DAY THIRTY NINE

Mock Test 2

(Based on Complete Syllabus)

Instructions

1. This question paper contains of 30 Questions of Chemistry, divided into two Sections :
   Section A Objective Type Questions and **Section B** Numerical Type Questions.
2. Section A contains 20 Objective questions and all Questions are compulsory (**Marking Scheme** : Correct +4, Incorrect –1).
3. Section B contains 10 Numerical value questions out of which only 5 questions are to be attempted (**Marking Scheme** : Correct +4, Incorrect 0).

Section A : Objective Type Questions

1 Of the following acids:

I. Hypophosphorus acid

II. Orthophosphorus acid

III. Caro's acid

IV. Glycine

(a) I, II monobasic ; III dibasic acid and IV amphoteric
(b) II monobasic ; I, III dibasic acid and IV amphoteric
(c) I monobasic ; II, III dibasic acid and IV amphoteric
(d) I, II, III dibasic acids and IV amphoteric

2 Magnetic moments of Cr ($Z = 24$), Mn ($Z = 25$) and Fe ($Z = 26$) are x, y and z respectively. Hence,

(a) $x = y = z$ (b) $x = z < y$
(c) $x < y < z$ (d) $x > y > z$

3 **Assertion** (A) Aldehydes and ketones, both react with Tollens' reagent to form silver mirror.

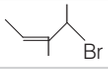
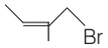
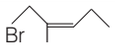
Reason (R) Both, aldehydes and ketones contain a hydrogen attached to a carbonyl group.

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A
(c) A is true but R is false
(d) A and R are false

4 $NaAlH_4$ reduces an ester into HCHO and $(CH_3)_2CHOH$. Thus, ester is

(a) $HCOOCH(CH_3)_2$ (b) $(CH_3)_2CHCOOCH_3$
(c) $HCOOCH_2CH_2CH_3$ (d) $CH_3CH_2COOCH_3$

5 Match the structures given in Column I with the names given in Column II.

Column I	Column II
A. 	1. 4-bromopent-2-ene
B. 	2. 4-bromo-3-methylpent-2-ene
C. 	3. 1-bromo-2-methylbut-2-ene
D. 	4. 1-bromo-2-methylpent-2-ene

Codes

	A	B	C	D
(a)	4	2	1	3
(c)	1	2	3	4

	A	B	C	D
(b)	1	3	2	4
(d)	2	3	1	4

6 Arrange the following compounds in decreasing order of basicity

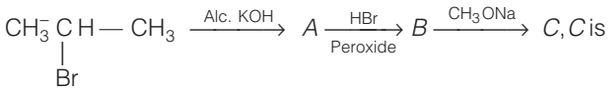
I. ethylamine II. 2-amino ethanol

III. 3-amino-1-propanol

(a) I > II > III (b) III > I > II

(c) I > III > II (d) I < II > III

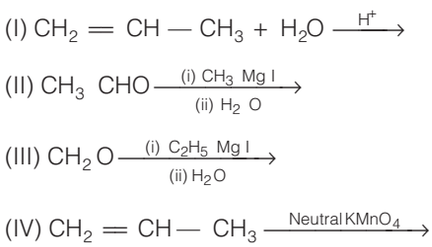
7 In the reaction,



(a) diethyl ether (b) 1-methoxy propane

(c) isopropyl alcohol (d) propylene glycol.

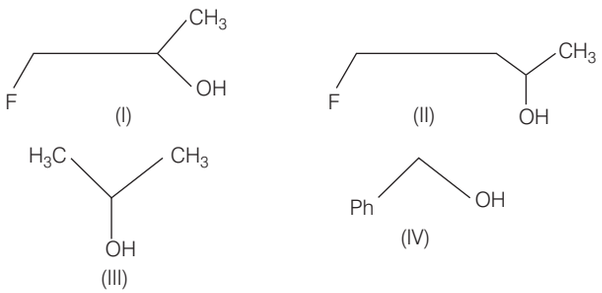
8 Which one/ones of the following reactions will give 2-propanal? Choose the right answer form (a), (b) and (c) and (d).



(a) I and II (b) II and III

(c) III and I (d) II and IV

9 The order of reactivity of the following al whorls:



Towards conc. HCl is

(a) I > II > III > IV (b) IV > III > II > I

(c) I > III > IV > II (d) IV > I > II > III

10 **Assertion (A)** Isotonic solutions do not show the phenomenon of osmosis.

Reason (R) Isotonic solutions have different osmotic pressure.

In the light of the above statements, choose the most appropriate answer from the options given below.

