SOLUTIONS TO IIT–JEE 2004, (SCREENING)

MEMORY BASED QUESTIONS

CHEMISTRY

1. The pair of the compounds in which both the metals are in the highest possible oxidation state is

(a) $[Fe(CN)_6]^{3-}$, $[Co(CN)_6]^{3-}$ (b) CrO_2Cl_2, MnO_4^-

(c) TiO_3, MnO_2 (d) $[Co(CN)_6]^{3-}$,MnO_3

Sol. $\overset{+6}{Cr}O_2Cl_2$, $\overset{+7}{Mn}O_4^-$

∴ **(b)**

2. The acid having O – O bond is

(a) $H_2S_2O_3$ (b) $H_2S_2O_6$

(c) $H_2S_2O_8$ (d) $H_2S_4O_6$

Sol.

(Marshall's Acid)

∴ **(c)**

3. $(NH_4)_2Cr_2O_7$ on heating liberates a gas. The same gas will be obtained by

(a) heating NH_4NO_2 (b) heating NH_4NO_3

(c) treating H_2O_2 with $NaNO_2$ (d) treating Mg_3N_2 with H_2O

Sol. $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2\uparrow + Cr_2O_3 + 4H_2O$

$NH_4NO_2 \xrightarrow{\Delta} N_2\uparrow + 2H_2O$

∴ **(a)**

4. Pb and Sn are extracted from their chief ore by

(a) Carbon reduction and self reduction (b) Self reduction and carbon reduction

(c) Electrolysis and self reduction (d) Self reduction and electrolysis

Sol. $PbS + 2PbO \longrightarrow 3Pb + SO_2\uparrow$

$SnO_2 + C \longrightarrow Sn + CO_2\uparrow$

(Anthracite)

∴ **(b)**

5. Benzamide on reaction with $POCl_3$ gives

(a) Aniline (b) Chlorobenzene

(c) Benzyl amine (d) Benzonitrile

Sol.

∴ **(d)**

6. The major product obtained when Br_2/Fe is treated with

is

(a)

(b)

(c)

(d)

Sol. The phenyl ring having H–N< group is activated while another one is deactivated due to $-\overset{\overset{O}{||}}{C}-$, so electrophilic aromatic bromination will occur at para position with respect to H – N< group in activated ring.

∴ **(a)**

7. The species having tetrahedral shape is

(a) $[PdCl_4]^{2-}$ (b) $[Ni(CN)_4]^{2-}$

(c) $[Pd(CN)_4]^{2-}$ (d) $[NiCl_4]^{2-}$

Sol.

sp^3, Tetrahedral

∴ **(d)**

8. Total number of lone pair of electrons in $XeOF_4$ is

(a) 0 (b) 1

(c) 2 (d) 3

Sol.

Therefore, total number of lone pair of electron on central atom xenon = 1

∴ **(b)**

9. The correct order of reactivity of PhMgBr with

$Ph-\overset{\overset{\large O}{||}}{C}-Ph$ (I) $CH_3-\overset{\overset{\large O}{||}}{C}-H$ (II) $CH_3-\overset{\overset{\large O}{||}}{C}-CH_3$ (III)

is

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

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

Sol. In nucleophilic addition reaction, the carbonyl compound will respond in preference, which is sterically more exposed and electronically have intact positive charge over carbonyl carbon. So reactivity order towards reaction with PhMgBr is (II) > (III) > (I).

∴ **(c)**

10. In the given conformation C_2 is rotated about $C_2 - C_3$ bond anticlockwise by an angle of 120° then the conformation obtained is

(a) Fully eclipsed conformation (b) Partially eclipsed conformation
(c) Gauche conformation (d) Staggered conformation

Sol.

(Gauche conformation)

∴ **(c)**

11. The spin magnetic moment of cobalt in the compound $Hg[Co(SCN)_4]$ is

(a) $\sqrt{3}$ (b) $\sqrt{8}$
(c) $\sqrt{15}$ (d) $\sqrt{24}$

Sol. In this complex Co^{2+} ion have 3 unpaired electrons so spin only magnetic moment will be $\sqrt{3(3+2)}$ i.e. $\sqrt{15}$ BM.

∴ **(c)**

12. A sodium salt on treatment with $MgCl_2$ gives white precipitate only on heating. The anion of the sodium salt is

(a) HCO_3^- (b) CO_3^{2-}
(c) NO_3^- (d) SO_4^{2-}

Sol. $MgCl_2 + 2NaHCO_3 \longrightarrow Mg(HCO_3)_2(aq) + 2NaCl$

$Mg(HCO_3)_2(aq) \xrightarrow{\Delta} MgCO_3\downarrow + H_2O + CO_2\uparrow$
(white ppt.)

