CHEMISTRY
JEE-MAIN (September-Attempt)
2 September (Shift-2) Paper

SECTION - A

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. **1**

Refer topic metallurgy

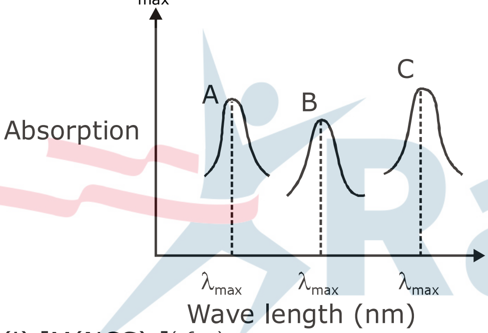
2. The shape/structure of $[XeF_5]^-$ and XeO_3F_2, respectively, are :

(1) Pentagonal planar and trigonal bipyramidal
(2) Trigonal bipyramidal and trigonal bipyramidal
(3) Octahedral and square pyramidal
(4) Trigonal bipyramidal and pentagonal planar

Sol. **1**

$[XeF_5]^-$ 5BP + 2LP = 7VSEP $\Rightarrow$ sp^3d^3 hybridisation
XeO_3F_2 5BP + 0LP = 5VSEP $\Rightarrow$ sp^3d hybridisation

3. Simplified absorption spectra of three complexes ((i), (ii) and (iii)) of M^{n+} ion are provided 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) $[MF_6]^{(-6+n)}$
(iii) $[M(NH_3)_6]^{n+}$

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

Sol. **2**

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

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 Δ+e
crystal field spliting energy
So. NH_3 complex $\rightarrow$ A
F^- complex – C
NCS^- complex $\rightarrow$ B

4. The correct observation in the following reactions is :

$$\text{Sucrose} \xrightarrow[\substack{\text{Cleavage} \\ \text{(Hydrolysis)}}]{\text{Glycosidic bond}} A + B \xrightarrow[\text{reagent}]{\text{Seliwanoff's}} ?$$

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

Sol. **1**

$$\text{Sucrose} \xrightarrow[\substack{\text{Cleavage} \\ \text{(Hydrolysis)}}]{\text{Glycosidic bond}} \text{Glucose} + \text{Fructose} \xrightarrow[\text{reagent}]{\text{Seliwanoff's}} \text{Red Colour}$$

5. The results given in the below table were obtained during kinetic studies of the following reaction :
$2A + B \rightarrow C + D$

Experiment	[A]/ $molL^{-1}$	[B]/ $molL^{-1}$	Initial rate/ $molL^{-1}\ min^{-1}$
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	X	0.2	7.20×10^{-2}
V	0.3	Y	2.88×10^{-1}

X and Y in the given table are respectively :

(1) 0.4, 0.4
(2) 0.3, 0.4
(3) 0.4, 0.3
(4) 0.3, 0.3

Sol. **2**

$2A + B \longrightarrow C + D$

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

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

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

exp. (I) ÷ 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) ÷ 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 :

	A		B
(I)	ion-ion	(a)	$\frac{1}{r}$
(II)	dipole-dipole	(b)	$\frac{1}{r^2}$
(III)	London dispersion	(c)	$\frac{1}{r^3}$
		(d)	$\frac{1}{r^6}$

(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. **4**

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 :

(1) $CH_3CH_2CH=C(CH_3)-F$

(2) $CH_3CH_2-CH(Br)-CH=CH_2$

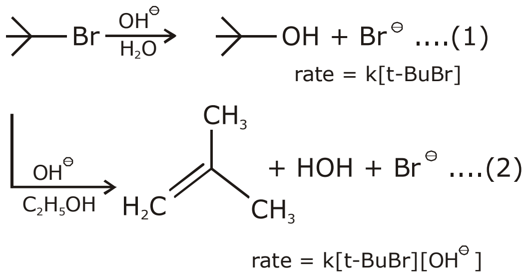
(3) $CH_3-CH_2-C(Br)=C-CH_3$

(4) $CH_3-CH=CH-CH(F)-CH_3$

Sol. **1**

$C-C-C(Br)-C(F)-C \xrightarrow{E_2\text{ 'elin'}} CH_3-CH_2-CH=C(F)-CH_3$

8. Consider the reaction sequence given below :



Which of the following statements is true :

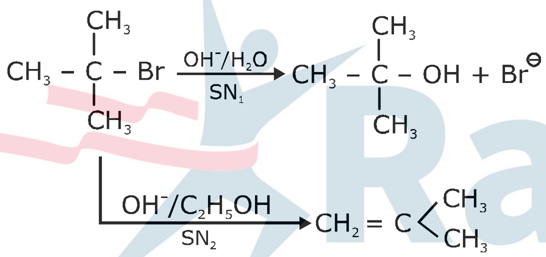
(1) Changing the concentration of base will have no effect on reaction (1).

