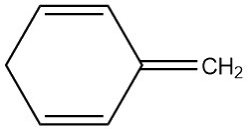
JEE MAIN 16th March Shift-1 2021 (Chemistry)

SECTION-A

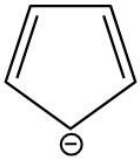
1. Among the following, the aromatic compounds are:

A.



B.

C.



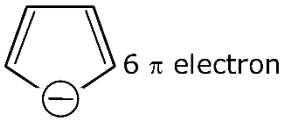
D.

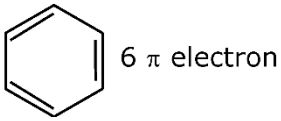
Choose the correct **Ans:** from the following options:

a. (A) and (B) only
b. (A), (B) and (C) only
c. (B), (C) and (D) only
d. (B) and (C) only

Ans: (d)

Solution:





2. Given below are two statements:
   Statement I: H_2O_2 can act as both oxidizing and reducing agent in basic medium.
   Statement II: In the hydrogen economy, the energy is transmitted in the form of dihydrogen.
   In the light of the above statements, choose the correct **Ans:** from the options given below:
   a. Statement I is false but statement II is true
   b. Both Statement I and Statement II are true
   c. Statement I is true but statement II is false
   d. Both Statement I and Statement II are false

   Ans:: (b)
   Solution:
   H_2O_2 can act as oxidizing & reducing agent in both acidic & basic medium.

3. Which of the following is Lindlar catalyst?
   a. Zinc chloride and HCl
   b. Partially deactivated palladised charcoal
   c. Sodium and Liquid NH_3
   d. Cold dilute solution of $KMnO_4$

   Ans:: (b)
   Solution:
   Lindlar's catalyst $\Rightarrow Pd/CaCo_3 + (CH_3COO)_2\,Pb$ + quinoline

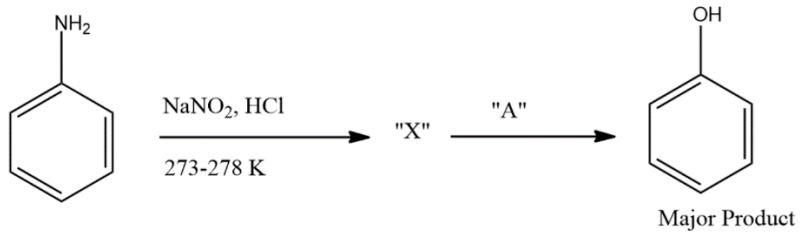
4. In chromatography technique, the purification of compound is independent of:
   a. Length of the column or TLC plate
   b. Mobility or flow of solvent system
   c. Physical state of the pure compound
   d. Solubility of the compound

   Ans:: (c)
   Solution:
   Based on NCERT

5. Which among the following pairs of Vitamins is stored in our body relatively for longer duration?
   a. Ascorbic acid and Vitamin D
   b. Thiamine and Ascorbic acid
   c. Vitamin A and Vitamin D
   d. Thiamine and Vitamin A

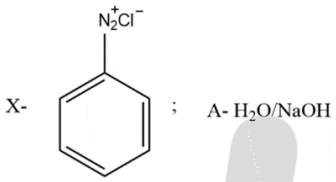
Ans:: (c)
Solution:
Based on NCERT

6.



In the above chemical reaction, intermediate "X" and reagent/condition "A" are:

a.



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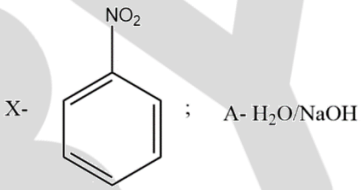
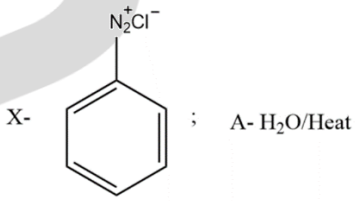
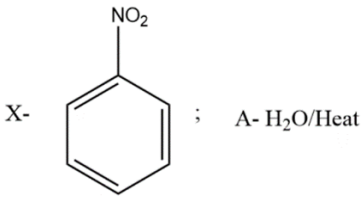


c.

