Mock Board Exam
Chemistry
Solutions

SECTION-A

1. (a) Melting point of corresponding element of second and third transition series are higher as compared to first transition series elements. Also due to half filled stable configuration, melting point of Mn is significantly less than that of Cr.

∴ Correct order of melting point is

W > Mo > Cr > Mn **[1]**

(b)

Element	**Enthalpy atomization of** **[1]**
Cr	397
V	515
Ti	473
Sc	326

(c) On moving left to right in the lanthanoid series, the ionic radii of Ln^{3+} ion decreases because of lanthanoid contraction.

∴ Correct order of ionic radii is

$Lu^{3+} < Er^{3+} < Eu^{3+} < Pm^{3+}$ **[1]**

2. $\wedge^{\circ}_{m}(CH_3COOH) = \lambda^{\circ}_{m}(CH_3COO^-) + \lambda^{\circ}_{m}(H^+)$ **[½]**

$\wedge^{\circ}_{m}(CaCl_2) = \lambda^{\circ}_{m}(Ca^{2+}) + 2\lambda^{\circ}_{m}(Cl^-)$

$\wedge^{\circ}_{m}(HCl) = \lambda^{\circ}_{m}(H^+) + \lambda^{\circ}_{m}(Cl^-)$

$\wedge^{\circ}_{m}\left[(CH_3COO)_2Ca\right] = 2\lambda^{\circ}_{m}(CH_3COO^-) + \lambda^{\circ}_{m}(Ca^{2+})$ **[½]**

$\wedge^{\circ}_{m}(CH_3COOH) = \frac{1}{2}\wedge^{\circ}_{m}\left[(CH_3COO)_2Ca\right] + \wedge^{\circ}_{m}(HCl) - \frac{1}{2}\wedge^{\circ}_{m}(CaCl_2)$ **[½]**

$$= \frac{1}{2}z + y - \frac{1}{2}x$$

$$= \left(\frac{1}{2}(z - x) + y\right) S\ cm^2\ mol^{-1}$$

[½]

3. (a) In Gabriel phthalimide synthesis, phthalimide on treatment with ethanolic potassium hydroxide forms potassium salt of phthalimide which on heating with alkyl halide followed by alkaline hydrolysis produces the corresponding primary amine. Aromatic primary amines cannot be prepared by this method because aryl halides do not undergo nucleophilic substitution with the anion formed by phthalimide. **[1]**

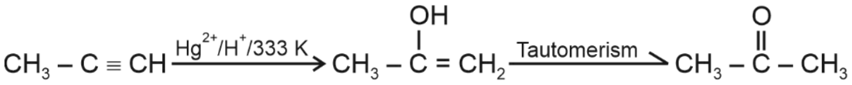
(b) Primary and secondary amines are engaged in intermolecular association due to hydrogen bonding between nitrogen of one and hydrogen of another molecule. This intermolecular association is more in primary amines than in secondary amines as there are 2 hydrogen atoms in primary amines and 1 hydrogen atom in secondary amines which causes hydrogen bonding. Tertiary amines are not involved in intermolecular hydrogen bonding because of the absence of hydrogenation.

∴ Correct order of boiling point of isomeric amines is

Primary > Secondary > Tertiary. **[1]**

SECTION-B

4. (a) Propyne to propan-2-one



$$CH_3-C\equiv CH\xrightarrow{Hg^{2+}/H^{+}/333\ K}CH_3-\underset{}{\overset{OH}{\overset{|}{C}}}=CH_2\xrightarrow{Tautomerism}CH_3-\overset{O}{\overset{\|}{C}}-CH_3$$

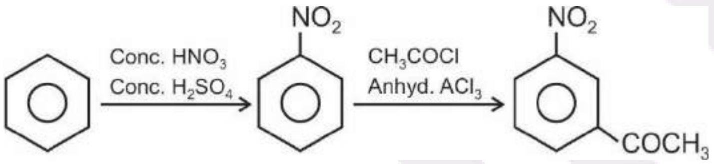
[1]

(b) Chloroethane to propanal

$$H_3C-CH_2-Cl\xrightarrow{KCN}CH_3CH_2CN\xrightarrow{SnCl_2\ +\ HCl}CH_3CH_2-CH=NH\xrightarrow{H_3O^{+}}CH_3CH_2CHO$$

[1]

(c) Benzene to m-nitroacetophenone



[1]

OR

(a) Benzoic acid do not undergo Friedel Crafts reaction because the carboxyl group is deactivating and the catalyst aluminium chloride (Lewis acid) gets bonded to the carboxyl group. **[1]**

(b) $RCOOH + SOCl_2 \rightarrow RCOCl + SO_2\uparrow + HCl\uparrow$

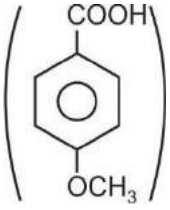
Thionyl chloride is preferred because the other two products are gaseous and escape from the reaction mixture making the purification of the products easier. **[1]**

(c) Electron donating group, decreases the acidic strength.

