

Date: 2nd September 2020 **Time** : 2 : 00 pm - 5 : 00 pm

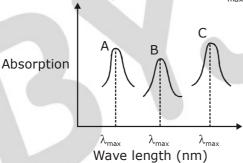
Subject: Chemistry

- 1. Cast iron is used for the manufacture of :
 - (1) Wrought iron and steel (2) Wrought iron and pig iron
 - (3) Wrougth iron, pig iron and steel
- (4) Pig iron, scrap iron and steel

- Sol. Refer topic metallurgy
- The shape/structure of $[XeF_5]^-$ and XeO_3F_2 , respectively, are : 2.
 - (1) Pentagonal planar and trigonal bipyramidal
 - (2) Trigonal bipyramidal and trigonal bipyramidal
 - (3) Octahedral and square pyramidal
 - (4) Trigonal bipyramidal and pentagonal planar
- Sol.

 $5BP + 2LP = 7VSEP \Rightarrow sp^3d^3$ hybridisation [XeF₅] $XeO_{3}F_{2}$ $5BP + 0LP = 5VSEP \Rightarrow sp^3d$ hybridisation

Simplified absorption spectra of three complexes ((i), (ii) and (iii)) of Mn+ ion are pro-3. vided below; their λ_{max} values are marked as A, B and C respectively. The correct match between the complexes and their λ_{max} values is :



- (i) $[M(NCS)_6]^{(-6+n)}$
- (ii) [MF₆]⁽⁻⁶⁺ⁿ⁾ (iii) [M(NH₃)₆]ⁿ⁺
- (1) A-(i), B-(ii), C-(iii)
- (3) A-(ii), B-(iii), C-(i)

- (2) A-(iii), B-(i), C-(ii)
- (4) A-(ii), B-(i), C-(iii)

Sol.

$$\Delta = \frac{hc}{\lambda_{absorbedf(max)}}$$

 $A \rightarrow NH_3 comp (iii)$

 $B \rightarrow NCS comp (i)$

 $C \rightarrow F^- comp (ii)$

using spectrochemical series of ligand

 $F^- < NCS^- < NH_3$ order of $\Delta + e$ crystal field spliting energy

So. NH₃ complex \rightarrow A

F- complex - C

 NCS^- complex $\rightarrow B$



4. The correct observation in the following reactions is:

- (1) Formation of red colour
- (2) Formation of blue colour
- (3) Formation of violet colour
- (4) Gives no colour

Sol.

$$\begin{array}{c} \text{Sucrose} & \xrightarrow{Gly \, cosidic \, bond} & \text{Glu} \, cos \, e + Fructose & \xrightarrow{Seliwanoff's} & \text{Re} \, d \, Colour \\ & \text{Cleavage} \\ & \text{(Hydrolysis)} & \end{array}$$

5. The results given in the below table were obtained during kinetic studies of the following reaction:

2A		В				
<i>/</i> A	+	ъ	\rightarrow		+	
_, \		_	,	\sim		_

21(10/010						
Evporiment	[A]/	[B]/	Initial rate/			
Experiment	molL ^{−1}	molL ⁻¹	molL ⁻¹ min ⁻¹			
I	0.1	0.1	6.00×10^{-3}			
II	0.1	0.2	2.40×10^{-2}			
III	0.2	0.1	1.20×10^{-2}			
IV	Χ	0.2	7.20×10^{-2}			
V	0.3	Υ	2.88×10^{-1}			

X and Y in the given table are respectively:

(1) 0.4, 0.4Sol.

$$2A + B \longrightarrow C + D$$

Exp. (I)
$$6 \times 10^{-3} = K (0.1)^p (0.1)^q$$

(II) $2.4 \times 10^{-2} = K (0.1)^p (0.2)^q$
(III) $1.2 \times 10^{-2} = K (0.2)^p (0.1)^q$