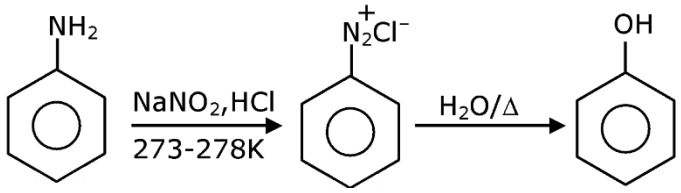


d.



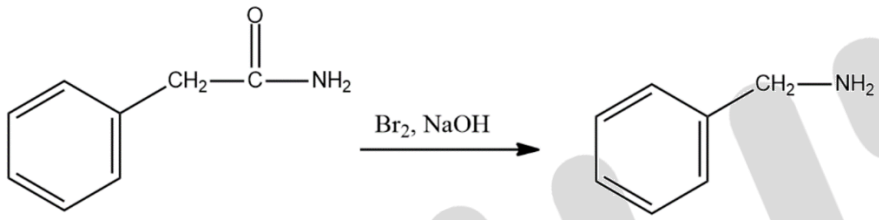
Ans: (c)

Solution:

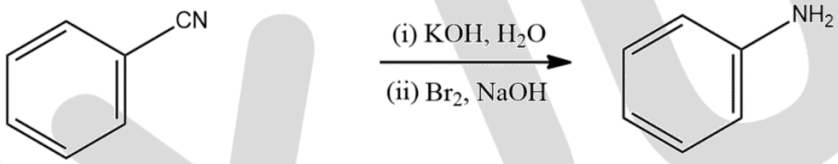


7. Which of the following reaction DOES NOT involve Hoffmann bromamide degradation?

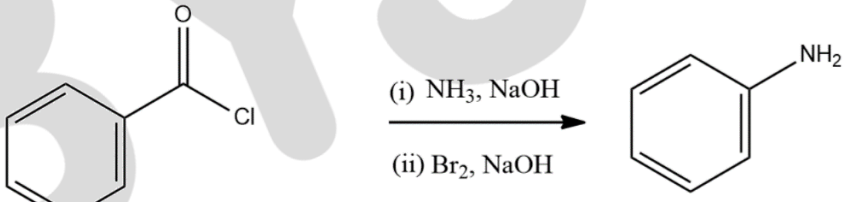
a.



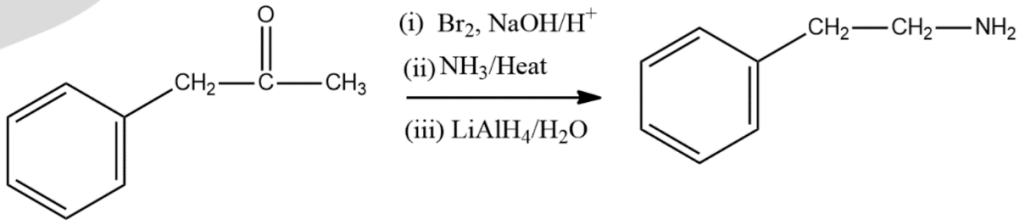
b.



c.



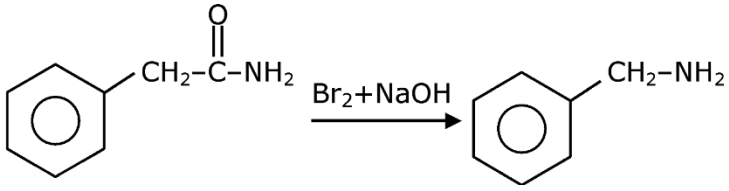
d.



Ans: (d)

Solution:

a.