(2) Doubling the concentration of base will double the rate of both the reactions.

(3) Changing the base from $OH^{\ominus}$ to $^{\ominus}OR$ will have no effect on reaction (2).

(4) Changing the concentration of base will have no effect on reaction (2).

Sol. **1**



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)

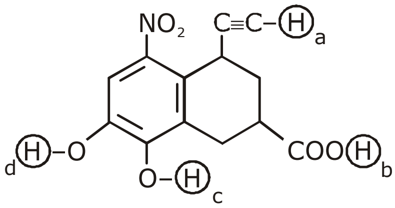
10. If you spill a chemical toiled cleaning liquid on your hand, your first aid would be :

(1) Aqueous NH_3
(2) Aqueous $NaHCO_3$
(3) Aqueous NaOH
(4) Vinegar

Sol. **2**

Fact

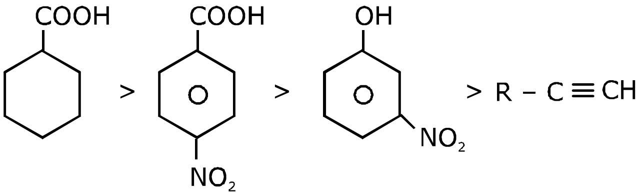
11. Arrange the followig labelled hydrogens in decreasing order of acidity :



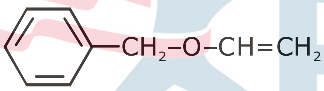
(1) b > a > c > d
(2) b > c > d > a
(3) c > b > d > a
(4) c > b > a > d

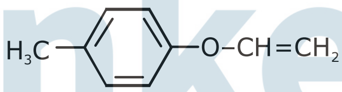
Sol. **2**

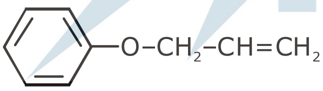
Order of acidic strength

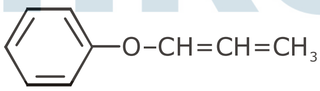


12. An organic compound 'A' ($C_9H_{10}O$) when treated with conc. HI undergoes cleavage to yield compounds 'B' and 'C'. 'B' gives yellow precipitate with $AgNO_3$ where as 'C' tautomerizes to 'D'. 'D' gives positive iodoform test. 'A' could be :

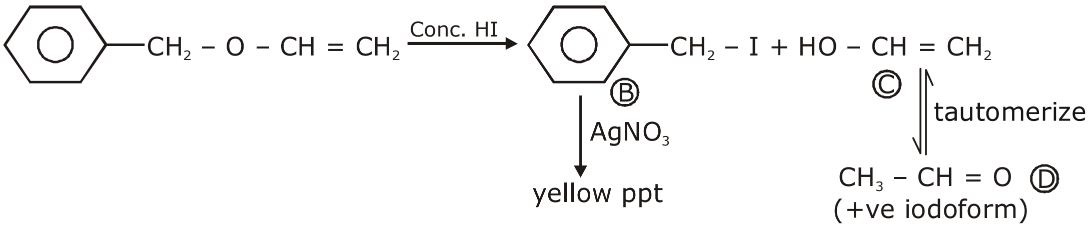
(1) 

(2) 

(3) 

(4) 

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. **4**

$LiHCO_3$ & $Mg(HCO_3)_2$ does not exist in solid form but both forms nitrides with nitrogen gas