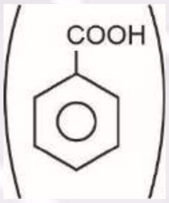
$\therefore$ 4-methoxy benzoic is less acidic than benzoic acid.

Also, as the acidic strength decreases, the pK_a value increases.

$\therefore$ pK_a of 4-methoxy benzoic acid



is greater than that of benzoic acid



[1]

5. (a) Unit of rate constant is $\dfrac{(\text{mol L}^{-1})^{1-n}}{\text{s}}$, where n is order of reaction:

So, unit of rate constant for a second order reactionis $(\text{Mol L}^{-1})^{1-2}\ \text{s}^{-1}$ **[1]**

i.e. $\text{Mol}^{-1}\ \text{L}\ \text{s}^{-1}$

(b) When reaction is 99.9% completed, $[R]_t = [R]_0 - 0.999[R]_0$ **[½]**

So, $k = \dfrac{2.303}{t}\log\dfrac{[R]_0}{[R]_t}$ **[½]**

$$= \frac{2.303}{t}\log\frac{[R]_0}{[R]_0 - 0.999[R]_0}$$

$$= \frac{2.303}{t}\log 10^3$$

$t = \frac{6.909}{k}$ **[½]**

For half life of the reaction,

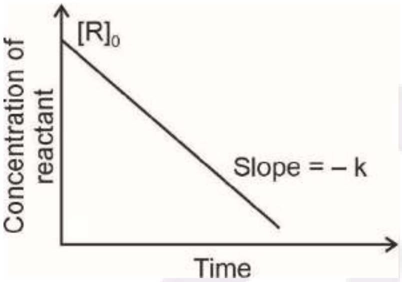
$$t_{\frac{1}{2}} = \frac{6.909}{k}$$

$$\frac{t_{99.9\%}}{t_{\frac{1}{2}}} = \frac{6.909}{k} \times \frac{k}{0.693} = 10$$

[½]

OR

(a) For zero order reaction, $[R] = -kt + [R]_0$



[1]

(b) The reaction is $X \rightarrow Y$

According to rate law,

Rate = $k[X]^2$ **[½]**

If [X] is increased to 3 times, then the new rate is **[½]**

Rate′ = $k[3X]^2$ **[½]**

Rate′ = $9k[X]^2$

= 9 Rate **[½]**

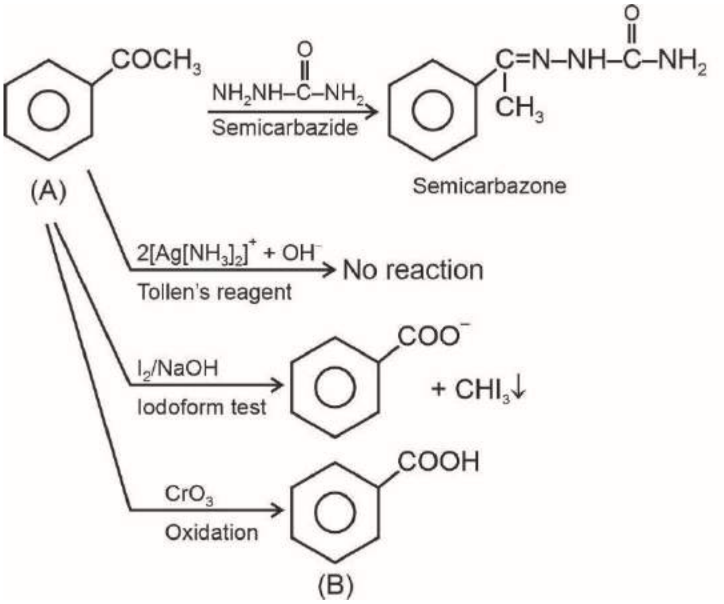
Thus, the rate of reaction becomes 9 times and hence rate of formation of Y increases 9 times.

6. (a) Cr^{2+} is reducing as its configuration changes from $d^4 t_0 d^3$, the latter having a half filled t_{2g} level. On the other hand, the change from Mn^{3+} to Mn^{2+} results in the half filled d^5 configuration which has extra stability. **[1]**

(b) Both fluorine and oxygen have very high electronegativity values. They can oxidise the metals to the highest oxidation state. As a result, the highest oxidation states are shown by fluorides and oxides.