(II)
$$2.4 \times 10^{-2} = K (0.1)^p (0.2)^q$$

(2) 0.3, 0.4

$$\frac{\exp(I)}{\exp(II)} \qquad \frac{1}{4} = \left(\frac{1}{2}\right)^{q} \Rightarrow q = 2$$

$$\frac{\mathsf{Exp.}(\mathsf{I})}{\mathsf{Exp.}(\mathsf{III})} \qquad \frac{1}{2} = \left(\frac{1}{2}\right)^{\mathsf{p}} \Rightarrow \mathsf{p} = 1$$

exp.
$$(I) \div exp (IV)$$

$$\frac{0.6 \times 10^{-2}}{7.2 \times 10^{-2}} = \left(\frac{0.1}{x}\right)^{1} \cdot \left[\frac{0.1}{0.2}\right]^{2}$$

$$\frac{1}{12} = \frac{0.1}{x} - \frac{1}{4}$$

$$[x] = 0.3$$

$$exp(I) \div exp(V)$$

$$\frac{0.6 \times 10^{-2}}{2.88 \times 10^{-1}} = \left(\frac{0.1}{0.3}\right)^{1} \times \left(\frac{0.1}{y}\right)^{2}$$

$$\frac{1}{48} = \frac{1}{3} \times \frac{10^{-2}}{y^2} \Rightarrow y^2 = 0.16$$

$$y = 0.4$$

Ans(2)



6. Match the type of interaction in column A with the distance dependence of their interaction energy in column B:

- (I) ion-ion
- (a)
- (II) dipole-dipole
- (b)
- London dispersion (III)

(d)

- (1) (I)-(a), (II)-(b), (III)-(d)
- (2) (I)-(a), (II)-(b), (III)-(c)
- (3) (I)-(b), (II)-(d), (III)-(c)
- (4) (I)-(a), (II)-(c), (III)-(d)

Sol.

ion - ion
$$\alpha \frac{1}{r}$$

dipole – dipole
$$\alpha \frac{1}{r^3}$$

Londong dispersion $\alpha \frac{1}{r^6}$

7. The major product obtained from E_2 – elimination of 3-bromo-2-fluoropentane is :

$$CH_3CH_2CH=C-F$$

Sol.

8. Consider the reaction sequence given below:

$$\begin{array}{c}
CH_{3} \\
+ HOH + Br^{\ominus}(2)
\end{array}$$

$$\begin{array}{c}
CH_{3} \\
+ CH_{3}
\end{array}$$

$$rate = k[t-BuBr][OH^{\Theta}]$$

Which of the following statements is true:

- (1) Changing the concentration of base will have no effect on reaction (1).
- (2) Doubling the concentration of base will double the rate of both the reactions.
- (3) Changing the base from OH° to ${}^{\circ}OR$ will have no effect on reaction (2).
- (4) Changing the concentration of base will have no effect on reaction (2).



Sol. 1

$$CH_{3} - CH_{3} - C$$

- **9.** The size of a raw mango shrinks to a much smaller size when kept in a concentrated salt solution. Which one of the following process can explain this?
 - (1) Diffusion

(2) Osmosis

(3) Reverse osmosis

(4) Dialysis

Sol. 2

Theoritical Ans. Osmosis Option (2)

- 10. If you spill a chemical toiled cleaning liquid on your hand, your first aid would be :
 - (1) Aqueous NH,

(2) Aqueous NaHCO₃

(3) Aqueous NaOH

(4) Vinegar

Sol. 2

Fact

11. Arrange the followig labelled hydrogens in decreasing order of acidity:

(1) b > a > c > d (3) c > b > d > a (2) b > c > d > a

Sol. 2

Order of acidic strength

COOH COOH OH
$$> \bigcirc > \bigcirc > R - C \equiv CH$$

$$NO_{2}$$

- **12.** An organic compound 'A' $(C_9H_{10}O)$ when treated with conc. HI undergoes cleavage to yield compounds 'B' and 'C'. 'B' gives yellow precipitate with AgNO₃ where as 'C' tautomerizes to 'D'. 'D' gives positive iodoform test. 'A' could be :
 - (1) $\langle \rangle$ $CH_2 O CH = CH_2$
- (3) O-CH₂-CH=CH
- (4) O-CH=CH=CH₃



Sol. 1

- **13**. Two elements A and B have similar chemical properties. They don't form solid hydrogencarbonates, but react with nitrogen to form nitrides. A and B, respectively, are:
 - (1) Na and Ca

(2) Cs and Ba

(3) Na and Rb

(4) Li and Mg

Sol.