(a) (A) is false but (R) is true

(b) (A) is true but (R) is false

(c) Both (A) and (R) are true and (R) is the correct explanation of (A).

(d) Both (A) and (R) are true but (R) is not the correct explanation of (A).

11 **Statement I** All amino acids exist as *Zwitter* ions.

Statement II Amino acids have both —NH_2 and —COOH group.

In the light of the above statements, choose the most appropriate answer from the options given below.

(a) Statement I is false but statement II is true.

(b) Statement I is true but statement II is false.

(c) Both statement I and statement II are false.

(d) Both statement I and statement II are true.

12 For the reaction $2Fe^{3+} + Fe \longrightarrow 3Fe^{2+}$, $E° = 1.21$ V, hence

(a) the reaction occurs even in the absence of a second half-cell or a current

(b) in a complete cell, Fe is anode but Pt is the cathode

(c) Fe cannot be used as cathode, because it would directly react with Fe^{3+}, thus short-circuiting the cell

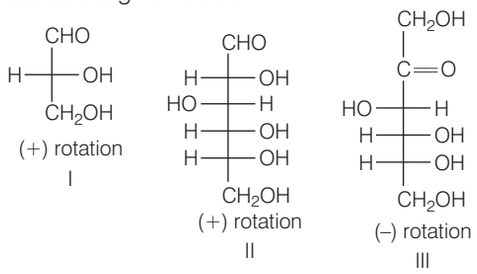
(d) All of the above

13 Reduction of a metal oxide by excess carbon at high temperature is a method for the commercial preparation of some metals. This method can be successfully applied in the case of

(a) BeO and Al_2O_3 (b) ZnO and Fe_2O_3

(c) CaO and Cr_2O_3 (d) BaO and U_3O_8

14 Optical rotations of some compounds along with their structures are given below:



Which of them have D-configuration?

(a) I, II and III (b) II and III

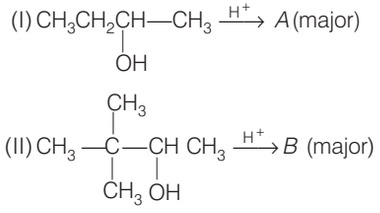
(c) I and II (d) Only III

15 Following is the concentration cell in which electrode is reversible with respect to anion

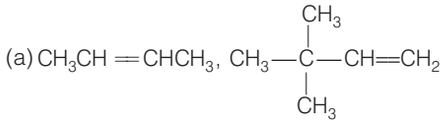
The cell reaction is spontaneous, if

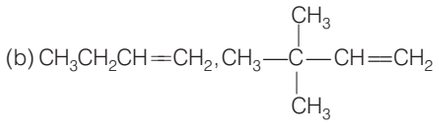
(a) $C_1 > C_2$ (b) $C_1 < C_2$ (c) $C_1 = C_2$ (d) $C_1 = 0$

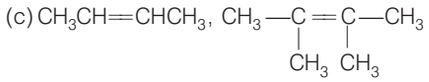
16 Consider the following reactions,

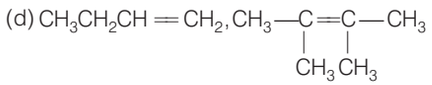


A and *B* are respectively

(a) $CH_3CH=CHCH_3$, 

(b) $CH_3CH_2CH=CH_2$, 

(c) $CH_3CH=CHCH_3$, 

(d) $CH_3CH_2CH=CH_2$, 

17 The correct name for the complex compound $[Cr(PPh_3)(CO)_5]$ is

(a) pentaphenylpentacarbonylchromium (o)

(b) pentacarbonyltriphenylphosphinechromium (o)

(c) triphenylpentacarbonylphosphinechromium (o)

(d) None of the above

18 A laboratory reagent imparts green colour to the flame. On heating with solid $K_2Cr_2O_7$ and conc. H_2SO_4 it evolves an orange red gas. Identify the reagent.

(a) $CaCl_2$ (b) $BaCl_2$

(c) $CuCl_2$ (d) None of these

19 van't Hoff factors are x, y and z in case of association, ionisation and no change, respectively. Their increasing order is

(a) $x < y < z$

(b) $x = y = z$

(c) $y < x < z$

(d) $x < z < y$

20 Which of the following does not illustrate the anomalous properties of Li?

(a) The melting point and boiling point of Li are comparatively high

(b) Li forms a nitride Li_3N unlike group I metals

(c) Li is much softer than the other group I metals

(d) $LiNO_3$ on decomposition produces its oxide unlike group I metals

Section B : Numerical Type Questions

21 If for a reaction $A \longrightarrow B$, $\Delta H = -10$ kJ mol^{-1} and $E_a = 50$ kJ mol^{-1}, the energy of activation for reaction $B \longrightarrow A$ is …… kJ mol^{-1}.