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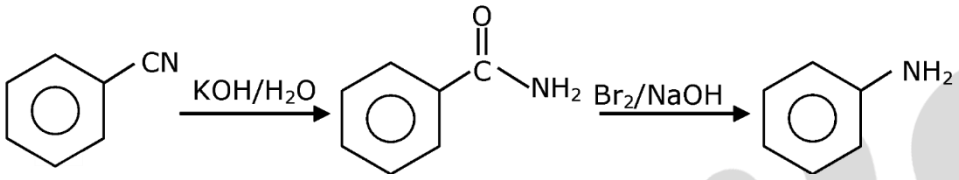
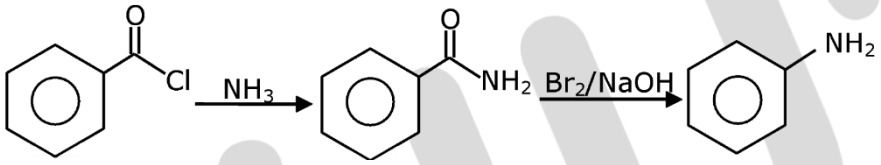
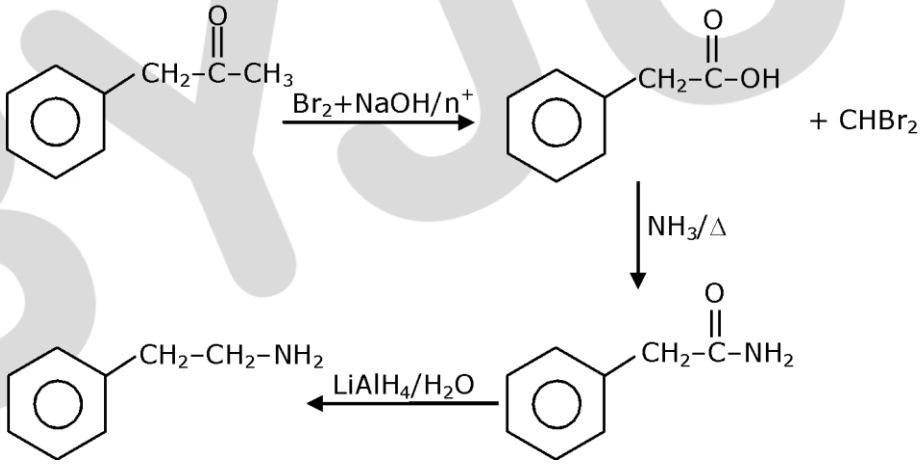


c.



d.



8. A group 15 element, which is a metal and forms a hydride with strongest reducing power among group 15 hydrides. The element is:

a. Bi
b. As
c. P
d. Sb

Ans: (a)

Solution:

BiH_3 is strongest reducing agent among the hydrides of 15 group elements as Bi – H bond dissociation energy is very less.

9. Given below are two statement: One is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: Size of Bk^{3+} ion is less than Np^{3+} ion.

Reason R: The above is a consequence of the lanthanoid contraction.

In the light of the above statements, choose the correct **Ans:** from the options given below:

a. A is false but R is true

b. Both A and R are true but R is not the correct explanation of A

c. A is true but R is false

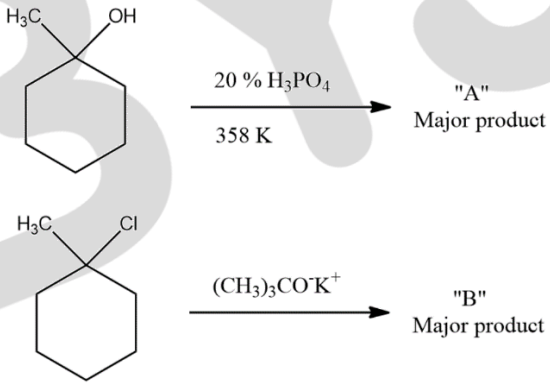
d. Both A and R are true and R is the correct explanation of A

Ans:: (c)

Solution:

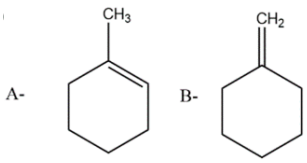
$_{93}Np^{3+}$ $_{97}BK^{3+}$ as atomic no. increase ionic size decreases. It is due to actinoid contraction.

