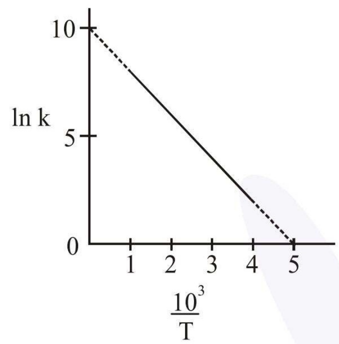
FINAL JEE-MAIN EXAMINATION - SEPTEMBER, 2020
Held On Saturday, 5 September 2020
TIME : 3: 00 PM to 6 : 00 PM

1. The rate constant (k) of a reaction is measured at different temperatures (T), and the data are plotted in the given figure. The activation energy of the reaction in kJ mol^{-1} is :
(R is gas constant)



(1) 2R (2) R
(3) 1/R (4) 2/R

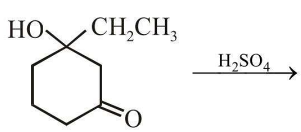
Sol. Official Ans. by NTA (1)

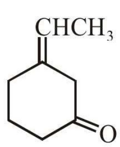
$$\text{Slope} = -\frac{E_a}{R}$$

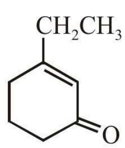
$$-\frac{10}{5} = -\frac{E_a}{R}$$

$E_a = 2R$

2. The major product of the following reaction is:



(1)


(2)


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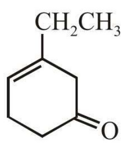

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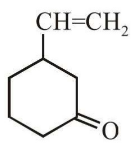
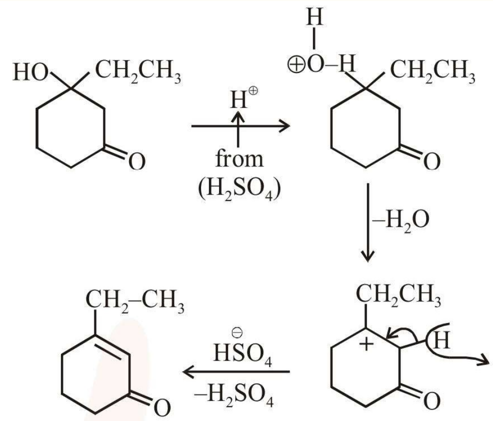
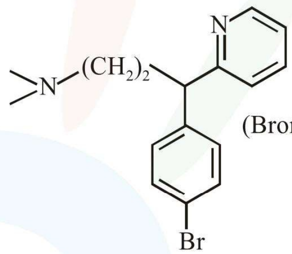


Official Ans. by NTA (2)

Sol.



3. The following molecule acts as an :



(Brompheniramine)

(1) Antiseptic (2) Anti-bacterial
(3) Anti-histamine (4) Anti-depressant

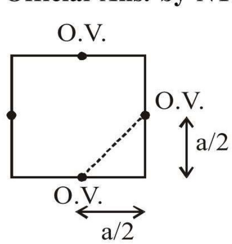
Official Ans. by NTA (3)

4. An element crystallises in a face-centred cubic (fcc) unit cell with cell edge a. The distance between the centres of two nearest octahedral voids in the crystal lattice is

(1) a (2) $\sqrt{2}a$ (3) $\frac{a}{\sqrt{2}}$ (4) $\frac{a}{2}$

Official Ans. by NTA (3)

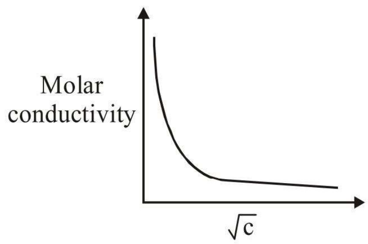
Sol.



distance between nearest octahedral voids(O.V.)

$$= \sqrt{\left(\frac{a}{2}\right)^2 + \left(\frac{a}{2}\right)^2} \Rightarrow = \frac{a}{\sqrt{2}}$$

5. The variation of molar conductivity with concentration of an electrolyte (X) in aqueous solution is shown in the given figure.



