

**Taxila Central College – Horana**  
**General Certificate of Education (Ad. Level) Examination -2021,**

**Grade 13**

**3<sup>rd</sup> TERM TEST –NOVEMBER -2021**

**CHEMISTRY/02E**

**PAPER I**

**TIME :2 HOURS**

Universal gas constant  $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$

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

Planck's constant  $h = 6.626 \times 10^{-34} \text{ Js}$

Velocity of light  $C = 3 \times 10^8 \text{ ms}^{-1}$

1. The scientists that introduced wave properties for small particles in definite condition is,

1. Albert Einstein.

2. Max Planck.

3. Niels Bohr

4. De Broglie.

5. Rutherford

2. Number of electrons in  $\text{Sc}^{3+}$  having azimuthal quantum number  $l = 1$  and magnetic quantum number  $m_l = -1$  respectively,

1. 2 and 6

2. 6 and 10

3. 6 and 2

4. 10 and 4

5. 12 and 4

3. Find group of M in the periodic table which M is an element in 3<sup>rd</sup> period and which makes polar covalent compound  $\text{MCl}_2$ .

1. 2

2. 13

3. 14

4. 15

5. 16

4. Number of resonance structures that can be drawn for  $\text{HN}_3$  is,

1. 2

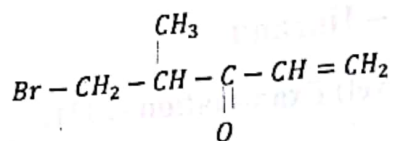
2. 3

3. 4

4. 5

5. 6

5. IUPAC name of the compound given below is,



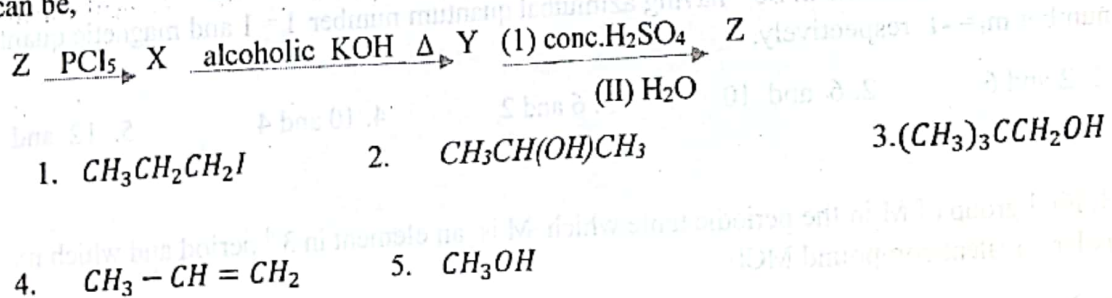
1. 1-bromo-2-methylpent-1-en-3-one
2. 5-bromo-4-methylpent-1-en-3-one
3. 1-bromo-2-methylpent-1-eneone
4. 5-bromo-4-methylpent-1-enol
5. 1-bromo-2-methylpentene-3-one

6. Molecules or ions having same shape is/ are,

- A)  $\text{HF}_2\text{O}^+$       B)  $\text{ClO}_3^-$       C)  $\text{OF}_2$       D)  $\text{NO}_3^-$       E)  $\text{NF}_3$
1. A and B
  2. A and D
  3. A, B and E
  4. C and D
  5. B, C and D

7. Consider reaction chain given below.

Z can be,



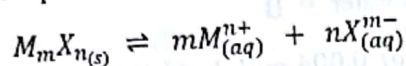
8. Nitrogen(IV) oxide is given by the complete reaction of 3mol of nitrogen(II) oxide with 2mol of  $\text{O}_2$ . Volume of mixture is  $0.8314 \text{ m}^3$  at  $400\text{K}$ . Calculate pressure of the mixture of gas in  $\text{Nm}^{-2}$  if temperature remains constant.

1. 3000
2. 6000
3. 8000
4. 14000
5. 16000

9. Select correct ascending order of boiling point of the compound given.

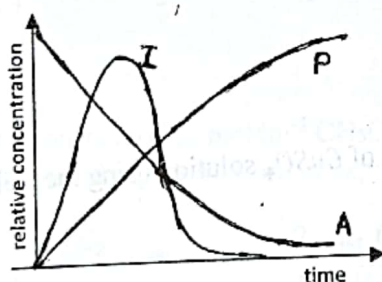
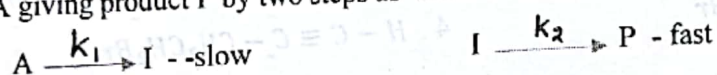
1.  $C_2H_5OH < C_2H_6 < C_2H_5F < H_2O$
2.  $C_2H_6 < C_2H_5F < H_2O < C_2H_5OH$
3.  $C_2H_5F < C_2H_6 < C_2H_5OH < H_2O$
4.  $C_2H_6 < C_2H_5F < C_2H_5OH < H_2O$
5.  $C_2H_6 < C_2H_5OH < C_2H_5F < H_2O$

10.  $M_mX_n$  salt is in equilibrium with the solubility  $S$  in an aqueous solution. Correct relationship between  $K_{sp}$  of  $M_mX_n$  and  $S$  is,



