Taxila Central College - Horana

02 S II

General Certificate of Education (Adv. Level) Examination - 2026

3rd Term Test, July - 2026

Chemistry II | **Grade 13** | *Time : 3 hours*

$R=8.314\ Jk^{-1}\ mol^{-1}$

$N_A = 6.022 \times 10^{23}\ mol^{-1}$

PART B - Essay

- **Answer only two questions**

05. (a) Consider the reaction.

$$A(g) \rightleftharpoons B(g) + C(g)$$

This equilibrium is acheived in 5 dm^3 container at 27°C . Initial moles of A in the container is 3.0 mol

Amount of moles of A remains in the equilibrium mixture 60% from its initial amount.

i. Calculate equilibrium moles of each camponent.

ii. Calculate Kc of this system at 27°C.

iii. Calculate Kp of this system at 27°C (RT = 2500 J mol^{-1})

iv. If the volume of the container is suddenly doubled at 27°C , after equilibrium Predic the direction of reaction shift to achieve equilibrium by doing calculatein

v. If the volume of the container is suddenly halved (from initial volume) at 27°C , after equilibrium. Predic the direction of reaction of equilibrium by doing calculation

(b) i. Given below are some standard enthalpy changes

Standard enthapy of formation of $H_2O(l)$ = -286 kJ mol^{-1}

Standard enthapy of combustion of $C_2H_2(g)$ = -1310 kJ mol^{-1}

Standard enthapy of combustion of $C_2H_4(g)$ = -1362kJ mol^{-1}

Calculate the staandard enthalpy change of hydrogenation of $C_2H_2(g)$ in the presence of $H_2(g)$ + $BaSO_4$ + Pd + Quinoline using thermochemical cycle.

ii. Calculate the equilibrium constant Kc for the reaction given below at 25°C.

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ $\quad \Delta S_R^\theta = 122\ Jk^{-1}\ mol^{-1}$

$\Delta H_R^\theta = 77\ kJ\ mol^{-1}$

($\Delta G^\theta = -2.303\ RT \log K_c$)

$RT = 2500\ J\ mol^{-1}$

06. (a) i. What do you mean by buffer solution

i. Write two examples of buffer system

ii. Show buffer action of one of them by adding small amount of acid and by adding small amount of base.

iv. Consider buffer system made by NH_4Cl and NH_3 solution.

How many moles of NH_4Cl are necessery to be added to 1.0 dm^3 of 0.1 $moldm^{-3}$ NH_3 solution to perpare a buffer solution with pH 9.0 at 25°C

(K_b ($NH_3(aq)$ = 1.8 x 10^{-5} $moldm^{-3}$ at 25°C)

(b) i. Write expression for solubility product K_{sp} of $Cu(OH)_2(s)$

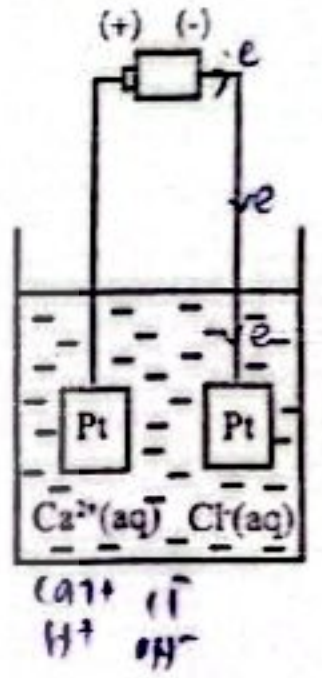
ii. Calculate the $Cu^{2+}(aq)$ solubility in a saturated solution of $Cu(OH)_2$ at 298 K, when pH = 8.00

$K_{sp}(Cu(OH)_2 = 2.2 \times 10^{-20}$ mol^3 dm^{-9}

(c) Saturated vapour pressure of diethylether ($C_2H_5OC_2H_5$)) is 4.41 x 10^4 Pa at 298 K. 37 g of diethylether is mixed with 5.1 g of compound A. Then vapour pressure of diethyl ether is 4.26 x 10^4 Pa. Calculate molar mass of A by considering A and diethylether mixture behave as ideal immiscible solution.