The electrolyte X is :

(1) CH_3COOH (2) KNO_3

(3) HCl (4) NaCl

Official Ans. by NTA (1)

Sol. Its a weak electrolyte hence : CH_3COOH

6. The one that is NOT suitable for the removal of permanent hardness of water is :

(1) Treatment with sodium carbonate

(2) Calgon's method

(3) Clark's method

(4) Ion-exchange method

Official Ans. by NTA (3)

Sol. Temporary hardness of water is removed by clark method and boiling. While permanent hardness of water is removed by treatment with sodium carbonate (Na_2CO_3), calgons method and ion-exchange method

7. The correct statement about probability density (except at infinite distance from nucleus) is :

(1) It cn be negative for 2p orbital

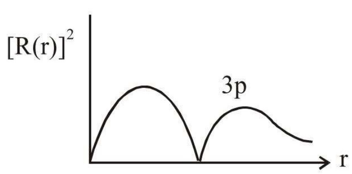
(2) It can be zero for 3p orbital

(3) It can be zero for 1s orbital

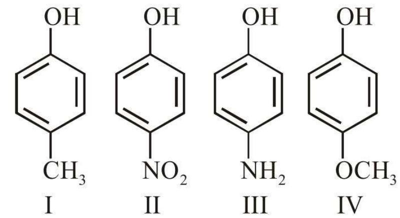
(4) It can never be zero for 2s orbital

Official Ans. by NTA (2)

Sol.



8. The increasing order of boiling points of the following compounds is :



(1) I < IV < III < II

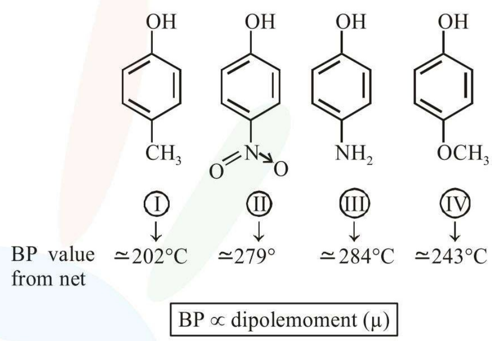
(2) IV < I < II < III

(3) I < III < IV < II

(4) III < I < II < IV

Official Ans. by NTA (1)

Sol.



Alter

Increasing order of boiling point is :

I.

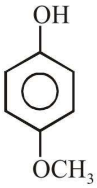
⇒ Shows hydrogen bonding from –O–H group only

II.

⇒ Shows strongest hydrogen bonding from both sides of –OH group as well as $–NO_2$ group.

III.

⇒ Shows stronger hydrogen from both side of –OH group as well as $–NH_2$ group.

IV. 

⇒ Shows stronger hydrogen bonding from one side –OH–group and another side of $–OCH_3$ group shows only dipole-dipole interaction.

⇒ Hence correct order of boiling point is:

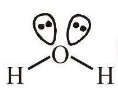
(I) < (IV) < (III) < (II)

9. The compound that has the largest H–M–H bond angle (M=N, O, S, C), is :

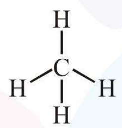
(1) H_2O (2) CH_4

(3) NH_3 (4) H_2S

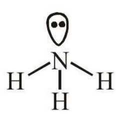
Official Ans. by NTA (2)

Sol. (1) 

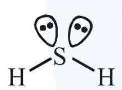
sp^3, 104°5'

(2) 

sp^3, 109°28'

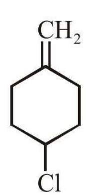
(3) 

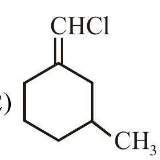
sp^3, 107°

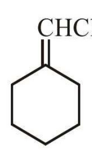
(4) 

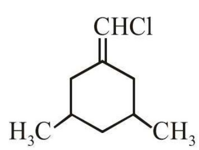
92°

10. Among the following compounds, geometrical isomerism is exhibited by :

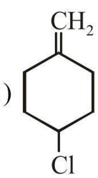
(1) 