22 Relative lowering of vapour pressure of an aqueous glucose dilute solution is found to be 0.018. Hence, elevation in boiling point is …
(Given, that 1 molal aqueous urea solution boils at 100.54°C at 1 atm pressure)

23 For the following cell reaction,

$Pb(s) + Hg_2SO_4(s) \rightleftharpoons PbSO_4(s) + 2Hg(l)$;
$E^\circ_{cell} = 0.92$ V

$K_{sp}(PbSO_4) = 2 \times 10^{-8}$, $K_{sp}(Hg_2SO_4) = 1 \times 10^{-6}$

Hence, E_{cell} is …… V.

24 16 g of an ideal gas SO_x occupies 5.6 L at STP. The value of x for this gas is

25 One gram of hydrogen and 112 g of nitrogen are enclosed in two separate containers each of volume 5 L at 27°C. If the pressure of hydrogen is 1 atm, the pressure of nitrogen is …… atm.

26 Elevation in boiling point of an aqueous urea solution is 0.52° ($K_b = 0.52°\,mol^{-1}$ kg). Hence, mole fraction of urea in this solution is

27 A 100 mL sample is removed from water solution saturated with $CaSO_4$ at 25°C. The water is completely evaporated from the sample and a deposit of 0.24 g $CaSO_4$ is obtained. The K_{sp} of $CaSO_4$ at 25°C is ……$\times 10^4$.

28 A buffer solution contains 100 mL of 0.01 M CH_3COOH and 200 mL of 0.02 M CH_3COONa. 700 mL of water is added to this solution. The pH before and after dilution are …… ($pK_a = 4.74$)

29 When FeS_2 is burnt in air, it converts to Fe_2O_3. The change in percentage by weight of iron in the process is …… % increase (Fe = 56).

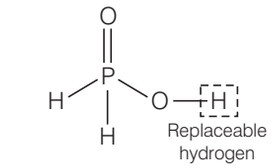
30 pK_a of a weak acid (HA) and pK_b of a weak base (BOH) are 3.2 and 3.4, respectively. The pH of their salt (AB) solution is …… .

ANSWERS

1 (c)	**2** (d)	**3** (d)	**4** (a)	**5** (c)	**6** (c)	**7** (b)	**8** (a)	**9** (b)	**10** (a)
11 (a)	**12** (d)	**13** (b)	**14** (a)	**15** (a)	**16** (c)	**17** (b)	**18** (b)	**19** (d)	**20** (c)
21 (60)	**22** (0.54)	**23** (0.95)	**24** (2)	**25** (8)	**26** (0.018)	**27** (3.115)	**28** (5.34, 5.34)	**29** (23)	**30** (6.9)

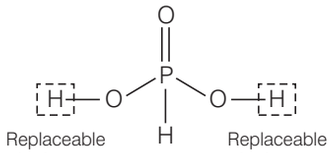
Hints and Explanations

1 I.



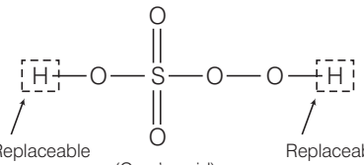
(Hypophosphorous acid)
(monobasic acid)

II.



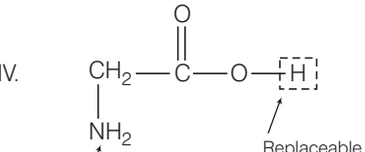
(Orthophosphorous acid)
(dibasic acid)

III.



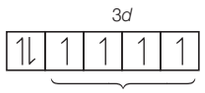
(Caro's acid)
(dibasic acid)

IV.

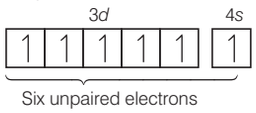


(Glycine) (amphoteric)

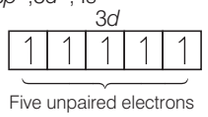
2 Fe (26) = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^6, 4s^2$



Cr (24) = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$



Mn (25) = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^2$



Magnetic moment $(\mu) = \sqrt{n(n+2)}$

where, n = number of unpaired electrons.

Greater the number of unpaired electrons, greater will be the magnetic moment.

Thus, the correct order is $x > y > z$

3 **Correct Assertion** Aldehydes but not ketones react with Tollens' reagent to form silver mirror.

Correct Reason Aldehyde contains a hydrogen attached to carboxyl group while ketone does not.