(C =12, H= 1, O=16)

07. (a) 0.1 A constant currect flows through 100 cm^3 of 0.1 $moldm^{-3}$ $CaCl_2$ soultion at 25°C as shown below.



$E^{\theta}_{Ca^{2+}(aq)|Ca(s)} = -2.87$ V

$E^{\theta}_{H_2O(l)|H_2(g)} = -0.83$ V

$E^{\theta}_{Cl_2(g)|Cl^-(aq)} = +1.36$ V

i. Write reduction reaction and oxidation reaction occurs at two electrodes

ii. Write cell reaction.

iii. Write direction that current flows through external circuit.

iv. Solubility product of $Ca(OH)_2$ at 25°C is 1 x 10^{-5} mol^3 dm^{-9}. Assume volume of the aqueous layer is constant and ionization of water is negligible. Calculate OH^- ion concentration needed to precipitate $Ca(OH)_2$

v. Calculate time spent until formation of $Ca(OH)_2(s)$ precipitate.

vi. Calculate volume released at the anode when starts precipitating $Ca(OH)_2$

(b) A and B are aqueous co-ordinated complexes of two 3d elements. A and B are octahedral in geometry. Both A and B has same type of ligands and ions joined to it by ionic bonds

	A(aq)	B(aq)
Colour of the aqueous solution	blue	pink
10 cm^3 of 1 mol dm^{-3} aqueous solution	Adding excess solution of $BaCl_2$, mass of the formed white precipitate is 2.33 g. It is insoluble in acidic medium.	Adding $AgNO_3$ solution in excess, gives white precipitate with mass 2.87 g. This precipitate is dis-solved in dil NH_3.
Excess NH_3 solution	dark blue solution (C)	yellow - brown solution (D)
Conc. HCl solution	Yellow solution (E)	blue solution (F)

i. Identify two cations in A and B complexes.

ii. Write electron configuration of both cations in A and B.

iii. Identify two anoins in A and B

iv. Write structural formulae of A and B.