∴ **(a)**

13. The product of oxidation of I^- with MnO_4^- in alkaline medium is

(a) IO_3^- (b) I_2
(c) IO^- (d) IO_4^-

Sol. $6MnO_4^- + I^- + 6OH^- \longrightarrow 6MnO_4^{2-} + IO_3^- + 3H_2O$

∴ **(a)**

14. The emf of the cell

$Zn \mid Zn^{2+}$ (0.01 M) $\parallel Fe^{2+}$ (0.001 M) $\mid Fe$

at 298 K is 0.2905 then the value of equilibrium constant for the cell reaction is

(a) $e^{\frac{0.32}{0.0295}}$ (b) $10^{\frac{0.32}{0.0295}}$
(c) $10^{\frac{0.26}{0.0295}}$ (d) $10^{\frac{0.32}{0.0591}}$

Sol. Cell reaction: $Zn + Fe^{2+} \longrightarrow Zn^{2+} + Fe$

$$E = E^\circ - \frac{0.0591}{2}\log\frac{10^{-2}}{10^{-3}}$$

$$E^\circ = 0.2905 + \frac{0.0591}{2} = 0.32$$

$$0.32 = \frac{0.0591}{2}\log K_{eq}$$

$$K_{eq} = 10^{\frac{0.32}{0.0295}}$$

∴ **(b)**

15. The pair of compounds in which both the compounds give positive test with Tollen's reagent is

(a) Glucose and Sucrose (b) Fructose and Sucrose
(c) Acetophenone and Hexanal (d) Glucose and Fructose

Sol. Tollen's reagent oxidizes the compound having aldehyde group like glucose and also oxidizes α–hydroxyketones having $-COCH_2OH$ group as in fructose.

∴ **(d)**

16. According to molecular orbital theory which of the following statement about the magnetic character and bond order is correct regarding O_2^+.

(a) Paramagnetic and Bond order < O_2 (b) Paramagnetic and Bond order > O_2
(c) Diamagnetic and Bond order < O_2 (d) Diamagnetic and Bond order > O_2

Sol. O_2: $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2, \begin{cases}\pi 2p_y^2, \\ \pi 2p_z^2,\end{cases} \begin{cases}\pi^* 2p_y^1 \\ \pi^* 2p_z^1\end{cases}$; Bond order = $\frac{10-6}{2} = 2$

(two unpaired electrons in antibonding molecular orbital)

O_2^+: $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2, \begin{cases}\pi 2p_y^2, \\ \pi 2p_z^2,\end{cases} \begin{cases}\pi^* 2p_y^1 \\ \pi^* 2p_z^0\end{cases}$; Bond order = $\frac{10-5}{2} = 2.5$

(one unpaired electron in antibonding molecular orbital)

∴ **(b)**

17. A weak acid HX has the dissociation constant 1×10^{-5} M. It forms a salt NaX on reaction with alkali. The degree of hydrolysis of 0.1 M solution of NaX is

(a) 0.0001% (b) 0.01%
(c) 0.1% (d) 0.15%

Sol. $X^- + H_2O \rightleftharpoons HX + OH^-$

$$K_h = \frac{10^{-14}}{10^{-5}}$$

$$h = \sqrt{\frac{10^{-14}}{10^{-5} \times 0.1}} = 10^{-4}$$

Percentage hydrolysis = 0.01%

∴ **(b)**

18. The product of acid catalyzed hydration of 2–phenyl propene is

(a) 3–phenyl–2–propanol (b) 1–phenyl–2–propanol

(c) 2–phenyl–2–propanol (d) 2–phenyl–1–propanol

Sol. $CH_3-\overset{\overset{Ph}{|}}{C}=CH_2 \xrightarrow{H_3O^+} CH_3-\underset{\underset{OH}{|}}{\overset{\overset{Ph}{|}}{C}}-CH_3$

∴ **(c)**

19. A 0.004 M solution of Na_2SO_4 is isotonic with a 0.010 M solution of glucose at same temperature. The apparent degree of dissociation of Na_2SO_4 is

(a) 25% (b) 50%

(c) 75% (d) 85%

Sol. $Na_2SO_4 \rightleftharpoons 2Na^+ + SO_4^{2-}$

$(0.004-x)$ $2x$ x

Since both the solutions are isotonic

$0.004 + 2x = 0.01$

∴ $x = 3 \times 10^{-3}$

∴ Percentage dissociation $= \dfrac{3\times10^{-3}}{0.004} \times 100 = 75$

∴ **(c)**

20. Adsorption of gases on solid surface is generally exothermic because

(a) Enthalpy is positive (b) Entropy decreases

(c) Entropy increases (d) Free energy increases

Sol. When a gas is adsorbed on the surface the freedom of movement of its molecules becomes restricted. This causes to decrease in the entropy of the gas after adsorption i.e., ΔS becomes negative.

