}$

SECTION A
Question One (30mks)

a) A neutral tin atom has 50 protons and 68 neutrons, state the mass number, atomic number and number of electrons for this isotope
(3mks)

b) State the chemical symbols used to represent lead, tungsten and mercury **(3mks)**

c) Sketch a diagram of a helium atom, which has two protons and two neutrons in its nucleus **(2mks)**

d) State the four quantum numbers of a 3d electron **(2mks)**

e) What is the predicted electron configuration for Sn, which has 50 electrons **(2mk)**

f) To form the precipitate $PbCl_2$, 2.88 g of NaCl and 7.21 g of $Pb(NO_3)_2$ are mixed in solution. The balanced chemical equation is $NaCl(aq) + Pb(NO_3)_2(aq) \rightarrow PbCl_2(s) + 2NaNO_3(aq)$. (Pb = 207g, Cl = 35.45g, N = 14, O = 16g)
i) How much precipitate is formed **(3mks)**
ii) How much of which reactant is in excess **(2mks)**

g) If the mass percentages for acetic acid are 39.9% C, 6.7% H and 53.4% O and the molecular mass of acetic acid has been found by experiment to be 60. Determine the molecular formula of acetic acid (C = 12g, H = 1g and O = 16g) **(5mks)**

h) Given the following reaction: $H_2 + I_2 \rightleftarrows 2HI$, if the equilibrium [HI] is 0.75 M and the equilibrium $[H_2]$ is 0.20 M, what is the equilibrium $[I_2]$ if the K_{eq} is 0.40
(3mks)

i) Given this reaction at equilibrium: $N_2 + 3H_2 \rightleftarrows 2 NH_3$, in which direction (toward reactants or toward products) does the reaction shift if the equilibrium is stressed by adding H_2.
(1mk)

j) What is the effect if pressure of the equilibrium reaction $N_2(g) + 3H_2(g) \rightleftarrows 2 NH_3(g)$ is increased. **(1mk)**

k) Combustion of 3.009 g sample of C_5H_{12} gives 3.774 g of H_2O. The chemical equation of the combustion is $C_5H_{12}(\ell) + 8 O_2(g) \rightarrow 5 CO_2 + 6 H_2O(\ell)$. Calculate the theoretical yield and the actual yield **(3mks)**

SECTION B

Answer any TWO questions from this section, each question carries 20 marks

Question Two (20mks)

a) Draw and label the three parts of an electrochemical cell

(5mks)

b) Distinguish between;
  (i)   voltaic and electrolytic cells **(1mks)**
  (ii)   Inert and reactive electrodes **(1mk)**
  (iii)   Anode and cathode **(1mk)**
  (iv)   Oxidation and reduction **(1mk)**
c) State any two factors that affect the reaction rate and current in electrochemistry **(2mks)**
d) Given the standard reduction potentials of zinc and copper to be +0.340V and -0.764 V respectively, calculate the electromotive force of a cell formed by the two materials. **(3mks)**
e) Is a cell between aluminium and silver feasible? (E_{red} (Ag) = 0.8V, E_{red} (Al) = -1.66V). Write the reduction equations of the two. **(6mks)**

**Question Three (20mks)**

a) Predict the effect of increasing the temperature on this equilibrium. $PCl_3 + Cl_2 \rightleftarrows PCl_5 + 60$ kJ **(1mk)**
b) Determine the pH of a 3.35 M solution of $HC_2H_3O_2$. The K_a for $HC_2H_3O_2$ is 1.8×10^{-5}. **(4mks)**
c) Define an acid base indicator **(1mk)**
d) Define and state the use of buffers **(2mks)**
e) State any two factors affecting solubility **(2mks)**
f) The concentration of hydrogen ions in a particular solution is; $[H^+] = 4.2 \times 10^{-3}$ M. Calculate the pH of the solution. **(2mks)**

g) The synthesis of NH_3 uses this chemical reaction. $N_2(g) + 3 H_2(g) \rightleftarrows 2 NH_3(g) + 92$ kJ Identify three stresses that can be imposed on the equilibrium to maximize the amount of NH_3. **(3mks)**

h) Distinguish between a strong and weak acid. **(1mk)**
i) State *Le Chatelier's principle* **(1mk)**
j) Write the equilibrium equation for auto-ionization of water and derive its equilibrium constant expression. **(3mks)**
Question Four (20mks)

a) Write the equilibrium concentration expression for each reaction

  i) $C_2H_5OH + NaI \rightleftarrows C_2H_5I + NaOH$ **(1mk)**

  ii) $2H_2O_2(g) \rightleftarrows 2H_2O(g) + O_2(g)$ **(1mks)**

b) Calculate the K_P for the reaction $4NO_2(g) + O_2(g) \rightleftharpoons 2N_2O_5$ at 310 K if the $K_{eq} = 6.22 \times 10^3$. **(3mks)**

c) What are $[Ba^{2+}]$ and $[F^-]$ in a saturated solution of $BaF_2(s)$ given that the K_{sp} of $BaF_2(s)$ is 1.8×10^{-7} **(4mks)**

d) Set up an ICE chart and solve for the equilibrium concentrations in this

$$N_2O_3(g) \rightleftharpoons NO(g) + NO_2(g) \quad K_{eq} = 2.50$$
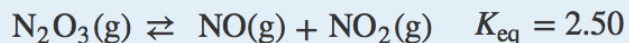
chemical reaction. $\quad 0.0663\,M$ **(4mks)**

e) How many atoms are present in 4.61×10^{-2} mol of O_2. **(2mks)**

f) Calculate the mass of 3.56 mol of $HgCl_2$ given that the molar mass of $HgCl_2$ is 271.49 g/mol **(2mks)**

g) Given this equilibrium equation $H_2(g) + I_2(s) \rightleftharpoons 2HI(g) \quad \Delta_r H = +53$ kJ, predict the direction of shift for the following stresses respectively i) decreased temperature, ii) increased pressure, iii) removal of HI **(3mks)**

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