10.

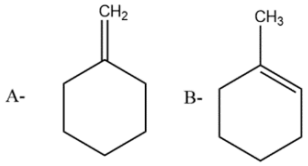


The products "A" and "B" formed in above reactions are:

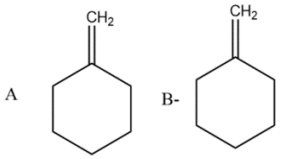
a.



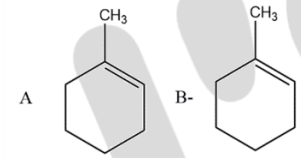
b.



c.

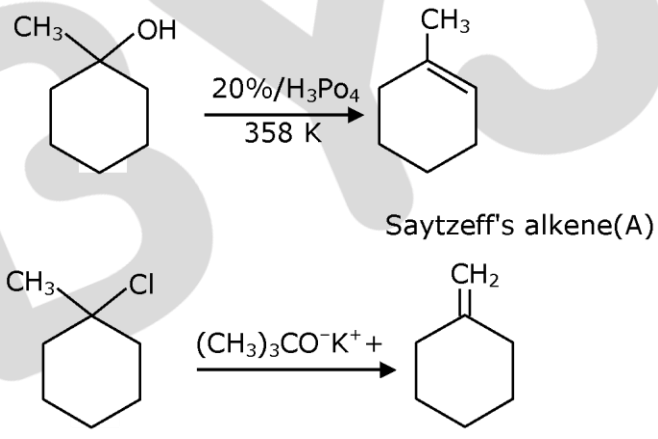


d.



Ans: (a)

Solution



11. The type of pollution that gets increased during the day time and in the presence of O_3 is:

a. Global warming
b. Reducing smog
c. Acid rain
d. Oxidizing smog

Ans: (d)

Solution:

$NO + O_2 \rightarrow NO_2$

$NO + O_3 \rightarrow NO_2 + O_2$

$NO_2 \xrightarrow{hv} NO + [O]$

$O + O_2 \rightarrow O_3$

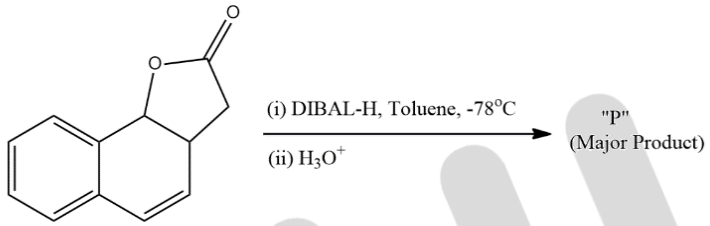
This O_3 is called bad ozone.

$CH_4 + O_2 \rightarrow CH_2 = O + H_2O$

Vehicle

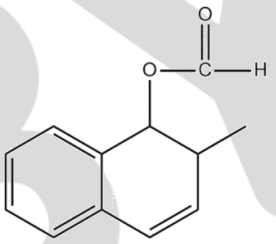
Exhaust

12.

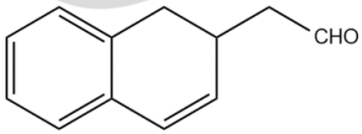


The product "P" in the above reaction is:

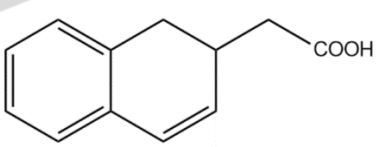
a.