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

(1) 4 (2) 8 (3) 2 (4) 16

Sol. **3**

n = 4

$\ell = 0$ m = 0

$\ell = 1$ m = − 1, 0, +1

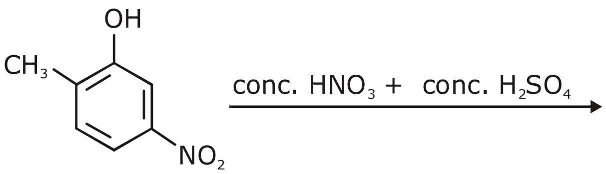
$\ell = 2$ m = − 2, + 2, −1, +1, 0

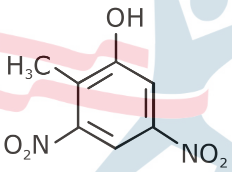
$\ell = 3$ $m = \pm 3, \pm 2, \pm 1, 0$

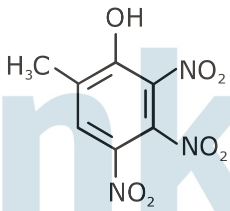
Ans. '2' Subshells

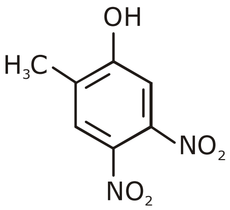
Option (3)

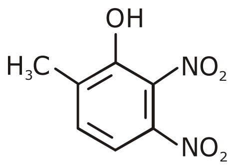
15. The major product of the following reaction is :



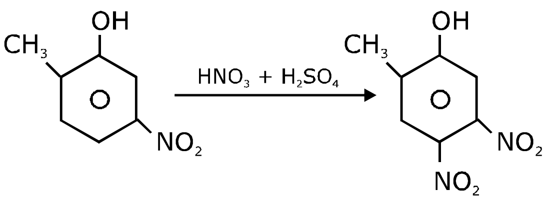
(1)


(2)


(3)


(4)


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

$D = H_3C-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$

(2) $C = H_3C-CH_2-\overset{\overset{OH}{|}}{CH}-CH_3;$

$D = H_3C-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-OH$

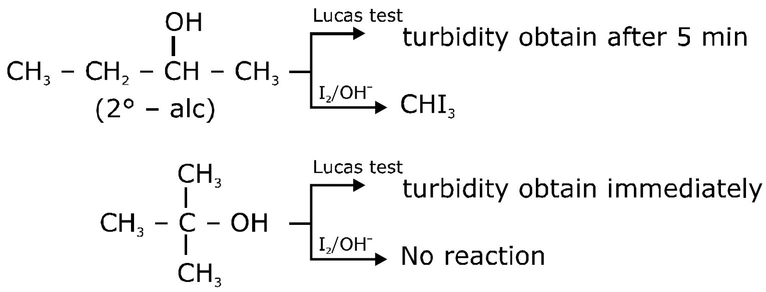
(3) $C = H_3C-CH_2-CH_2-CH_2-OH;$

$D = H_3C-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-OH$

(4) $C = H_3C-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-OH$

$D = H_3C-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$

Sol. 2



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

x	<	y	<	z
Mg		Al		Si
Basic oxide		amphoteric		acidic oxide

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) $[Ni(NH_3)_2Cl_2]$

Sol. 4

$[Ni(NH_3)_2Cl_2]$ Ni^{2+} is sp^3 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

SF_4 is 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	mole ratio
C	12	1	1
H	3	3	3
O	16	1	1

Empirical formula $\Rightarrow CH_3O$

as compound is satured a cyclic so,molecular formula is $C_2H_6O_2$.

$$\underset{2\,\text{mole}}{C_2H_6O_2} + \underset{5\ \text{mole}}{\frac{5}{2}O_{2(g)}} \longrightarrow 2CO_{2(g)} + 3H_2O_{(g)}$$

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 :

$(E^0_{Cu^{2+}/Cu^+} = 0.16\,V$

$E^0_{Cu^+/Cu} = 0.52\,V$

$\frac{RT}{F} = 0.025)$

Sol. **144**

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

$E^o = 0.52 - 0.16$

$= 0.36$

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

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

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

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

Ans. 144

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

Sol. **222**

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

$\lambda = 300$ nm

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

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

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

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

Ans. 222

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**

$K_2\overset{+6}{Cr_2}O_7$ $\quad K\overset{+7}{Mn}O_4$ $\quad K_2[\overset{+6}{Fe}O_4]$

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 27ºC (if all gases behave ideally) is (R = 2 cal $mol^{-1} K^{-1}$) ___________.

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

$$C_2H_5OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 3(H_2O)(l)$$

$\Delta E_c^0 = \Delta H_c^0 - \Delta ngRT$

$= -327 \times 1000 - (-1) \times 2 \times 300$

$= -327000 + 600$

$= -326400$