



FINAL JEE-MAIN EXAMINATION - SEPTEMBER, 2020

Held On Thursday, 3 September 2020

TIME : 3: 00 PM to 6 : 00 PM

1. Among the statements (I – IV), the correct ones are:

(I) Be has smaller atomic radius compared to Mg.

(II) Be has higher ionization enthalpy than Al.

(III) Charge/radius ratio of Be is greater than that of Al.

(IV) Both Be and Al form mainly covalent compounds.

(1) (I), (II) and (IV)

(2) (II), (III) and (IV)

(3) (I), (II) and (III)

(4) (I), (III) and (IV)

Official Ans. by NTA (3)

Sol. I, A_N : Be < Mg

II IE : Be > Al

III Charge/radius ratio of Be is less than that of Al

IV Be, Al mainly form covalent compounds

2. The strengths of 5.6 volume hydrogen peroxide (of density 1 g/mL) in terms of mass percentage and molarity (M), respectively, are:

(Take molar mass of hydrogen peroxide as 34 g/mol)

(1) 1.7 and 0.25 (2) 1.7 and 0.5

(3) 0.85 and 0.5 (4) 0.85 and 0.25

Official Ans. by NTA (2)

Sol. Volume strength = $11.2 \times$ molarity

$$\Rightarrow \text{molarity} = \frac{5.6}{11.2} = 0.5$$

Assuming 1 litre solution;

$$\text{mass of solution} = 1000 \text{ ml} \times 1 \text{ g/ml} = 1000 \text{ g}$$

$$\text{mass of solute} = \text{moles} \times \text{molar mass}$$

$$= 0.5 \text{ mol} \times 34 \text{ g/mol}$$

$$= 17 \text{ gm.}$$

$$\Rightarrow \text{mass\%} = \frac{17}{1000} \times 100 = 1.7\%$$

3. Consider the hypothetical situation where the azimuthal quantum number, l , takes values 0, 1, 2, $n + 1$, where n is the principal quantum number. Then, the element with atomic number :

(1) 13 has a half-filled valence subshell

(2) 9 is the first alkali metal

(3) 8 is the first noble gas

(4) 6 has a 2p-valence subshell

Official Ans. by NTA (1)

Sol. $l = 0$ to $(n + 1)$

$$n = 1 \qquad n = 2$$

$$l = 0, 1, 2 \qquad l = 0, 1, 2, 3$$

$$(n + l) \Rightarrow \begin{array}{c} 1s \ 1p \ 1d \\ 1 \ 2 \ 3 \end{array} \qquad \begin{array}{c} 2s \ 2p \ 2d \ 2f \\ 2 \ 3 \ 4 \ 5 \end{array}$$

$$n = 3$$

$$l = 0, 1, 2, 3, 4$$

$$\begin{array}{c} 3s \ 3p \ 3d \ 3f \ 3g \\ 3 \ 4 \ 5 \ 6 \ 7 \end{array}$$

Now, in order to write electronic configuration, we need to apply $(n + l)$ rule

Energy order : $1s < 1p < 2s < 1d < 2p < 3s < 2d \dots$

Option 1) 13 : $1s^2 1p^6 2s^2 1d^3$ is not half filled

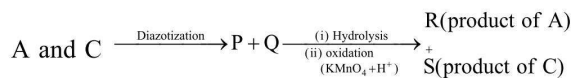
Option 2) 9 : $1s^2 1p^6 2s^1$ is the first alkali metal because after losing one electron, it will achieve first noble gas configuration

Option 3) 8 : $1s^2 1p^6$ is the first noble gas because after $1p^6 e^-$ will enter 2s hence new period

Option 4) 6 : $1s^2 1p^4$ has 1p valence subshell.