1.  $S = \frac{K_{sp}}{m^m n^n}$
2.  $S = \left[ \frac{K_{sp}}{m^m n^n} \right]^{\frac{1}{(m+n)}}$
3.  $S = K_{sp} \times m^m n^n$
4.  $S = \left[ \frac{m^m n^n}{K_{sp}} \right]^{\frac{1}{(m+n)}}$
5.  $S = \sqrt{K_{sp} m^m n^n}$

11. A giving product P by two steps as follows. It can be represented as follows.



Incorrect statement regarding above reaction is,

1. Concentration of reactant A decreases by time.
2. Intermediate I increases to maximum within short periods of time and drops to the zero.
3. Concentration of product P increases to definite value.
4. Molecularity of the reaction is 2.
5. Rate equation is  $R = -K_1[A]$

12. Descending order of bond angles of  $NF_3$ ,  $NH_3$ ,  $NOCl$ ,  $NO_2^+$   $NF_3$  is,

1.  $NF_3 > NH_3 > NOCl > NO_2^+$
2.  $NO_2^+ > NOCl > NH_3 > NF_3$
3.  $NO_2^+ > NH_3 > NF_3 > NOCl$
4.  $NO_2^+ > NOCl > NF_3 > NH_3$
5.  $NF_3 > NOCl > NH_3 > NO_2^+$

13. Dissociation constant of weak acid HA at  $25^\circ C$  is  $1 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ . Solution P is  $0.02 \text{ mol dm}^{-3}$  of HA.  $10 \text{ cm}^3$  solution P is mixed to get following B, C, D solutions

$10 \text{ cm}^3$  of solution P +  $10 \text{ cm}^3$  of water = B

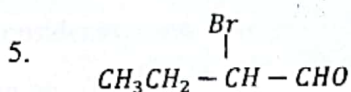
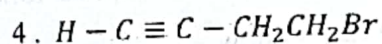
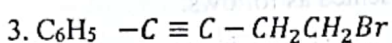
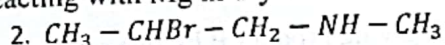
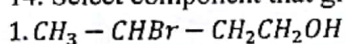
$10 \text{ cm}^3$  of solution P +  $10 \text{ cm}^3$  of  $0.004 \text{ mol dm}^{-3} \text{ HCl}$  = C

$10 \text{ cm}^3$  of solution P +  $10 \text{ cm}^3$  of  $0.004 \text{ mol dm}^{-3} \text{ NaOH}$  = D

Decreasing order of concentration ion A – in above B, C, D solutions at  $25^\circ C$  is,

1.  $B > C > D$
2.  $B > D > C$
3.  $D > B > C$
4.  $D > C > B$
5.  $C > D > B$

14. Select component that gives Grignard Reagent by reacting with Mg in dry ether



15. Select correct statement regarding electrolysis of  $CuSO_4$  solution using inert electrodes is,

1.  $H_2$  evolves at the anode
2.  $O_2$  evolves at the cathode.
3. Cu deposits on Anode.
4.  $SO_4^{2-}$  and  $OH^-$  ions attracted towards cathode.
5. Blue colouration of solution increases gradually.

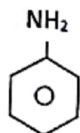
16.  $A(g) \longrightarrow B(g) + C(g)$  is an elementary reaction. Pressure of the system at  $t=0$  is  $P_1$ , and pressure of the system at  $t = t$  is  $P_2$ . Rate of this reaction is,

1.  $2P_1 - P_2$
2.  $P_2 - P_1$
3.  $P_1 - P_2$
4.  $P_2 - 2P_1$
5.  $2P + P_1$



17. Compound Y given by reaction of compound X when adding  $\text{NaNO}_2$  and  $\text{dil.HCl}$ . Y reacts with acidified,  $\text{KMnO}_4$  to give Z. Z gives orange precipitate with 2,4-DNP. X is,

1



2.  $\text{C}_2\text{H}_5\text{CONH}_2$

3.  $\text{C}_2\text{H}_5\text{CH}_2\text{CHNH}_2\text{CH}_3$

4.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

5.  $\text{CH}_3\text{CH}_2\text{COCH}_3$

18. A reaction is non spontaneous when increasing temperature however this reaction is spontaneous at room temperature and 1 atm pressure. Correct signs for this reaction at room temperature is,

	$\Delta G$	$\Delta H$	$\Delta S$
1.	0	+	-
2.	-	-	-
3.	-	-	+
4.	+	+	+
5.	+	-	-

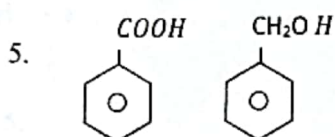
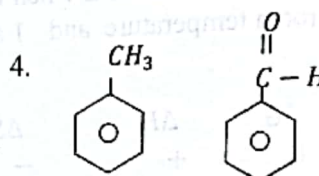
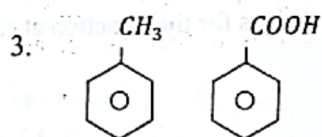
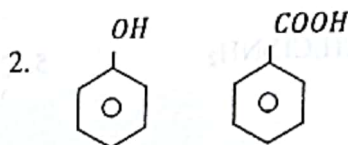
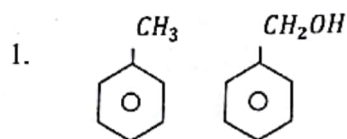
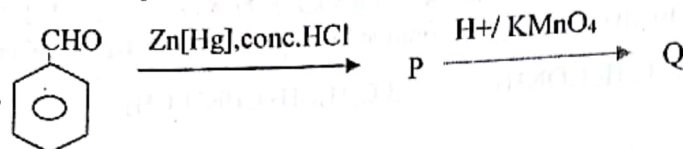
19. Dissociation constant of  $\text{C}_1 \text{ mol dm}^{-3} \text{CH}_3\text{COOH}$   $k_1$  and dissociation constant of  $\text{C}_2 \text{ mol dm}^{-3} \text{HCOOH}$   $k_2$  are mixed together. Correct expression for  $\text{H}^+$  concentration of solution is,