Also, the ability of oxygen to stabilise the higher oxidation states exceeds that of fluorine because of its ability to form multiple bonds with metal. **[1]**

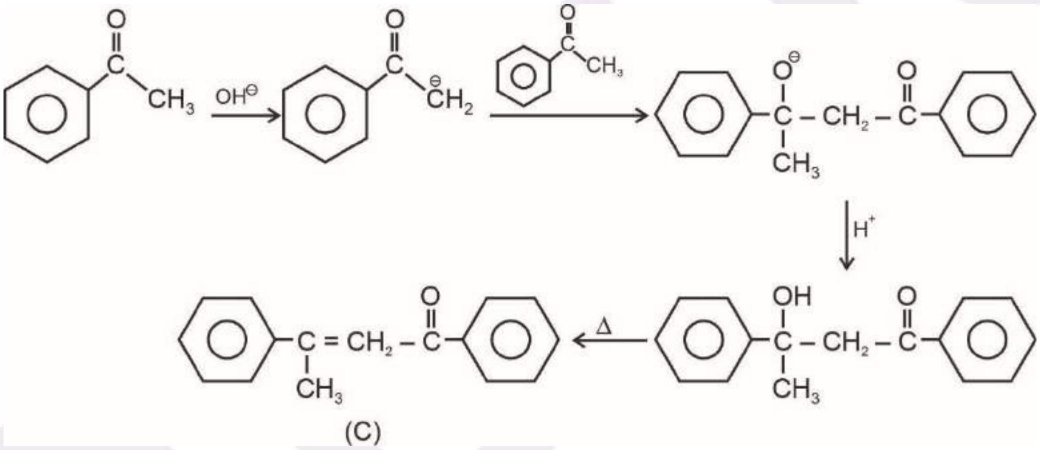
(c) Colour of lanthanoid ion may be attributed to the presence of *f* electrons, neither La^{3+} ion nor Lu^{3+} ion show any colour but the rest do so. **[1]**



[1]

[1]

7.



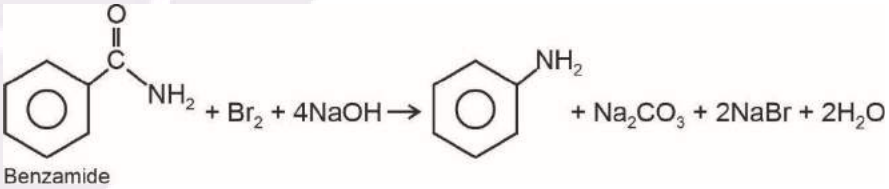
[1]

8. (a) In this figure, Tyndall effect is represented. **[1]**

(b) Tyndall effect is not observed when the diameter of the dispersed particle is smaller than 1 nm as the diameter of colloidal particle ranges from 1 to 1000 nm. **[1]**

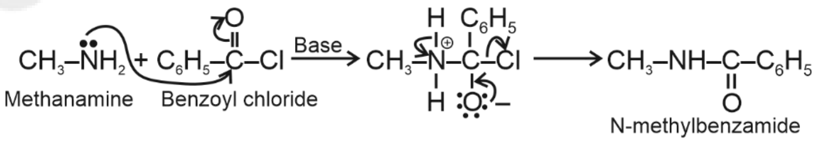
(c) No, Tyndall effect does not depend upon the charge of the colloidal particle. **[1]**

9. (a) When benzamide reacts with bromine in an aqueous or ethanolic solution of sodium hydroxide, aniline is formed.



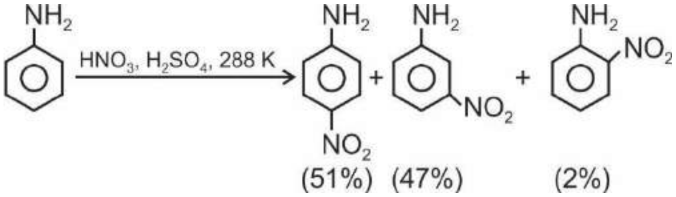
[1]

(b) When methanamine reacts with benzoyl chloride, N-methyl benzamide is formed.



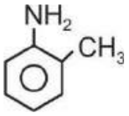
[1]

(c) In strongly acidic medium, aniline is protonated to form the anilinium ion which is meta directing. That is why besides the ortho and para derivatives, significant amount of meta-derivative is also formed.