(2) 

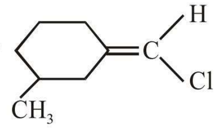
(3) 

(4) 

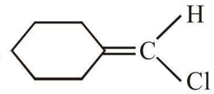
Official Ans. by NTA (2)

Sol. (1) 

Not show GI

(2) 

Show GI

(3) 

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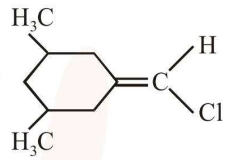
(4) 

Show GI

11. Which one of the following polymers is not obtained by condensation polymerisation?

(1) Buna - N (2) Bakelite

(3) Nylon 6 (4) Nylon 6, 6

Official Ans. by NTA (1)

Sol. BuNa–N is an addition polymer

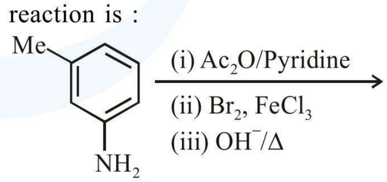
Buta-1, 3-diene + Acrylonitrile

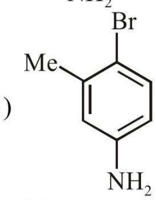
$CH_2=CH–CH=CH_2$ $CH_2=CH–C≡N$

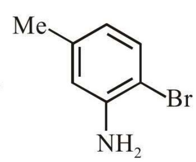
↓ Na

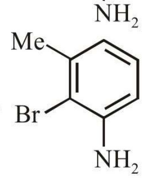
[BuNa-N]

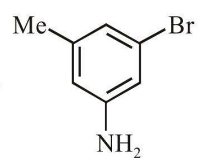
12. The final major product of the following reaction is :



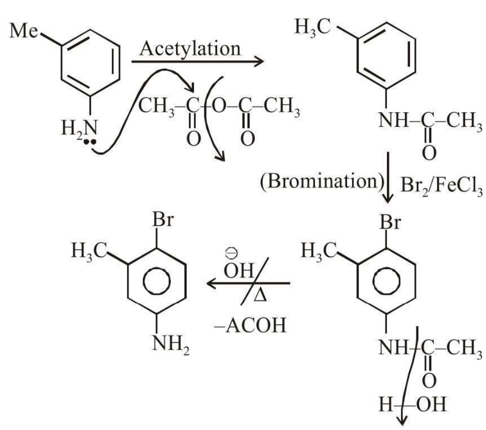
(1) 

(2) 

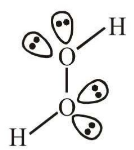
(3) 

(4) 

Official Ans. by NTA (1)

Sol. 

13. Hydrogen peroxide, in the pure state, is :
(1) non-planar and almost colorless
(2) linear and almost colorless
(3) planar and blue in color
(4) linear and blue in color
Official Ans. by NTA (1)

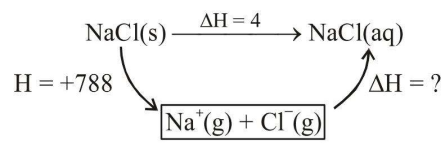
Sol. 

hydrogen peroxide, in the pure state, is non-planar and almost colourless (very pale blue) liquid.

14. Boron and silicon of very high purity can be obtained through :
(1) vapour phase refining
(2) electrolytic refining
(3) liquation
(4) zone refining
Official Ans. by NTA (4)

Sol. "Boron" and "Silicon" of very high purity can be obtained through :-
zone refining method only.
While other methods are used for other metals/ elements i.e.
(i) Vapour phase refining
(ii) electrolytic refining
(iii) liquation etc.

15. Lattice enthalpy and enthalpy of solution of NaCl are 788 kJ mol^{-1} and 4 kJ mol^{-1}, respectively. The hydration enthalpy of NaCl is :
(1) –780 kJ mol^{-1} (2) –784 kJ mol^{-1}
(3) 780 kJ mol^{-1} (4) 784 kJ mol^{-1}
Official Ans. by NTA (2)

Sol. 