- |  |                                    |                               |
|--|------------------------------------|-------------------------------|
| 1. $k_1 C_1 + k_2 C_2$                 | 2. $k_1 C_1 - k_2 C_2$             | 3. $\sqrt{k_1 C_1 + k_2 C_2}$ |
| 4. $\frac{k_1}{k_2} = \frac{C_1}{C_2}$ | 5. $\sqrt{k_1 C_1 \times k_2 C_2}$ |                               |

20 Correct descending order of ionic radius of given species  $\text{S}^{2-}$ ,  $\text{Cl}^-$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$  is,

- |  |  |
|--|--|
| 1. $\text{S}^{2-} > \text{Cl}^- > \text{K}^+ > \text{Ca}^{2+}$ | 2. $\text{Cl}^- > \text{S}^{2-} > \text{K}^+ > \text{Ca}^{2+}$ |
| 3. $\text{S}^{2-} > \text{Cl}^- > \text{Ca}^{2+} > \text{K}^+$ | 4. $\text{Ca}^{2+} > \text{K}^+ > \text{S}^{2-} > \text{Cl}^-$ |
| 5. $\text{K}^+ > \text{Ca}^{2+} > \text{Cl}^- > \text{S}^{2-}$ |  |

21. Consider sequence of reaction given below and P and Q respectively is,



22. Calculate number of moles of  $\text{MnO}_4^-$  needed to react with 1 mol of  $\text{H}_2\text{O}_2$  in acidic medium when  $\text{H}_2\text{O}_2$  react with  $\text{MnO}_4^-$  in an acidic medium to give  $\text{O}_2$ ,  $\text{Mn}^{2+}$ , and  $\text{H}_2\text{O}$ .

1. 0.4 mol      2. 0.8      3. 2.0      4. 2.5      5. 5.0

23. Volume of  $0.1 \text{ mol dm}^{-3}$  NaOH needed to react with  $25 \text{ cm}^3$   $0.1 \text{ mol dm}^{-3}$  HA to become  $[\text{HA}] = [\text{A}^-]$

1.  $12.50 \text{ cm}^3$       2.  $25.00 \text{ cm}^3$       3.  $37.50 \text{ cm}^3$   
4.  $6.25 \text{ cm}^3$       5.  $50.00 \text{ cm}^3$

24. Calculate the concentration of  $\text{Cu}^{2+}$  ion when it is saturated with copper hydroxide solution at  $\text{pH} = 10$  at 298K.

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

1.  $2.2 \times 10^{-16} \text{ mol dm}^{-3}$
2.  $2.2 \times 10^{-12} \text{ mol dm}^{-3}$
3.  $22 \times 10^{-16} \text{ mol dm}^{-3}$
4.  $(4.4) \times 10^{-20} \text{ mol dm}^{-3}$
5.  $44 \times 10^{-18} \text{ mol dm}^{-3}$

25. Standard electrode potential of electrochemical cell  $\text{Cu}_{(s)} | \text{Cu}_{(aq)}^{2+} || \text{Ag}_{(aq)}^+ | \text{Ag}_{(s)}$  is 0.46 V. calculate electrode potential of the cathode.

$$E^\circ_{\text{Cu}_{(aq)}^{2+}/\text{Cu}_{(s)}} = +0.34 \text{ V}$$

1. +0.42 V
2. +0.12 V
3. +0.80 V
4. -0.42 V
5. -0.80 V

26.  $75 \text{ cm}^3$  of aqueous solution of E is mixed with  $50 \text{ cm}^3$   $\text{CHCl}_3$  and allowed to reach equilibrium at room temperature. 75% of E extracted to the organic layer at equilibrium. Calculate distribution coefficients  $K_D$  between  $\text{CHCl}_3$  and water.

1. 0.25
2. 0.9
3. 4.5
4. 9.0
5. 45

27.  $K_c$  value of reaction  $\text{A(g)} \rightleftharpoons \text{B(g)} + \text{C(g)}$  is  $2 \times 10^{-3}$ , after t. time composition of each in mixture  $[\text{A(g)}] = [\text{B(g)}] = [\text{C(g)}] = 3 \times 10^{-4} \text{ mol dm}^{-3}$ . Correct statement regarding this reaction is,

1. Reaction occurs towards forward direction due to  $Q_c < K_c$
2. Reaction is in equilibrium due to  $Q_c = K_c$
3. Reaction occurs back world reaction do to  $Q_c < K_c$
4. Reaction tend to backward reaction due to  $Q_c > K_c$
5. Reaction tend to forward reaction due to  $Q_c > K_c$

28. Select reaction that is not involved in Born Haber cycle of formation of  $\text{MgCl}_{2(s)}$ .

1.  $\text{Mg}_{(s)} \rightarrow \text{Mg}_{(g)}^+ + e$
2.  $\text{Mg}_{(g)} \rightarrow \text{Mg}_{(g)}^+ + e$
3.  $\text{Cl}_{2(g)} \rightarrow 2\text{Cl}_{(g)}$
4.  $e + \text{Cl}_{(g)} \rightarrow \text{Cl}_{(g)}^-$
5.  $\text{Mg}_{(g)}^{2+} + 2\text{Cl}_{(g)}^- \rightarrow \text{MgCl}_{2(s)}$

29. Correct statement regarding polymer is,

1. Teflon is thermosetting polymer.
2. Polystyrene is condensation polymer.
3. Nylon -6,6- is thermosetting polymer.
4. Bakelite form due to addition polymerization of phenol and formaldehyde.
5. Elasticity of natural rubber is due to cis- polyisoprene chains.