4 $HCOOCH(CH_3)_2 \xrightarrow{NaAlH_4} HCHO + (CH_3)_2CHOH.$

5 A → 1, B → 2, C → 3, D → 4

6 The electron releasing inductive effect of —OH group decreases the electron density on nitrogen, thus lowers the basicity of amines. This effect diminishes with distance from the amino group. Thus,

ethylamine > 3-amino-1-propanol > 2-amino ethanol.

7 $CH_3—\underset{\underset{Br}{|}}{CH}—CH_3 \xrightarrow{Alc.\,KOH} CH_3CH=CH_2 \xrightarrow[Peroxide]{HBr}$

$CH_3CH_2—CH_2 \xrightarrow{CH_3ONa} \underset{\text{1-methoxy propane}}{CH_3CH_2CH_2OCH_3}$

8 (I) $CH_2=CH—CH_3 \xrightarrow[H^+]{H_2O} CH_3—\underset{\underset{OH}{|}}{CH}—OCH_3$

(II)

$CH_3CHO \xrightarrow{(i)\,CH_3MgI} CH_3CH\begin{matrix}OMgBr\\ CH_3\end{matrix} \xrightarrow{H_2O} CH_3\underset{\underset{OH}{|}}{CH}—CH_3$

9. The order of reactivity depends upon the stability of carbocations formed. The relative stability of the carbocations follows the order:

$Ph\overset{+}{C}H_2 > CH_2\overset{+}{C}HCH_3 > FCH_2CH_2\overset{+}{C}HCH_3 > FCH_2\overset{+}{C}HCH_3.$

Therefore, the order of reactivity of corresponding alcohols follows the order: IV > III > II > I

10 Isotonic solutions are those solutions which have same osmotic pressure. They do not show the phenomenon of osmosis.

11 All amino acids have amino as well as carboxylic group, —NH_2 group is basic while —COOH group is acidic. Hence, they behave as *Zwitter* ion (dipolar ion).

12 $E°$ is positive, thus the reaction occurs even in the absence of half-cell. At anode, oxidation takes place. Thus, all are correct.

13 Least active metals have the most positive standard reduction potentials and are the easiest to reduce, e.g.

$Fe_2O_3 + 3C \xrightarrow{\text{Blast furnace}} 2Fe + 3CO$

$ZnO + C \xrightarrow{1200°C} Zn + CO$

$PbO + C \longrightarrow Pb + CO$

14 In all the given three structures, configuration of OH at C, is towards right, hence all structures possess D-configuration.

15 $Pt(Cl_2)\,|\,Cl^-(C_1)\,||\,Cl^-(C_2)\,|\,Pt(Cl_2)$

1 atm 1 atm

$$E_{cell} = \frac{0.0591}{1} \log \frac{C_1}{C_2}$$

Thus, cell reaction is spontaneous when $C_1 > C_2$.

16 I. $CH_3CH_2\underset{OH}{\underset{|}{CH}}—CH_3 \xrightarrow{H^+} CH_3CH=\underset{A}{CH}—CH_3$

This is according to Saytzeff's rule.

II. $CH_3—\underset{CH_3}{\underset{|}{C}}(CH_3)—\underset{CH_3OH}{\underset{|}{CH}}—CH_3 \xrightarrow[-H_2O]{H^+} CH_3—\underset{CH_3}{\underset{|}{C}}(\oplus)—CHCH_3 \xrightarrow{\text{Methyl}} CH_3—\underset{\oplus}{C}(CH_3)—C(CH_3)(H)—CH_3 \longrightarrow \underset{B}{CH_3—C(CH_3)=C(CH_3)—CH_3}$

17 The correct name for the given complex compound is pentacarbonyltriphenylphosphinechromium.

18 Ba^{2+} ion imparts green colour to the flame and Cl^- ion forms chromyl chloride (which is orange red in colour) when treated with $K_2Cr_2O_7$ and conc. H_2SO_4. Thus, the reagent is

$$Ba^{2+} + 2Cl^- \longrightarrow BaCl_2$$

$$2BaCl_2 + K_2Cr_2O_7 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2BaSO_4 + \underset{\text{Chromyl chloride (orange red gas)}}{2CrO_2Cl_2\uparrow} + 3H_2O$$

19 In case of ionisation $i > 1$

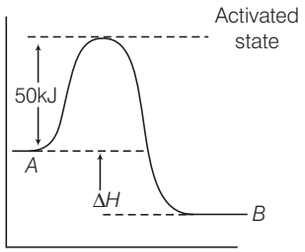
For no change $i = 0$

For association $i < 1$

Thus, ionisation > no change > association

20 In group I all the metals are soft because of weak metallic bonding and this softness increases down the group.

21 $\Delta H\ (A \rightarrow B) = -10$ kJ/mol, i.e. it is an exothermic reaction.