$4 = 788 + \Delta H$
$\Delta H = -784$ kJ

16. Reaction of ammonia with excess Cl_2 gives :
(1) NH_4Cl and N_2
(2) NCl_3 and NH_4Cl
(3) NH_4Cl and HCl
(4) NCl_3 and HCl
Official Ans. by NTA (4)

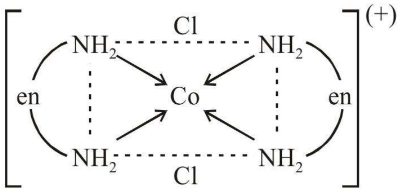
Sol. $NH_3 + \underset{\text{excess}}{3Cl_2} \longrightarrow NCl_3 + 3HCl$

17. The correct order of the ionic radii of O^{2-}, N^{3-}, F^-, Mg^{2+}, Na^+ and Al^{3+} is :
(1) $Al^{3+} < Na^+ < Mg^{2+} < O^{2-} < F^- < N^{3-}$
(2) $N^{3-} < O^{2-} < F^- < Na^+ < Mg^{2+} < Al^{3+}$
(3) $Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$
(4) $N^{3-} < F^- < O^{2-} < Mg^{2+} < Na^+ < Al^{3+}$
Official Ans. by NTA (3)

Sol. Correct order of size for isoelectronic species.
$Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$

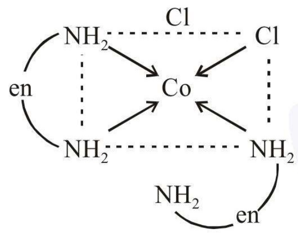
18. Consider the complex ions,
trans-$[Co(en)_2Cl_2]^+$ (A) and
cis-$[Co(en)_2Cl_2]^+$ (B). The correct statement regarding them is :
(1) both (A) and (B) can be optically active
(2) both (A) and (B) cannot be optically active
(3) (A) can be optically active, but (B) cannot be optically active
(4) (A) cannot be optically active, but (B) can be optically active
Official Ans. by NTA (4)

Sol. (A) *trans*-$[Co(en)_2Cl_2]^+$



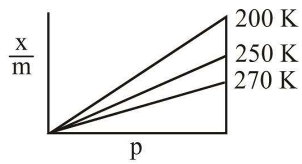
⇒ (A) is trans form and shows plane of symmetry which is optically inactive (not optically active)

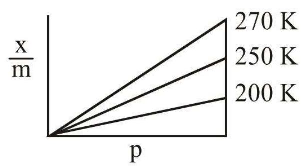
(B) *cis*-$[Co(en)_2Cl_2]^+$

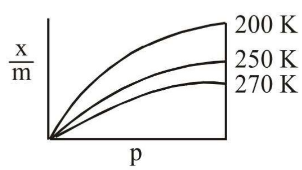


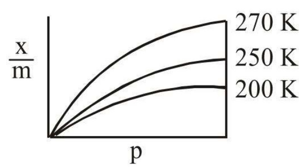
⇒ (B) is cis form and does not shows plane of symmetry, hence it is optically active.

19. Adsorption of a gas follows Freundlich adsorption isotherm. If x is the mass of the gas adsorbed on mass m of the adsorbent, the correct plot of $\frac{x}{m}$ versus p is :

(1) 

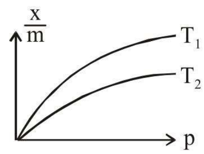
(2) 

(3) 

(4) 

Official Ans. by NTA (3)