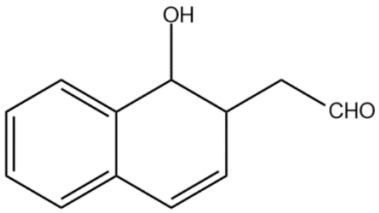
b.



c.

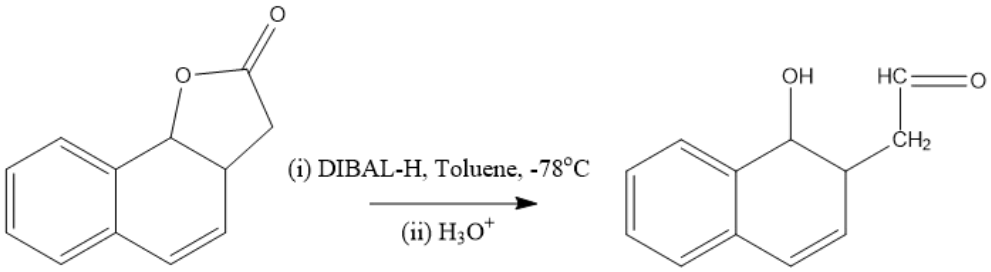


d.



Ans: (d)

Solution:



13. Match List – I with List – II:

	List-I **Industrial process**		**List-II** **Application**
(a)	Haber's process	(i)	HNO_3 synthesis
(b)	Ostwald's process	(ii)	Aluminium extraction
(c)	Contact process	(iii)	NH_3 synthesis
(d)	Hall-Heroult process	(iv)	H_2SO_4 synthesis

Choose the correct **Ans:** from the options given below:

a. (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

b. (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

c. (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

d. (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

Ans: (d)

Solution:

Haber's process is used for NH_3 manufacture.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

Ostwald's process is used for preparation of HNO_3 by catalytic oxidation of NH_3

Contact process is used for preparation of H_2SO_4 using V_2O_5 catalyst

Hall Heroult process is used for Al extraction.

14. Given below are two statements:

Statement I: The E^o value for Ce^{4+}/Ce^{3+} is $+1.74$ V.

Statement II: Ce is more stable in Ce^{4+} state than Ce^{3+} state.

In the light of the above statements, choose the correct **Ans:** from the options given below:

a. Both Statement I and Statement II are correct

b. Statement I is incorrect but statement II is correct

c. Both Statement I and Statement II are incorrect

d. Statement I is correct but statement II is incorrect

Ans: (d)

Solution:

Ce^{4+} is good oxidising agent as Ce^{3+} is more stable

$Ce^{4-} + e^- \rightarrow Ce^{3+}$

$E^o = 1.74$ volt

15. Given below are two statements:

Statement I: Both $CaCl_2.6H_2O$ and $MgCl_2.8H_2O$ undergo dehydration on heating.

Statement II: BeO is amphoteric whereas the oxides of other elements in the same group are acidic.

In the light of the above statements, choose the correct **Ans:** from the options given below:

a. Statement I is true but statement II is false

b. Both Statement I and Statement II are false

c. Statement I is false but statement II is true

d. Both Statement I and Statement II are true

Ans:: (b)

Solution:

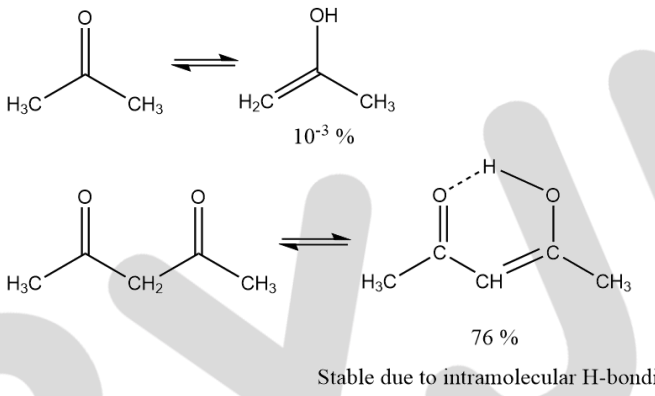
$CaCl_2.6H_2O \xrightarrow{\Delta} CaCl_2 + 6H_2O$