$\therefore$ $\Delta H\ (B \rightarrow A) = 10$ kJ/mol

$E_a\ (A \rightarrow$ activated state$) = 50$ kJ/mol

$\therefore$ $E_a\ (B \rightarrow$ activated state$) = 50 + 10 = 60$ kJ/mol

22 ΔT_b for urea solution $= 0.54° = K_b \times$ molality

$$K_b = \frac{0.54°}{1} = 0.54°\ \text{kg mol}^{-1}$$

$$\frac{\Delta p}{p°} = \frac{w_2 m_1}{mw} \Rightarrow \frac{w_2}{m_2 w_1} = \frac{\Delta p}{p° m_1} = \frac{0.018}{18}$$

$$\Delta T_b\ (\text{glucose}) = \frac{1000 K_b w_2}{m_2 w_1} = \frac{1000 \times 0.54 \times 0.018}{18} = 0.54°$$

23 $Q = \dfrac{[Pb^{2+}]}{[Hg_2^{2+}]} = \dfrac{\sqrt{K_{sp}\ (PbSO_4)}}{\sqrt{K_{sp}(Hg_2SO_4)}} = \dfrac{\sqrt{2\times 10^{-8}}}{\sqrt{1\times 10^{-6}}} = \sqrt{2\times 10^{-2}} = 0.14$

$$E_{cell} = E°_{cell} - \frac{0.059}{2}\log 0.14 = 0.92 - 0.0295 \log 0.14$$

$$= 0.95\ \text{V}$$

24 1 mole of the gas at STP = 22.4 L

5.6 L at STP = 16 g

Hence, 22.4 L at STP $= \dfrac{16 \times 22.4}{5.6} = 64$ g

Thus, molecular mass of gas = 64 g

Given, gas is SO_x. $32 + 16x = 64$ or $x = 2$

Thus, gas is SO_2.

25 Number of moles of hydrogen $(n_{H_2}) = \dfrac{1}{2}$ mol

Number of moles of nitrogen $(n_{N_2}) = \dfrac{112}{28} = 4$ mol

$$\frac{p_{H_2}V}{p_{N_2}V} = \frac{n_{H_2}RT}{n_{N_2}RT} \Rightarrow \frac{1}{p_{N_2}} = \frac{1}{2\times 4} \Rightarrow p_{N_2} = 8\ \text{atm}$$

26 $\Delta T_b = m \times K_b \Rightarrow 0.52 = m \times 0.52$

Molality $(m) = 1$ mol kg^{-1}

Moles of urea = 1

Moles of $H_2O = \dfrac{1000}{18} = 55.55 \Rightarrow X_{urea} = \dfrac{1}{56.5} = 0.018$

27 100 mL of saturated $CaSO_4$ solution has 0.24 g of $CaSO_4$.

Thus, solubility of $CaSO_4 = 2.4$ gL^{-1}

$$= \frac{2.4}{136}\ \text{mol L}^{-1} = 0.01765$$

$$K_{sp} = S^2 = (0.01765)^2 = 3.115 \times 10^{-4}$$

28 pH (before dilution) $= pK_a + \log\dfrac{[\text{salt}]}{[\text{acid}]} = 4.74 + \log\dfrac{200\times 0.02}{100\times 0.01}$

$$= 4.74 + \log 4 = 5.34$$

Dilution has no effect on pH of buffer solution, hence pH after dilution = 5.34

29 $FeS_2 + O_2 \longrightarrow Fe_2O_3 + SO_2$

For FeS_2, Molecular weight $= 56 + 32\times 2 = 120$

$\therefore$% of Fe $\dfrac{56}{120}\times 100 = 46.67\%$

For Fe_2O_3, Molecular weight $= 56\times 2 + 3\times 16 = 160$

$\therefore$ % of Fe $= \dfrac{112}{160}\times 100 = 70\%$

Per cent increase $= 70 - 46.67 = 23\%$ (approx.)

30 For a salt of weak acid and weak base,

$$\text{pH} = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$$

Given, $pK_a\ (HA) = 3.2, pK_a(BOH) = 3.4$

$\therefore$ $\text{pH} = 7 + \dfrac{1}{2}(3.2), -\dfrac{1}{2}(3.4)$

$$= 7 + 1.6 - 1.7 = 6.9$$