30. Reaction  $A + B \longrightarrow C$  is zeroth order with respect to B and first order with respect to A. Select the correct statement regarding that time taken to reduce concentration of B exactly half is,

1. It depends on initial concentration of B and does not depend on initial concentration of A.
2. It depends on initial concentration A and does not depend on the initial concentration of B
3. It depends on initial concentrations of both A and B.
4. It does not depend on initial concentration of both A and B.
5. Only concentration of A depends on the reaction rate.

• For each of the questions 31 to 40, one or more responses out of the four responses (a), (b), (c) and (d) given is /are correct. Select the correct response/responses in accordance with the instructions given on your answer sheet,

Mark (1) If only (a) and (b) are correct.

(2) If only (b) and (c) are correct.

(3) If only (c) and (d) are correct.

(4) If only (d) and (a) are correct.

(5) If any other number or combination of responses is correct.

Summary of above Instructions,

1	2	3	4	5
Only (a) and (b) are correct	Only (b) and (c) are correct	Only (c) and (d) are correct	Only (a) and (d) are correct	Any other number or combination of responses is correct



31. Select correct statement or statements regarding chemistry of ammonia.

- a. It acts as both acid and a base.
- b. It can act as both oxidizing agent and reducing agent.
- c. It reacts sodium to make  $\text{Na}_3\text{N}$ .
- d. Makes hydrogen bonds with water.

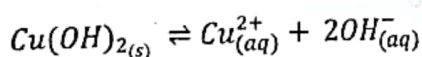
32. Correct statement regarding alkynes is/are,

- a. All alkynes react with sodium and evolve ammonia.
- b. Alkynes with terminal hydrogen are less acidic than that of alcohols and water.
- c. Make acetylides with  $\text{Ag}^+$  and  $\text{Cu}^{2+}$  ions to make insoluble metal acetylides.
- d. All carbon atoms in alkynes are  $\text{sp}$  hybridized.

33. Correct statement regarding the endothermic reaction which occurs spontaneously at constant temperature and pressure is /are,

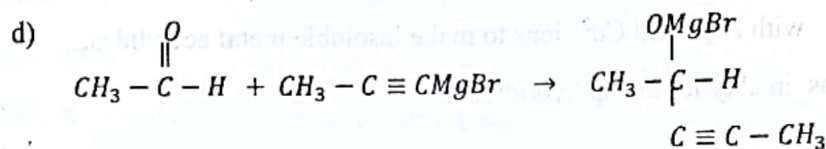
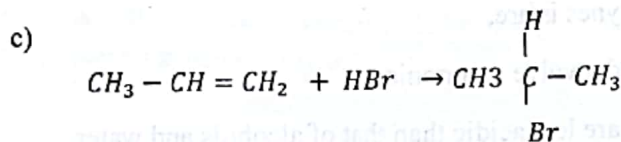
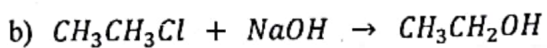
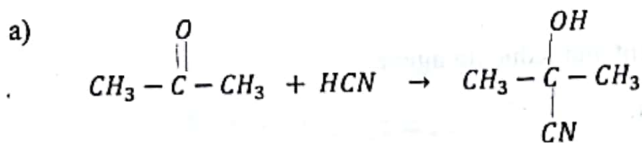
- a. Entropy change is positive.
- b. Entropy change is negative.
- c. The value of  $\Delta H$  is greater than  $T\Delta S$ .
- d. The value of  $\Delta H$  is less than  $T\Delta S$ .

34. Correct statement regarding given equilibrium system is,

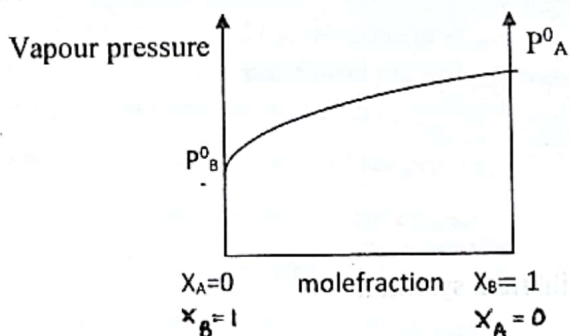


- a. Increasing pH value increases the solubility of  $\text{Cu}(\text{OH})_{2(s)}$ .
- b. Decreasing the pH value equilibrium tends towards left.
- c. The solubility of  $\text{Cu}(\text{OH})_{2(s)}$  increases by adding dilute ammonia solution drop by drop.
- d. Increasing temperature, increases the solubility.