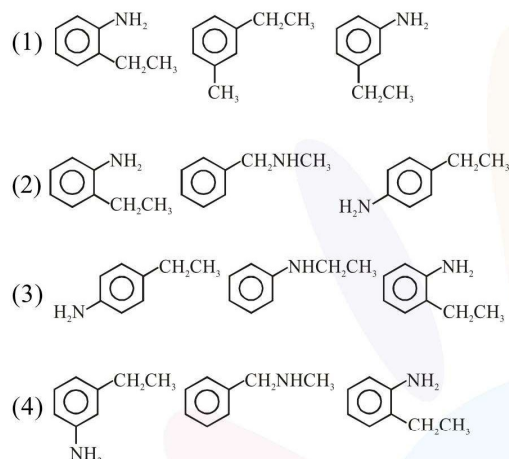
4. Three isomers A, B and C (mol. formula $C_8H_{11}N$) give the following results :



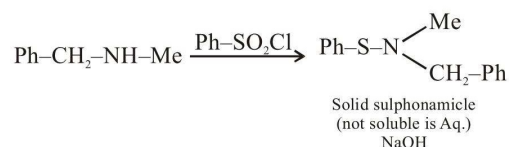
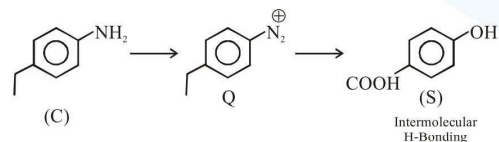
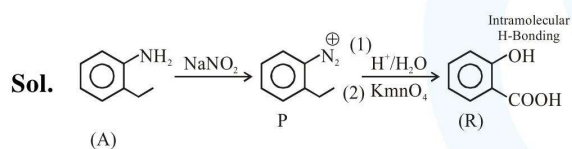
R has lower boiling point than S

B $\xrightarrow{C_6H_5SO_2Cl}$ alkali-insoluble product

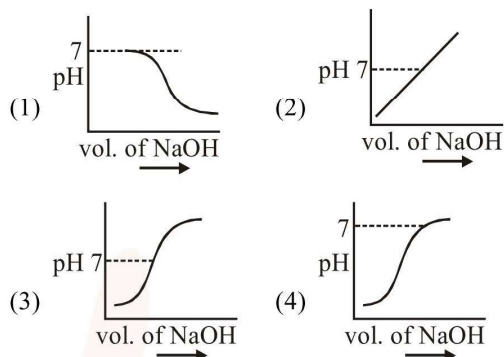
A, B and C, respectively are :



Official Ans. by NTA (2)



5. 100 mL of 0.1 M HCl is taken in a beaker and to it 100 mL of 0.1 M NaOH is added in steps of 2 mL and the pH is continuously measured. Which of the following graphs correctly depicts the change in pH?



Official Ans. by NTA (3)

Sol. Steep rise in pH around the equivalence point for titration of strong acid with strong base.

6. The incorrect statement(s) among (a) – (d) regarding acid rain is (are) :

- (a) It can corrode water pipes.
- (b) It can damage structures made up of stone.
- (c) It cannot cause respiratory ailments in animals.
- (d) It is not harmful for trees

- (1) (c) and (d)
- (2) (a), (b) and (d)
- (3) (c) only
- (4) (a), (c) and (d)

Official Ans. by NTA (2)

Sol. (1) Acid rain corrodes water pipes resulting in the leaching of heavy of heavy metals such as iron, lead and copper into the drinking water.

- (2) Acid rain damages buildings and other structures made of stone or metal.
- (3) It causes respiratory ailments in human beings and animals.
- (4) It is harmful for agriculture, trees and plants as it washes down the nutrients needed for its growth.