v. Write IUPAC names of A and B

vi. Write structural formulae of C, D, E, and F

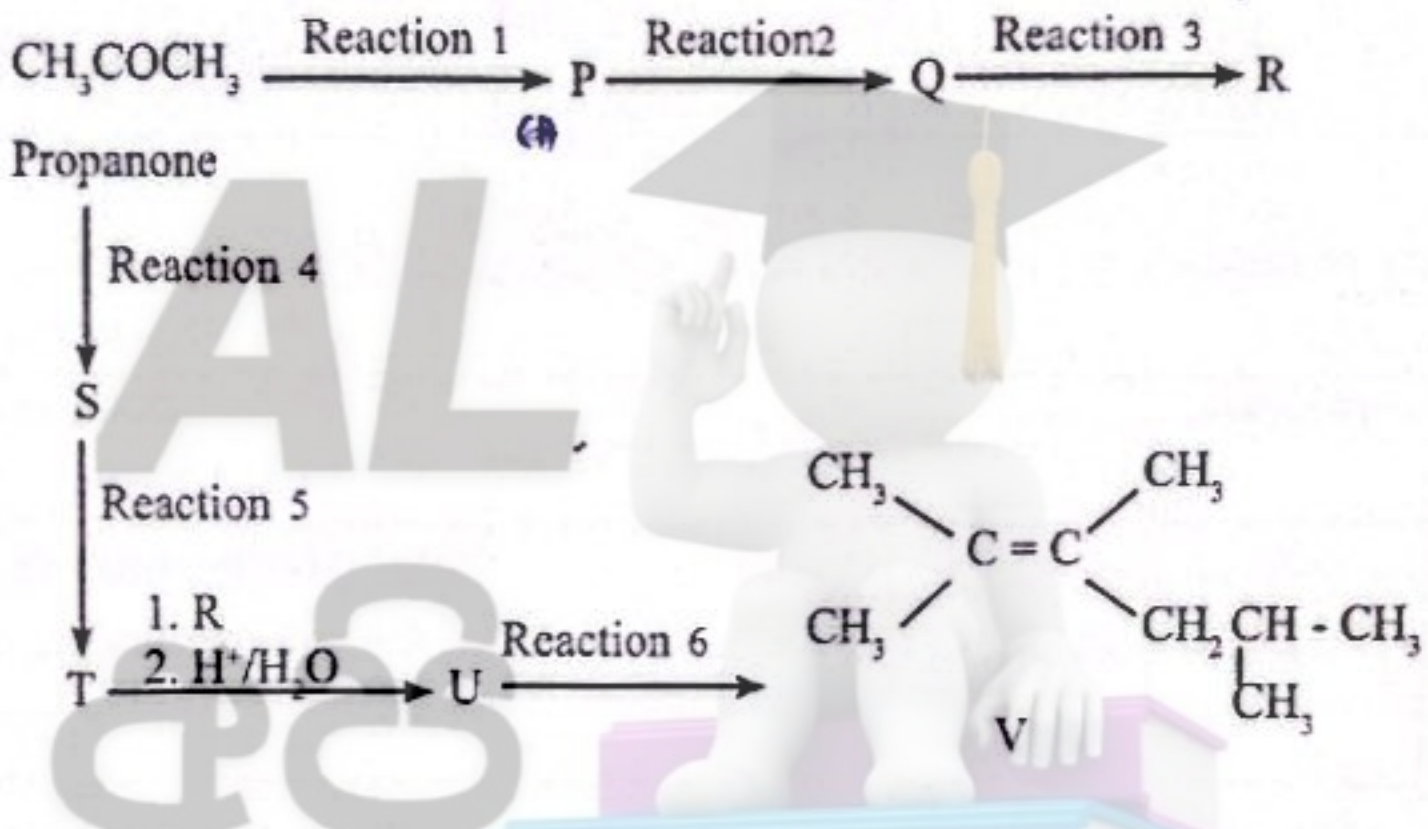
vii. Cation of A makes octahedral ions with bidentate ligand $NH_2CH_2CH_2NH_2$.Draw it's structural formula.

(Ag = 108, Cl=35.5, S = 32, O=16, Ba=137)

PART C

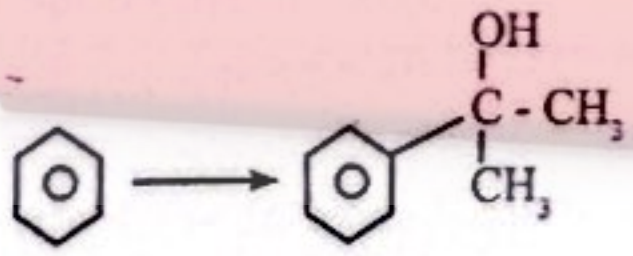
- **Answer only two quesctions.**

08. (a) Complete following reaction scheme to mark by starting from propanone. Write P, Q, R, S, T, and U



list of chemicals
$NaOH(aq)$, $H^+/KMnO_4$, conc. H_2SO_4, H_2, $LiAlH_4$, dry ether, Mg, PCl_5, H^+/H_2O, Ni

(b) Do following conversion not more than three steps.



(c) Consider two compounds Ethanol and Phenol

i. Which compound is more acidic

ii. Write balanced chemical equations those ethanol and phenol undergo equilibrium in aqueous solution.

iii. Draw resonance structures of phenate ion.

iv. Explain answer given for question (i) above.

v. Give suitable example to show more acidity of compound given (Answer in (i))

(d) Write mechanism for ethanal with HCN by writing product.