35. Select the nucleophilic addition reactions / reaction,



37. Select correct statement regarding vapor pressure, composition curve given for nonideal A,B mixture



- Attraction forces A-A and B-B are stronger than A-B.
- Attraction forces of A-A and B-B are <sup>weaker</sup> stronger than A-B.
- Heat evolves when mixing A and B liquids.
- Heat absorbs when mixing A and B liquids.

37. Select correct statement / statements regarding compounds of group 16 elements in periodic table

- a.  $\text{H}_2\text{O}_2$  has both oxidizing and reducing abilities.
- b. Rhombic sulfur is the most stable allotrope of sulfur.
- c. No reduction of  $\text{SO}_4^{2-}$  ion to either S or  $\text{S}^{2-}$
- d.  $\text{S}_2\text{O}_3^{2-}$  is reducing agent.

38. Select statement that can be applicable for all Co, Ni, Zn

- a. Transition metals.
- b. They make colored complexes with aqueous ammonia.
- c. Stable ion of them are divalent cation
- d. Hydroxides of them are coloured

Following paragraph is for question number 39 and 40

A and B liquids make ideal solution when they mixed. Their saturated vapor pressure  $P_A^0$  and  $P_B^0$  respectively. Equimolar a mixture of A and B are added to the rigid container allowed to attain equilibrium. The mole fractions of A and B in liquid phase is  $X_A$  and  $X_B$  and vapour phase  $Y_A$  and  $Y_B$  respectively. Pressures of A and B at equilibrium are  $P_A$  and  $P_B$  respectively. The boiling points of A and B at the equilibrium are  $T_A$  and  $T_B$ .

39. Correct statement regarding A and B.

- a)  $X_A > 0.5 > X_B$
- b)  $Y_A < 0.5 < Y_B$
- c)  $Y_A > 0.5 > Y_B$
- d)  $X_A > 0.5 > Y_B$

40. Correct statement regarding properties of A and B.

- a)  $T_A > T_B$
- b)  $T_B > T_A$
- c)  $P_A + P_B > P_A^0$
- d)  $P_A^0 X_A + P_B^0 (1 - X_A) < P_B^0$



In question numbers 41 to 50, two statements are given in respect of each question. From the table given below, select the response out of the responses (1), (2), (3), (4) and (5) that best fits the two statements and mark appropriately on your answer sheet.

Response	1 <sup>st</sup> Statement	2 <sup>nd</sup> Statement
1	True	True 1 <sup>st</sup> statement is explained correctly
2	True	True 1 <sup>st</sup> statement is not explained correctly
3	True	False
4	False	True
5	False	False

	First statement	Second statement
41.	F <sub>2</sub> is more reactive from the halogens.	Bond energy of F <sub>2</sub> is the minimum from halogens.
42.	Always Methyl orange used as indicator in titration between HCl and NH <sub>3</sub> (aq)	pH of the equilibrium point of titration between HCl and NH <sub>3</sub> (aq) is less than 7 because of hydrolysis of NH <sub>4</sub> <sup>+</sup> ion.
43.	It is not suitable to heat higher temperatures during extraction of essential oils.	Most of the essential oils get decomposed or get polymerized due to heat.
44.	Compressibility factor becomes zero when pressure of any gas decreases.	Intermolecular forces become strong when decreasing pressure.
45.	Those are not mirror images of each other are diastereomers.	Asymmetric carbon atoms bonded to four asymmetric groups.
46.	Benzene undergoes electrophilic substitution reactions	Benzene ring is stable due to delocalized $\pi$ electron cloud.
47.	NH <sub>4</sub> OH reacts with aqueous CO <sub>2</sub> to give NH <sub>4</sub> HCO <sub>3</sub> is an exothermic reaction.	Ammonium hydroxide is basic gas and carbon dioxide is acidic gas.
48.	Tertiary alkyl halides undergo nucleophilic substitution reactions.	Tertiary carbocation is more stable than primary carbocation.
49.	The slowest step of the multi-step reaction determines the rate of the reaction.	Molecularity of any reaction is same as stoichiometry of the reaction.
50.	All HFC, CFC, HCFC are greenhouse gases.	Any gas that absorbs IR rays are greenhouse gas.



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**Grade 13**

**3<sup>rd</sup> TERM TEST –NOVEMBER -2021- CHEMISTRY**

PAPER 11

TIME: 2 HOURS

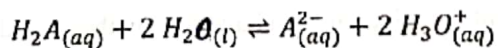
**PART B- Answer only two questions**

5) Gas A achieves an equilibrium  $a A_{(g)} \rightleftharpoons b B_{(g)}$  above  $100^{\circ}C$  temperature by partial decomposition.

Equilibrium point of above equilibrium shifts towards right by increasing temperature of this system from 400 K to 500K.