Sol. $\frac{x}{m} = K.P.^{1/n}$



$(T_2 > T_1)$

20. The major product formed in the following reaction is :

$CH_3CH = CHCH(CH_3)_2 \xrightarrow{HBr}$

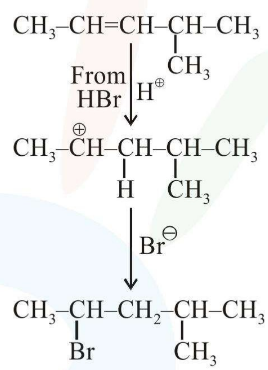
(1) $CH_3\ CH_2\ CH_2\ C(Br)\ (CH_3)_2$

(2) $Br(CH_2)_3\ CH(CH_3)_2$

(3) $CH_3\ CH_2\ CH(Br)\ CH(CH_3)_2$

(4) $CH_3\ CH(Br)\ CH_2\ CH(CH_3)_2$

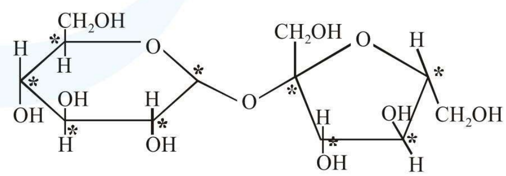
Official Ans. by NTA (1)

Sol. 

Addition of HBr according to M.R.

21. The number of chiral carbons present in sucrose is________ .

Official Ans. by NTA (9)

Sol. 

[α-D-Glucose] [β-D-Fructose]

Total no. of chiral carbon in sucrose = 9

22. For a dimerization reaction,

$2\ A(g) \rightarrow A_2(g)$

at 298 K, $\Delta U^{\ominus}$, = – 20kJ mol^{-1}, $\Delta S^{\ominus}$ = –30 J $K^{-1}\ mol^{-1}$, then the $\Delta G^{\ominus}$ will be __________J.

Official Ans. by NTA (–13538.00)

Sol. $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

$= (\Delta U^\circ + \Delta n_g RT) - T\Delta S^\circ$

$$= \left[\left\{-20 + (-1))\frac{8.314}{1000}\times 298\right\} - \frac{298}{1000}\times(-30)\right] \text{kJ}$$

$= -13.537572$ kJ

$= -13537.57$ Joule

23. For a reaction $X + Y \rightleftharpoons 2Z$, 1.0 mol of X, 1.5 mol of Y and 0.5 mol of Z were taken in a 1 L vessel and allowed to react. At equilibrium, the concentration of Z was 1.0 mol L^{-1}. The equilibrium constant of the reaction is ______ $\frac{x}{15}$. The value of x is ________ .

Official Ans. by NTA (16)

Sol.

	X	+ Y	= 2Z
t = 0	1	1.5	0.5
At eq.	0.75	1.25	1

;

$$K_{eq.} = \frac{1^2}{\frac{3}{4}\times\frac{5}{4}} = \frac{16}{15}$$

24. The volume, in mL, of 0.02 M $K_2Cr_2O_7$ solution required to react with 0.288 g of ferrous oxalate in acidic medium is_______.

(Molar mass of Fe = 56 g mol^{-1})

Official Ans. by NTA (50.00)

Sol. $K_2Cr_2O_7 + FeC_2O_4 \longrightarrow Cr^{+3} + Fe^{+3} + CO_2$

n = 6 n = 3

$$\frac{0.02\times 6\times V(mL)}{1000} = \frac{0.288}{144}\times 3$$

$\Rightarrow \boxed{V = 50 mL}$

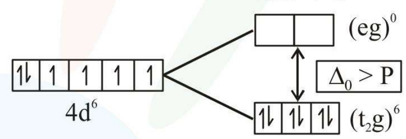
25. Considering that $\Delta_0 > P$, the magnetic moment (in BM) of $[Ru(H_2O)_6]^{2+}$ would be________ .

Official Ans. by NTA (00)

Sol. Magnetic moment (in B.M.) of $[Ru(H_2O)_6]^{2+}$ would be; while considering that $\Delta_0 > P$,

$Ru_{(44)}$; $[Kr]4d^7 5s^1$ (in ground state)

$\Rightarrow$ In $Ru^{2+} \Rightarrow 4d^6 \Rightarrow (t_2g)^6(eg)^0$



$\Rightarrow$ Here number of unpaired electrons in $Ru^{2+} = (t_2g)^6\ (eg)^0 = 0$ and Hence

$\mu_m = \sqrt{n(n+2)}$ B.M. $= \boxed{0\ \text{B.M.}}$