LiHCO₃ & Mg(HCO₃)₂ does not exist in solid form but both forms nitrides with nitrogen

- The number of subshells associated with n = 4 and m = -2 quantum numbers is : 14.
- Sol. 3

(3) 2

(4) 16

$$n = 4$$

$$\ell = 0$$

$$\ell = 0$$
 $m = 0$ $\ell = 1$ $m = -1, 0, +1$

$$\ell = 2$$

$$m = -2, +2, -1, +1, 0$$

$$\ell = 3$$

$$m = \pm 3, \pm 2, \pm 1, 0$$

Ans. '2' Subshells

Option (3)

15. The major product of the following reaction is:

$$CH_3$$
 CH_3 $CONC. HNO_3 + CONC. H_2SO_4$ NO_2

$$(1) \begin{array}{c} OH \\ O_2N \end{array}$$

(2)
$$H_3C$$
 NO_2 NO_2

(3)
$$H_3C$$
 NO_2 NO_2



Sol. 3

16. Two compounds A and B with same molecular formula (C_3H_6O) undergo Grignard's reaction with methylmagnesium bromide to give products C and D. Products C and D show following chemical tests.

Test	С	D	
Ceric ammonium nitrate Test	Positive	Positive	
Lucas Test	Turbidity obtained after five minutes	Turbidity obtained immediately	
Iodoform Test	Positive	Negative	

C and D respectively are:

(1)
$$C=H_3C-CH_2-CH_2-CH_2-OH$$
;

$$\begin{array}{c} \mathsf{D}{=}\mathsf{H}_{\scriptscriptstyle{3}}\mathsf{C}{-}\mathsf{C}\mathsf{H}_{\scriptscriptstyle{2}}{-}\mathsf{C}\mathsf{H}{-}\mathsf{C}\mathsf{H}_{\scriptscriptstyle{3}} \\ | \\ \mathsf{O}\mathsf{H} \end{array}$$

(2)
$$C=H_3C-CH_2-CH-CH_3$$
;

(3)
$$C = H_3C - CH_2 - CH_2 - CH_2 - OH$$
;



Sol. 2

$$CH_{3} - CH_{2} - CH - CH_{3} \xrightarrow{\text{Lucas test}} \text{turbidity obtain after 5 min}$$

$$(2^{\circ} - \text{alc}) \xrightarrow{\text{Lucas test}} \text{CHI}_{3}$$

$$CH_{3} - C - OH \xrightarrow{\text{Lucas test}} \text{turbidity obtain immediately}$$

$$CH_{3} - C - OH \xrightarrow{\text{Lucas test}} \text{No reaction}$$

- **17.** Three elements X, Y and Z are in the 3rd peroid of the periodic table. The oxides of X, Y and Z, respectively, are basic, amphoteric and acidic, The correct order of the atomic numbers of X, Y and Z is :
 - (1) X < Y < Z

(2) Y < X < Z

(3) Z < Y < X

(4) X < Z < Y

Sol. 1

- **18.** The one that is not expected to show isomerism is :
 - (1) $[Ni(NH_3)_4(H_2O)_2]^{2+}$
- (2) $[Ni(en)_3]^{2+}$

 $(3) [Pt(NH_3)_2Cl_2]$

 $(4) [Ni(NH_3),Cl_3]$

- Sol. 4
 - [Ni(NH₃)₂Cl₂] Ni²⁺ is sp³ hybridised & such tetrahedral complex does not show either of geometrical or optical isomerism

[Ni(en)₃]²⁺ shows only optical isomers while other three shows geometrical isomerism

- **19.** Amongst the following statements regarding adsorption, those that are valid are:
 - (a) ΔH becomes less negative as adsorption proceeds.
 - (b) On a given adsorbent, ammonia is adsorbed more than nitrogen gas.
 - (c) On adsorption, the residual force acting along the surface of the adsorbent increases
 - (d) With increase in temperature, the equilibrium concentration of adsorbate increases.
 - (1) (b) and (c)

(2) (c) and (d)

(3) (a) and (b)

- (4) (d) and (a)
- **Sol.** Statement 'a' & 'b'
- **20.** The molecular geometry of SF_6 is octahdral. What is the geometry of SF_4 (including lone pair(s) of electrons, if any) ?
 - (1) Pyramidal