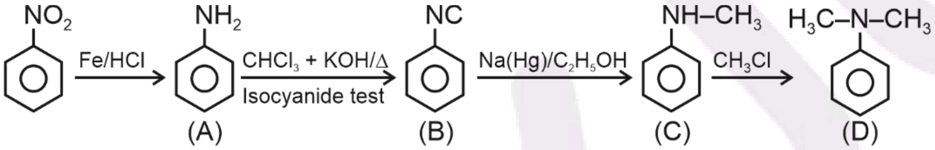


[1]

OR

(a) o-Toluidine is  **[1]**

IUPAC name is 2-Methylaniline

(b)  **[2]**

10. Applying Nernst equation,

$$E_{cell} = E^{\circ}_{cell} - \frac{0.0591}{n}\log\frac{[Ni^{2+}]}{[Ag^{+}]^2}$$ **[½]**

$$= 1.05\text{ V} - \frac{0.0591}{2}\log\frac{0.160}{(0.002)^2}$$ **[½]**

$$= 1.05 - \frac{0.0591}{2}\log(4\times10^4)$$ **[½]**

$$= 1.05 - \frac{0.0591}{2}(4.6021)$$ **[½]**

= 1.05 – 0.14 V **[½]**

= 0.91 V **[½]**

11. (a) The movement of colloidal particles under an applied electric potential is called electrophoresis. **[1]**

(b) In lyophilic sol, if the dispersion medium is separated from the dispersed phase, the sol can be reconstituted by simply remixing with the dispersion medium. That is why these sols are also called reversible sols. **[1]**

(c) For foam, the dispersed phase is gas and the dispersion medium is liquid.

Examples of foam are froth, whipped cream. **[1]**

OR

(a) The minimum concentration of an electrolyte in millimoles per litre required to cause precipitation of a sol in two hours is called coagulating value **[1]**

(b) In the coagulation of a negative sol, the flocculating power is in the order; $Na^+ < Ba^{2+} < Al^{3+}$ **[1]**

(c)

Physisorption	Chemisorption	
(1) It arises because of van der Waals forces	(1) It is caused by chemical bond formation	**[½]**
(2) It is reversible in nature	(2) It is irreversible in nature	**[½]**

SECTION-C

12. (a) $K_3[Cr(C_2O_4)_3]$

Potassium trioxalatochromate(III) **[1]**

(b) $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$

Let the oxidation state of Pt be x

$x + 0 – 1 + 0 – 1 = 0$

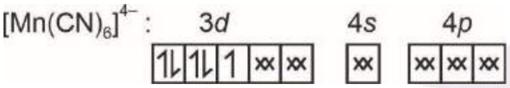
$x – 2 = 0$

$x = 2$ **[1]**

(c) $[Mn(CN)_6]^{4–}$

Mn(25) : $[Ar]4s^2 3d^5$

Mn^{2+} : $[Ar]3d^5 4s^0 4p^0$



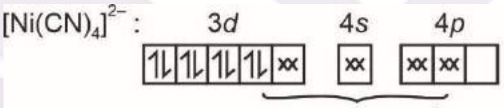
[½]

∵ $CN^–$ is a strong field ligand, ∴ Pairing will take place so, 1 unpaired electron is present. **[½]**

(d) $[Ni(CN)_4]^{2–}$

Ni(28) : $[Ar]4s^2 3d^8$ **[½]**

Ni^{2+} : $[Ar]3d^8$

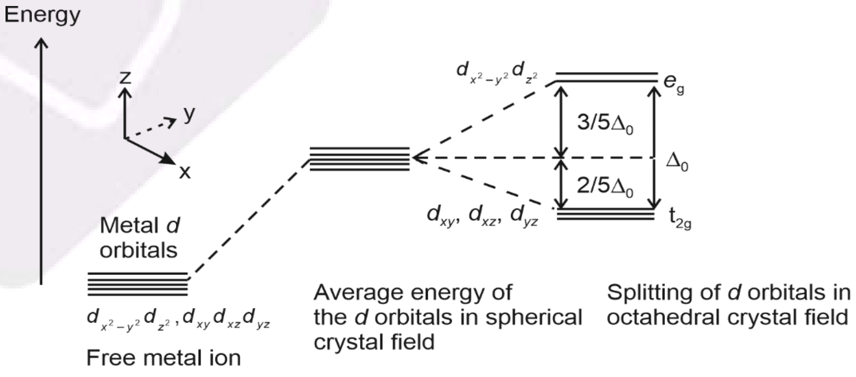


Hybridisation : dsp^2 [½]

Shape : Square planar [½]

[½]

OR



(d) **[2]**

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