$MgCl_2.6H_2O \longrightarrow MgCl(OH) + HCl + 5H_2O$

Among alkaline earth metal BeO is amphoteric & rest are basic oxide

16. **Assertion A:** Enol form acetone [CH_3COCH_3] exists in <0.1% quantity. However, the enol forms the acetyl acetone [$CH_3COCH_2OCCH_3$] exists in approximately 15% quantity.
Reason R: Enol form of acetyl acetone is stabilized by intramolecular hydrogen bonding, which is not possible in enol form of acetone.
Choose the correct statement:
a. A is true but R is false
b. Both A and R are true but R is the correct explanation of A
c. A is false but R is true
d. Both A and R are true but R is not the correct explanation of A

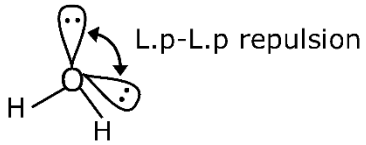
Ans: (b)
Solution:



17. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R
Assertion A: The H–O–H bond angle in water molecule is 104.5°
Reason R: The lone pair – lone pair repulsion of electrons is higher than the bond pair-bond pair repulsion.
In the light of the above statements, choose the correct **Ans:** 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

Ans: (c)

Solution:



2bp & 2-L.P.

In water O atom is sp^3 hybridized with 2 B.P & 2 L.P

18. Match List – I with List – II:

	List-I Name of oxo acid		List-II Oxidation state of 'P'
(a)	Hypophosphorous acid	(i)	+5
(b)	Orthophosphoric acid	(ii)	+4
(c)	Hypophosphoric acid	(iii)	+3
(d)	Orthophosphorous acid	(iv)	+2
		(v)	+1

Choose the correct answer from the options given below:

a. (a)-(iv), (b)-(v), (c)-(ii), (d)-(iii)
b. (a)-(v), (b)-(iv), (c)-(ii), (d)-(iii)
c. (a)-(v), (b)-(i), (c)-(ii), (d)-(iii)
d. (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Ans: (c)

Solution:

	+1
Hypophosphorous acid	H_3PO_2
	+5
Orthophosphoric acid	H_3PO_4
	+4
Hypophosphoric acid	$H_4P_2O_6$
	+3
Orthophosphorous acid	H_3PO_3

19. The process that involves the removal of sulphur from the ores is:
    a. Refining
    b. Roasting
    c. Smelting
    d. Leaching

Ans: (b)
Solution:
Roasting removes S as SO_2
$S + O_2 \longrightarrow SO_2$

20. The functions of antihistamine are:
    a. Antiallergic and Analgesic
    b. Antacid and antiallergic
    c. Antiallergic and antidepressant
    d. Analgesic and antacid

Ans: (b)
Solution:
Based on NCERT

SECTION-B

1. $2MnO_4^- + bC_2O_4^{2-} + cH^+ \rightarrow xMn^{2+} + yCO_2 + zH_2O$

If the above equation is balanced with integer coefficients, the value of c is_____. (Round off to the nearest integer)

Ans: 16
Solution: $16H^+ + 2MnO_4^- + 5C_2O_4^{2-} \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

2. Complete combustion of 750 g of an organic compound provides 420 g of CO_2 and 210 g of H_2O. The percentage composition of carbon and hydrogen in organic compound is 15.3 and _____ respectively. (Round off to the Nearest Integer).