(2) Trigonal bipyramidal

(3) Tetrahedral

(4) Square planar

- Sol. 2
 - ${\rm SF_4}$ is ${\rm Sp^3d}$ hybridised in which hybrid orbitals have TBP arrangement but its shape is sea-saw



- **21.** The ratio of the mass percentages of `C & H' and `C & O' of a saturated acyclic organic compound `X' are 4 : 1 and 3 : 4 respectively. Then, the moles of oxygen gas required for complete combustion of two moles of organic compound `X' is ______.
- **Sol.** Mass ratio of C : H is 4 : 1 \Rightarrow 12 : 3 & C : O is 3 : 4 \Rightarrow 12 : 16 So,

mass mole moleratio

Empirical formula \Rightarrow CH₃O as compound is satured a cyclic so, molecular formula is C₂H₆O₂.

$$C_{2}H_{6}O_{2} + \frac{5}{2}O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_{2}O_{(g)}$$

So, required moles of O_2 is $\Rightarrow 5$

22. For the disproportionation reaction $2Cu^+(aq) \rightleftharpoons Cu(s) + Cu^{2+}(aq)$ at K, ln K (where K is the equilibrium constant) is $____ \times 10^{-1}$.

Given:

$$\begin{aligned} &(E_{Cu^{2+}/Cu^{+}}^{0} = 0.16 \text{ V} \\ &E_{Cu^{+}/Cu}^{0} = 0.52 \text{ V} \\ &\frac{\text{RT}}{\text{F}} = 0.025) \end{aligned}$$

Sol. 144

$$2Cu^{+} \rightleftharpoons Cu(s) + Cu^{+2}$$

$$E^{0} = 0.52 - 0.16$$

$$= 0.36$$

$$E^{0} = \frac{RT}{nF} ln (k_{eq})$$

$$ln(k_{eq}) = \frac{0.36}{0.025} \times \frac{1}{1}$$

$$= \frac{360}{25} = 14.4$$

$$= 144 \times 10^{-1}$$
Ans. 144



- **23.** The work function of sodium metal is $4.41 \times 10^{-19} \text{J}$. If photons of wavelength 300 nm are incident on the metal, the kinetic energy of the ejected electrons will be $(h = 6.63 \times 10^{-34} \text{ J s}; c = 3 \times 10^8 \text{ m/s})$ _____ $\times 10^{-21} \text{ J}$.
- Sol. 222

$$\phi = 4.41 \times 10^{-19} \text{ J}$$

$$\lambda = 300 \text{ nm}$$

$$KE_{max} = \frac{hc}{\lambda} - \phi$$

$$= \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{300 \times 10^{-9}} - 4.41 \times 10^{-19}$$

$$= 6.63 \times 10^{-19} - 4.41 \times 10^{-19}$$

$$= 222 \times 10^{-21}$$

- **24.** The oxidation states of transition metal atoms in $K_2Cr_2O_7$, $KMnO_4$ and K_2FeO_4 , respectively, are x, y and z. The sum of x, y and z is ______.
- Sol. 19

Ans. 222

$$\mathsf{K_2} \overset{_{\scriptscriptstyle +6}}{\mathsf{Cr_2}} \mathsf{O_7} \qquad \qquad \mathsf{K} \overset{_{\scriptscriptstyle +7}}{\mathsf{Mn}} \, \mathsf{O_4} \qquad \qquad \mathsf{K_2} [\overset{_{\scriptscriptstyle +6}}{\mathsf{Fe}} \, \mathsf{O_4}]$$

25. The heat of combustion of ethanol into carbon dioxide and water is -327 kcal at constant pressure. The heat evolved (in cal) at constant volume and 27° C (if all gases behave ideally) is (R = 2 cal mol⁻¹ K⁻¹) ______.

Sol.
$$\Delta H_c^0[C_2H_5OH] = -327 \text{ kcal}$$

 $C_2H_5OH(I) + 3O_2(g) \longrightarrow 2CO_2(g) + 3(H_2O)(I)$
 $\Delta E_c^0 = \Delta H_c^0 - \Delta ngRT$
 $= -327 \times 1000 - (-1) \times 2 \times 300$
 $= -327000 + 600$
 $= -326400$