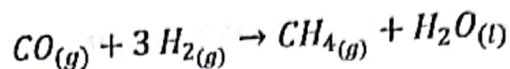
- i. Mention sign of the  $\Delta H$  of above reaction and explain it by giving reasons.
  - ii. 2 mol of A allows to get reacted at 400K. Then total number of moles increases by 40% than initial when 40% of A reacted. Calculate "a / b" ratio.
  - iii. Using calculation done in (ii) decide sign of the  $\Delta S$  and explain your answer.
  - iv. Calculate  $Q_p$  if total pressure of above mixture is 2.1 kPa at 400K.
  - v. State whether the system achieved equilibrium or not if  $K_p = 5 \times 10^3 \text{ Pa}$
  - vi. Deduce the reaction as spontaneous or not by considering sign of the  $\Delta G$  relevant to above (iv)<sup>th</sup> question.
  - vii. 2 mol gaseous A inserted to the system at 400K and allows to achieve equilibrium. The system achieved equilibrium after five minutes then 2 mol of B available in the system. Draw graph between concentration A and B with time.
  - viii. Solid catalyst is added to above system at 400K and then allows to achieve equilibrium. Draw the graph between concentration of A and B with time in same graph (use dash lines).
- b)  $K_{a1}$  and  $K_{a2}$  of dibasic acid  $H_2A$  are  $3.2 \times 10^{-6} \text{ mol dm}^{-3}$  and  $1 \times 10^{-7} \text{ mol dm}^{-3}$  respectively at  $25^{\circ}C$ .

- i. Calculate  $K_c$  of the reaction given at  $25^{\circ}C$ .



- ii. Calculate pH value of  $0.1 \text{ mol dm}^{-3} H_2A$  solution.

C) Consider reaction occurs at 25°C.



	Standard enthalpy of formation (KJmol <sup>-1</sup> )	Standard entropy (J mol <sup>-1</sup> k <sup>-1</sup> )
CH <sub>4(g)</sub>	-751	186
H <sub>2</sub> O <sub>(l)</sub>	-286	70
CO <sub>(g)</sub>	-111	198
H <sub>2(g)</sub>	0	131
CO <sub>2(g)</sub>	-393	214

- Deduce whether the reaction is spontaneous by doing calculation at 25°C.
- Explain reasons for your answer.
- Calculate the temperature if the reaction is not spontaneous.

06)i. Write down Rault's law

ii. A and B are two immiscible binary ideal solution. Saturated vapour pressures of A and B are  $P_A^0$  and  $P_B^0$ . Partial pressures of A and B are  $P_A$  and  $P_B$ . Mole fractions of A and B in liquid phase  $X_A$  and  $X_B$  respectively. Mole fractions of A and B in vapour phase is  $Y_A$  and  $Y_B$  respectively. Build relationship for  $Y_A$  and  $Y_B$  with other terms.

iii. Saturated vapour pressures of A and B at 25°C are 45KPa and 60KPa. 2mol A and 3mol of B mixed to get ideal binary solution. Calculate mole fraction of A and B in vapour phase.

iv. Draw temperature -composition phase diagram for above system.

v. Mark following points on diagram you have drawn above. Indicate points as given.

A) Composition of liquid  $X_1$  when 2 mol of A and 3 mol of B in liquid phase.

B) Boiling point  $T_1$  of liquid at composition  $X_1$ .

C) Composition of vapour  $Y_1$  when boiling the liquid at  $T_1$  which is in equilibrium with its liquid.

D) Composition  $X_2$  when condensing the gas with composition  $Y_1$ .

c. Dilute  $\text{AgNO}_3$  solution is added dropwise to the  $25\text{cm}^3$  mixture of  $0.1\text{mol dm}^{-3}$   $\text{KCl}$  and  $0.01\text{mol dm}^{-3}$   $\text{K}_2\text{CrO}_4$  solution.

i. Which compound get precipitated first, show it by doing calculation.

ii. Calculate the ion concentration got precipitated initially when 2<sup>nd</sup> salt get precipitated.

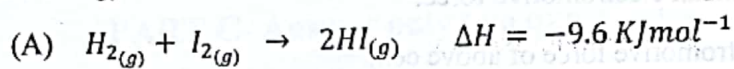
iii. Calculate the mass of 1<sup>st</sup> salt got precipitated when 2<sup>nd</sup> salt started to precipitate.

$$K_{sp}(\text{AgCl}) = 1.6 \times 10^{-10} \text{ mol}^2 \text{ dm}^{-6}$$

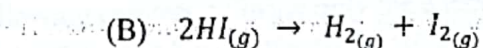
$$K_{sp}(\text{Ag}_2\text{CrO}_4) = 9.0 \times 10^{-12} \text{ mol}^3 \text{ dm}^{-9}$$