Ans: 3
Solution:
Liebeig method:

$$\% \text{ of H-element} = \frac{2}{18} \times \frac{Mass of H_2O}{Mass of compound} \times 100$$
$$= \frac{2}{18} \times \frac{210}{750} \times 100 = 3.11 \simeq 3$$

3. AB_2 is 10% dissociated in water to A^{2+} and B^-. The boiling point of a 10.0 molal aqueous solution of AB_2 is _____ ^oC. (Round off to the Nearest Integer).
[Given: Molal elevation constant of water $K_b = 0.5$ K kg mol^{-1} boiling point of pure water $= 100^oC$]

Ans:: 106

Solution:

$\Delta T_b = iK_bm$

$\alpha = \frac{i-1}{n-1}$

$0.1 = \frac{i-1}{3-1}$ $\{AB_2 \rightleftharpoons A^{2+} + 2B^-\}$

$i = 1.2$

$\Delta T_b = 1.2 \times 0.5 \times 10 = 6$

$(T_b)_{solution} = 106°C$

4. A certain element crystallizes in a bcc lattice of unit cell edge length 27Å. If the same element under the same conditions crystallises in the fcc lattice, the edge length of the unit cell in Å will be _____. (Round off to the Nearest Integer).
[Assume each lattice point has a single atom]
[Assume $\sqrt{3} = 1.73$, $\sqrt{2} = 1.41$]

Ans:: 33

Solution:

For BCC unit cell, $\sqrt{3}a = 4R$

$a = \frac{4R}{\sqrt{3}} = 27$

$R = \frac{27\sqrt{3}}{4}$

For fcc unit cell

$\sqrt{2}a = 4R$

$a = \frac{4}{\sqrt{2}}\left(\frac{27\sqrt{3}}{4}\right)$

$a = 27\frac{\sqrt{3}}{\sqrt{2}}$

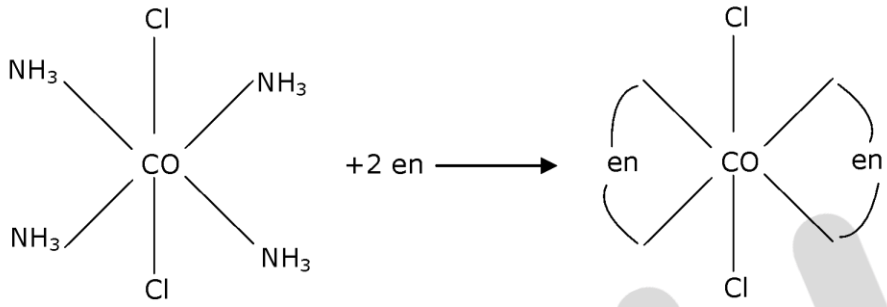
$a = 33.12 \approx 33$

5. The equivalents of ethylene diamine required to replace the neutral ligands from the coordination sphere of the trans-complex of $CoCl_3.4NH_3$ is _____. (Round off to the nearest Integer).

Ans: 2

Solution:

$COCl_3.4NH_3$ or $[CO(NH_3)_4Cl_2]Cl$



Trans-complex

6. For the reaction $A(g) \rightleftharpoons B(g)$ at 495 K, $\Delta_r G^o = -9.478$ kJ $mol^{-(1)}$
If we start the reaction in a closed container at 495 K with 22 millimoles of A, the amount of B in the equilibrium mixture is _____millimoles. (Round off to the nearest Integer).
[R = 8.314] mol^{-1} K^{-1}; ln 10 = 2.303]

Ans:: 20

Solution:

$\Delta G° = -RT \ln Keq$

$-9.478 \times 10^3 = -495 \times 8.314 \ln Keq$

$\ln Keq = 2.303 = \ln 10$

So, Keq = 10

Now,	A(g) ⇌	B(g)
t = 0	22	0
t = t	22–x	x

$Keq = \frac{[B]}{[A]} = \frac{x}{(22-x)} = 10$

x = 20

So, millimoles of B = 20

7. When light of wavelength 248 nm falls on a metal of threshold energy 3.0 eV, the de-Broglie wavelength of emitted electrons is _____Å. (Round off to the Nearest Integer).
[Use :$\sqrt{3} = 1.73$, h = 6.63×10^{-34} Js
$m_e = 9.1\times10^{-31}$ kg; c = $3.0\times10^{8}ms^{-1}$; 1eV = 1.6×10^{-19}J]