∴ **(b)**

21. On monochlorination of 2–methyl butane, the total number of chiral compounds is

(a) 2 (b) 4

(c) 6 (d) 8

Sol. The possible monochlorinated products of 2–methyl butane are

(+) and (–) forms

(+) and (–) forms

Therefore, a total of four chiral compounds are obtained.

∴ **(b)**

22. In the compound given below

the correct order of the acidity of the positions (X), (Y) and (Z) is

(a) (Z) > (X) > (Y) (b) (X) > (Y) > (Z)

(c) (X) > (Z) > (Y) (d) (Y) > (X) > (Z)

Sol. Position (X) is obviously most acidic. Position (Y) is comparatively more acidic than that of (Z) due to the presence of electron withdrawing –COOH group in close proximity.

∴ **(b)**

23. The root mean square velocity of one mole of a monoatomic gas having molar mass M is U_{rms}. The relation between the average kinetic energy (E) of the gas and U_{rms} is

(a) $U_{rms} = \sqrt{\frac{3E}{2M}}$ (b) $U_{rms} = \sqrt{\frac{2E}{3M}}$

(c) $U_{rms} = \sqrt{\frac{2E}{M}}$ (d) $U_{rms} = \sqrt{\frac{E}{3M}}$

Sol. The root mean square velocity of one mole of a monoatomic gas is

$$U_{rms} = \sqrt{\frac{3RT}{M}}$$

and average kinetic energy (E) is $\frac{3}{2}RT$. The relation between (E) and U_{rms} is

$$\sqrt{\frac{2E}{M}} = \sqrt{\frac{3RT}{M}}$$

$$U_{rms} = \sqrt{\frac{2E}{M}}$$

∴ **(c)**

24. Two mole of an ideal gas is expanded isothermally and reversibly from 1 litre to 10 litre at 300 K. The enthalpy change (in kJ) for the process is

(a) 11.4 kJ (b) –11.4 kJ

(c) 0 kJ (d) 4.8 kJ

Sol. $\Delta H = nC_p\Delta T$

The process is isothermal therefore $\Delta T = 0$

∴ $\Delta H = 0$

∴ **(c)**

25. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom?

(a) He^+ (n = 2) (b) Li^{2+} (n = 2)

(c) Li^{2+} (n = 3) (d) Be^{3+} (n = 2)

Sol. $r_H = 0.529\frac{n^2}{Z}$ Å

For hydrogen: n = 1 and Z = 1, Therefore $r_H = 0.529$Å

For Be^{3+}: Z = 4 and n = 2. Therefore, $r_{Be^{3+}} = \frac{0.529 \times 2^2}{4} = 0.529$Å

∴ **(d)**

26. Which of the following used for the conversion of 2–hexyne into trans–2–hexane?

(a) $H_2/Pd/BaSO_4$ (b) H_2, PtO_2

(c) $NaBH_4$ (d) $Li–NH_3/C_2H_5OH$`

Sol. The partial reduction of alkynes by active metal in liquid ammonia takes place through trans vinylic anion which ultimately produces trans alkene.

∴ **(d)**

27. The reaction, **X** ⟶ Product follows first order kinetics. In 40 minutes the concentration of **X** changes from 0.1 M to 0.025 M. Then the rate of reaction when concentration of **X** is 0.01 M

(a) 1.73×10^{-4} M min^{-1} (b) 3.47×10^{-5} M min^{-1}

(c) 3.47×10^{-4} M min^{-1} (d) 1.73×10^{-5} M min^{-1}

Sol. From data it is evident that

$t_{1/2} = \frac{40}{2} = 20$ min

The rate of reaction when [X] is 0.01 M = k[X] = $\frac{0.693}{20} \times 0.01 = 3.47 \times 10^{-4}$ M min^{-1}

∴ **(c)**

28. The enthalpy of vapourization of a liquid is 30 kJ mol^{-1} and entropy of vapourization is 75 J mol^{-1} K. The boiling point of the liquid at 1 atm is

(a) 250 K (b) 400 K

(c) 450 K (d) 600 K

Sol. $dS = \frac{dQ_{rev.}}{T}$

$75 = \frac{30 \times 10^3}{T}$

T = 400 K

∴ **(b)**

Note: *All these questions of IIT–JEE Screening 2004 are based on the memory of the select PIE students who appeared in the examination. PIE Education does not take any responsibility for any sort of discrepancy whatsoever.*