$$(\text{Ag}=108, \text{Cl}=35.5, \text{Cr}=52, \text{O}=16)$$

c) Activation energy of following reaction is  $+173.2\text{kJ mol}^{-1}$

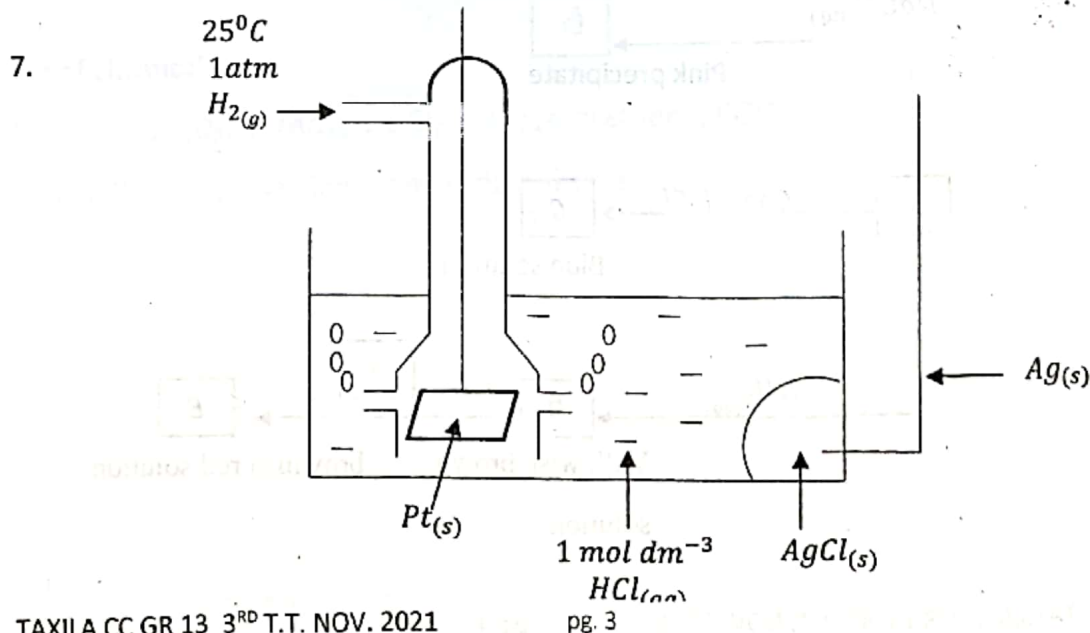
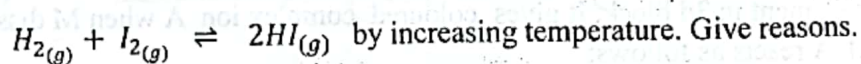


i. Calculate activation energy of following reaction (B)



ii. How does reaction rates of reactions A and B affect when increasing temperature.

iii. Deduce the direction of equilibrium point of reaction





An electrochemical cell is made as above

$$E^\circ_{H^+_{(aq)}/H_{2(g)}} = 0.00V$$

$$E^\circ_{AgCl(s)/Ag(s)} = +0.22V$$

i. Write balanced chemical equations for the following when current flows through the cell.

A. Anode reaction

B. Cathode reaction

C. Cell reaction

ii. Write IUPAC notation of the electrochemical cell.

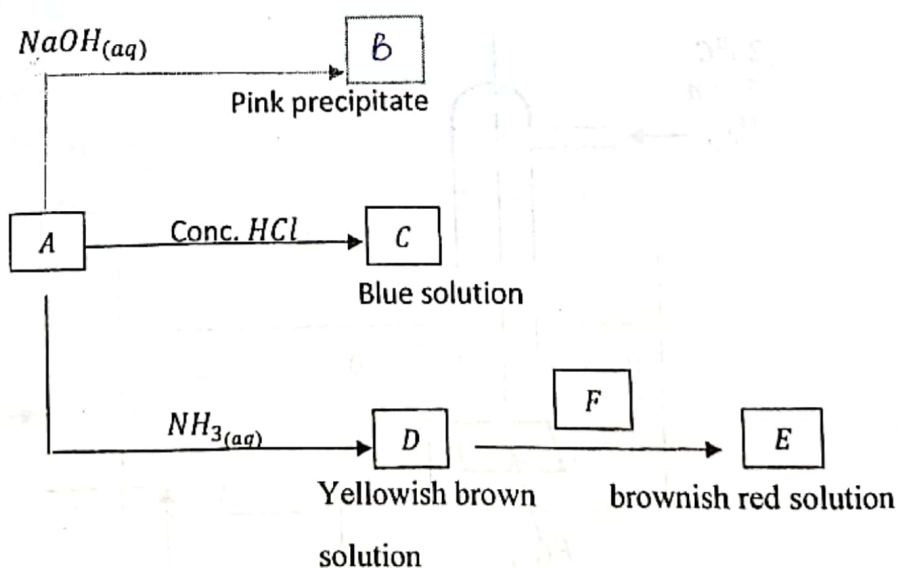
iii. What do you mean electromotive force.

iv. Calculate electromotive force of above cell.

v. Indicate the direction of electron flows in above cell while current flows.

b.  $50\text{cm}^3$  of aqueous  $\text{CuSO}_4$  solution is electrolysed by using Pt electrodes. 9.65s needed to deposit all  $\text{Cu}^{2+}$  ions as Cu on cathode by passing  $10^{-2}\text{A}$  current. Calculate  $\text{Cu}^{2+}$  ions concentration in the solution.

c. M is element in 3d block. It gives coloured complex ion A when M dissolves in dil. HCl. A reacts as follows:



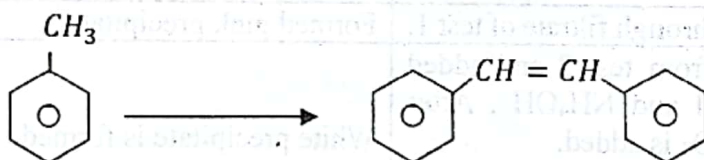


Hint : F is compound with two elements which belongs to initial periods of the periodic table.

- Identify element M. Give oxidation state of M in complex ion A.
- Write electron configuration of M in complex ion A.
- Write chemical formulae of A, B, C, D, E, and F.
- Write IUPAC names of A, C, D, and E.
- Write colour of A.
- Write balanced chemical equation that D, F react to give E.
- What would be the observation by passing  $H_2S$  through alkaline solution containing A at room temperature. . What is the chemical compound that gives the observation you mentioned.