Ans: 9

Solution:

$\lambda = 248 \times 10^{-9}m$

$w_0 = 3 \times 1.6 \times 10^{-19}$ J

$E = w_0 + K.E.$

$\frac{hc}{\lambda} = W_0 + K.E.$

$K.E = \frac{6.626\times10^{-34}\times3\times10^{8}}{248\times10^{-19}} - 3 \times 1.6 \times 10^{-19}$

$= 3.2 \times 10^{-19}$J

$P = \sqrt{2mK.E.}$

$P = \sqrt{2 \times 9.1 \times 10^{-31} \times 3.2 \times 10^{-19}}$

$P = 7.63 \times 10^{-25}$

$\therefore \lambda = \frac{h}{p} = \frac{6.626\times10^{-34}}{7.63\times10^{-25}}$

$\lambda = 8.7 \times 10^{-10} = 8.7Å \approx 9$

8. A 6.50 molal solution of KOH (aq.) has a density of 1.89 g cm^{-3}The molarity of the solution is _____ $moldm^{-3}$ (Round off to the Nearest Integer).
[Atomic masses : K : 39.0 u; O: 16.0 u; H: 1.0 u]

Ans: 9

Solution:

$m = \frac{1000\times M}{1000\times d - M\times M_{solute}}$

$6.5 = \frac{1000\times M}{1890 - M\times56}$

$12285 - 364M = 1000M$

$1364\ M = 12285$

$M = 9$

9. Two salts A_2X and MX have the same value of solubility product of 4.0×10^{-12}. The ratio of their molar solubilities i.e. $\frac{S(A_2X)}{S(MX)}$ =_____. (Round off to the Nearest Integer).

Ans: 50

Solution:

$A_2X(s) \rightleftharpoons 2A^+(aq) + X^{2-}(aq)$

Solubility: (x) $\frac{mole}{L}$ (2x) (x)

$\Rightarrow K_{sp} = 4\times10^{-12} = [A^+]^2[X^-] = 4x^3$

$\Rightarrow x = 10^{-4} = S_{A_2X}$

$MX(s) \rightleftharpoons M^+(aq) + X^-(aq)$

Solubility: (y) $\frac{mole}{L}$ (y) (y)

$\Rightarrow K_{sp} = 4\times10^{-12} = [M^+][X^-] = y^2$

$\Rightarrow y = 2\times10^{-6} = S_{MX}$

$\Rightarrow \frac{S_{A_2X}}{S_{MX}} = \frac{10^{-4}}{2\times10^{-6}} = 50$

10. The decomposition of formic acid on gold surface follows first order kinetics. If the rate constant at 300 K is 1.0×10^{-3} s^{-1} and the activation energy $E_a = 11.488$ kJ mol^{-1}, the rate constant at 200 K is _____$\times10^{-5}$ s^{-1}.(Round off to the Nearest Integer).

Ans: 10

Solution:

$$log\frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$log\frac{1.0\times10^{-3}s^{-1}}{K_1} = \frac{11.488\times1000}{2.303\times8.314}\left[\frac{1}{200} - \frac{1}{300}\right]$$

$$log\frac{10^{-3}}{K_1} = 600\times\frac{3-2}{600}$$

$$log\frac{10^{-3}}{K_1} = 1$$

$$\Rightarrow 10 = \frac{10^{-3}}{K_1}$$

$\Rightarrow K_1 = 10^{-4}$

So, $x\times10^{-5} = 10^{-4} \Rightarrow x = 10$

(Given: R = 8.314 J Mol^{-1} K^{-1})