09. (a) Aqueous solution X has four cations and two anions following 1-5 Tests done to identify those anions

Test No	Test	Observation
1	dil. HCl is added to a small portion of X solution.	Colourless gas (A_1) with pungent odour is released by forming yellow precipitate (P_1)
2	H_2S gas is passed through filtrate collected after separation of P_1.	Black precipitate (P_2) is formed
3	Filtrate obtained after separation of P_2 is boiled and NH_4Cl/ NH_4OH is added after cooling it to room temperature.	Two precipitates P_3 and P_4 are formed.
4	Small portion of X is mixed with NaOH and warmed.	Released bad odour gas (A_2)
5	Al powder is added to small portion of X and boiled with conc. NaOH	Released bad odour gas (A_2)

Following tests are done to idenify gases A_1, A_2 and precipitates P_2, P_3, P_4

Test No	Precipitate	Test	Observation
06	P_2	01. dil. HCl is added. 02. Added excess water to S_1	Black precipitate get disolved and colourless solution is given (S_1). White precipitate (P_5) formed.
07	Mixture of P_3 and P_4	Added excess NaOH	P_3 Precipitate is disolved then green solution (S_2) and reddish brown precipitate of P_4 is formed.
08	P_4	P_3 is dissolved in dil. HNO_3 and added $K_4[Fe(CN)_6]$	blue precipitate P_6 is given.

Test No	Gas	Test	Observation
09	A_1	A_1 passed through acidified $KMnO_4$ solution	Colour of the solution get decolorized and formed clear solution.
10	A_2	A_2 passed through aqueous solution of Ni^{2+}	Formed green precipitate (P_7) and passing gas further dark blue solution is given (S_3)

i. Identify four cations and two anions in solution X and write

ii. Identify A_1, A_2, P_1, P_2, P_3, P_4, P_5, P_6, P_7, S_1, S_2, S_3 and write their chemical formulae

iii. Write balanced chemical reaction for the test number (06).

(b) Oxoanion of metal X is XO_4^{3-} Iodometry is used to analyze concentration of XO_4^{3-} ions.

XO_4^{3-} reduces to XO^- by I^- formed I_2 is analysed using Standerdized $Na_2S_2O_3$ solution

A. Standerdization of $Na_2S_2O_3$ solution

10.7 g KIO_3 is taken to the volumetric flask and 250 cm^3 solution is made. 25cm^3 of this solution is mixed with 20 cm^3 ⟶ of 1.0 $moldm^{-3}$ H_2SO_4 and 5 cm^3 of 5 mol dm^{-3} KI solution. This solution is titrated with $Na_2S_2O_3$ solution. Burette reading is 40 cm^3

B. 25 cm^3 of XO_4^{3-} ion solution is mixed with 15 cm^3 of KI solution and then titrated with $Na_2S_2O_3$ which is standerdized in an acidic medium, Burette reading is 12 cm^3.

i. Write balanced chemical equations for reaction XO_4^{3-} with I^- to give XO^-

ii. Write balanced chemical equation to represet reaction KIO_3 with KI in 1 mol dm^{-3} H_2SO_4 medium

iii. Calculate concentration of $Na_2S_2O_3$ solution by writin all reactions.

iv. Calculate concentration of XO_4^{3-}.

v. Write sutitable indicator and write instant that indicator added.

10. (a) Consider industrial production of HNO_3 by Ostwald process.

i. Write raw materials

ii. Write suitable conditions and balanced chemical equations.

iii. Write steps that should be taken to increase efficiency of this process at the final step.

iv. Write three uses of HNO_3 acid.

v. Write three adverse effects that can be affected to the environment by doing this method

(b) i. Write adverse effect to the environment due to two nitrogen containng compounds.

Nitrogen containing compound	Adverse effects
1.	.....
2.	.....

ii. Write an environmental issue that causes by nitrogen containing compound mentioned above which reduces the visibility of environment by writing relevant balanced chemical equations.

iii. Write how to minimize the issue mentioned above.

iv, Write relevant chemical equations to represent availability of N_2 in an air.

v. Write a ploymer which contains Nitrogen and write its monomer.

vi. Write two features and two uses of this mentioned polymer.

(c) i Write three water quality parameters used to analyse water pollution .

ii. Explain one of these, and mention precautions that can be taken to minimize adverse effects.