### PART C- Answer only two questions

8. a) Do the following conversion using only the chemicals given in the list – ( The conversion must not exceed 7 steps )

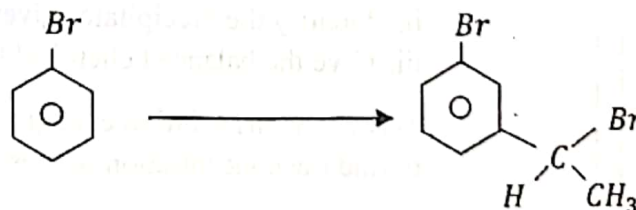


List of chemicals

Anhydrous  $Al_2O_3$ ,  $LiAlH_4$ ,  $PCl_5$ ,  $Mg$ , dry ether,  $PCC$ ,  $H^+/KMnO_4$ ,  $H^+/H_2O$

- b) Do following conversion not more than 6 steps

I.



c) Write reaction mechanism for the reaction of benzene with  $\text{CH}_3\text{CH}_2\text{Cl}$  in the presence of anhydrous  $\text{AlCl}_3$ .

Write electrophile, Lewis acid and base in this reaction.

9. a) When metal A is heated with non-metal B, white colour solid C is obtained. C dissolves in water and produce a gas D. When flame test is carried out after the addition of  $\text{HCl}$  to C, it gives green colour flame. When gas D reacts with another gas E, element B and substance F are obtained, here F is liquid at room temperature which converts  $\text{BiCl}_3$  to white solid G. The product H is obtained in the reaction between C i. Identify A, B, C, D, E, F, and G

ii. What are the possible products obtained in the reaction between element B and  $\text{NaOH}$ . Give the balanced chemical equations for the formation of those products.

b). The coloured aqueous solution Q contains, three metal ions as, their chlorides. The test performed with solution Q together with their observation are given below.

Test	Observation
1. Added equal volumes of $\text{NH}_4\text{Cl}$ and $\text{NH}_4\text{OH}$ to the part of the solution Q.	A green color precipitate is formed. Adding excess $\text{KOH}$ solution to the precipitate dark green solution is formed.
2. Passed $\text{H}_2\text{S}$ gas through filtrate of test 1.	Formed pink precipitate.
3. Heated filtrate from test 2 and added excess $\text{NH}_4\text{Cl}$ and $\text{NH}_4\text{OH}$ . After that $(\text{NH}_4)_2\text{CO}_3$ is added. Flame test is done for the formed precipitate.	White precipitate is formed. Crimson red flame is given.
4. 8-hydroxy quinoline is added for the filtrate from test 3.	Yellow green complex is given

i. Identify the metal ions in solution Q.

ii. Identify the precipitates given by above tests 1, 2, and 3.

iii. Give the balanced chemical for the reaction of the dark green colored formed in test 1

c) An aqueous solution contains  $\text{Cr}_2\text{O}_7^{2-}$  and  $\text{PO}_4^{3-}$  ions. A quantitative analysis has done to find the concentration of these ions as follows.

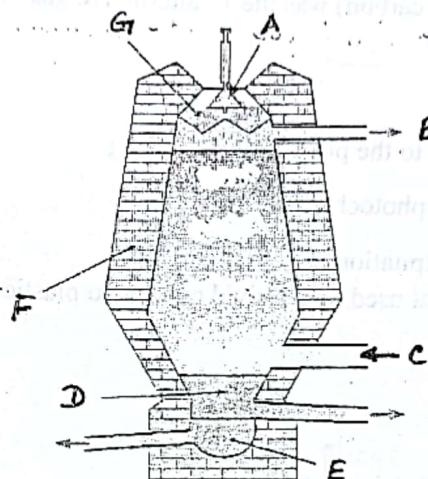
i) Mass of the precipitate which has obtained when excess  $\text{BaCl}_2$  solution added to  $100\text{cm}^3$  of the given solution is 1.855g.

II) 60 cm<sup>3</sup> of 0.05 mol dm<sup>-3</sup> Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub> has spent another 100 cm<sup>3</sup> of the solution is reacted with Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub> solution which is acidified with dil. H<sub>2</sub>SO<sub>4</sub>.

Calculate the concentration of each Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup> and PO<sub>4</sub><sup>3-</sup> ion in the solution.

(Ba=137, Cr=52, O=16, P=31)

10 a) Blast furnace is used to extract iron using raw material. following is a diagram of a blast furnace



- i. Name parts A, B, C, D, E, F and G.
  - ii. Write raw materials used for iron extraction.
  - iii. Indicate the direction of
    - I. Mass flow
    - II. Compress air flow inside the blast furnace.
  - iv. What are the two reducing agents used during the process and indicate the main reducing agent from them.
  - v. What are the factors that decided the rate of burning reaction.
  - vi. Write balanced chemical equations to show extraction of Fe using
    - I. Haematite
    - II. Magnetite
- b) Write monomer, repeating unit and polymer of following polymers
- i. Teflon



ii. PET (Polyethelene tetraphthalate)

~~iii. Bakelite~~

c.) Write main chemical species available in following essential oils.

i. Citronella oil

ii. Clove oil

iii. Lemon grass oil

d) i. HCFC (Hydrochlorofluoro carbon) was the 1<sup>st</sup> alternative gas used for CFCs. Write two structures of them (HCFC)

ii. Write I. Green house gases

II. Pollutants contribute to the photochemical smog.

iii. Write two adverse effect of photochemical smog.

iv. What are the ways of precipitation of water on earth.

v. Write Leaded pigments that used to get vivid colours to plastic.