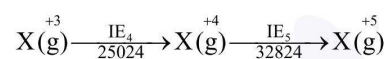
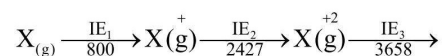


7. The five successive ionization enthalpies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol⁻¹. The number of valence electrons in the element is :

- (1) 2 (2) 3
(3) 4 (4) 5

Official Ans. by NTA (2)

Sol. Let suppose element X ⇒



X⁺³ has stable inert gas configuration as there is high jump after IE₃

So valence electrons are 3

8. A mixture of one mole each of H₂, He and O₂ each are enclosed in a cylinder of volume V at temperature T. If the partial pressure of H₂ is 2 atm, the total pressure of the gases in the cylinder is :

- (1) 14 atm (2) 22 atm
(3) 6 atm (4) 38 atm

Official Ans. by NTA (3)

Sol. According to Dalton's law of partial pressure

$$p_i = x_i \times P_T$$

p_i = partial pressure of the ith component

x_i = mole fraction of the ith component

p_T = total pressure of mixture

$$\Rightarrow 2 \text{ atm} = \left(\frac{n_{H_2}}{n_{H_2} + n_{He} + n_{O_2}} \right) \times p_T$$

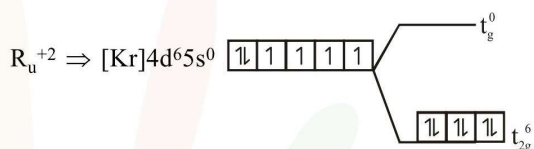
$$\Rightarrow p_T = 2 \text{ atm} \times \frac{3}{1} = 6 \text{ atm}$$

9. The d-electron configuration of [Ru(en)₃]Cl₂ and [Fe(H₂O)₆]Cl₂, respectively are :

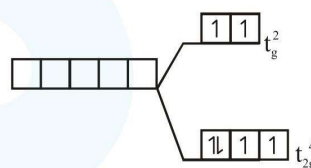
- (1) t_{2g}⁴ e_g² and t_{2g}⁶ e_g⁰
(2) t_{2g}⁶ e_g⁰ and t_{2g}⁶ e_g⁰
(3) t_{2g}⁴ e_g⁰ and t_{2g}⁴ e_g²
(4) t_{2g}⁴ e_g² and t_{2g}⁴ e_g²

Official Ans. by NTA (3)

Sol. [Ru(en)₃]Cl₂ R_u ⇒ 4d series
en ⇒ chelating ligand
CN = 6, octahedral splitting hence lye splitting of d-subshell



[Fe(H₂O)₆]Cl₂ ⇒ H₂O ⇒ Weak filled ligand
Fe⁺² ⇒ [Ar] 3d⁶4s⁰
less plitting
CN = 6 octahedral splitting

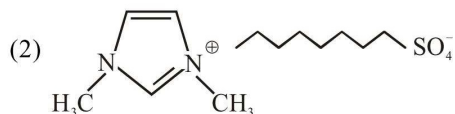


10. An ionic micelle is formed on the addition of :

excess water to liquid



excess water to liquid

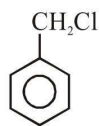


- (3) liquid diethyl ether to aqueous NaCl solution
(4) sodium stearate to pure toluene

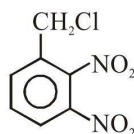
Official Ans. by NTA (2)

Sol. Correct Ans. is (2)

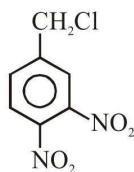
11. The decreasing order of reactivity of the following compounds towards nucleophilic substitution (S_N^2) is :



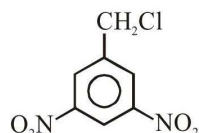
(I)



(II)



(III)



(IV)

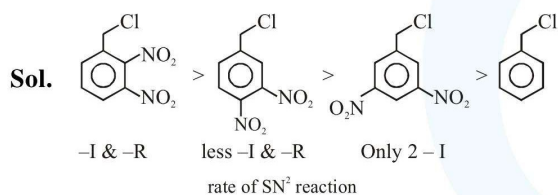
(1) (IV) > (II) > (III) > (I)

(2) (II) > (III) > (IV) > (I)

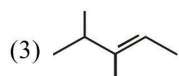
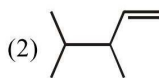
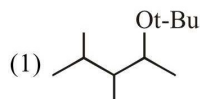
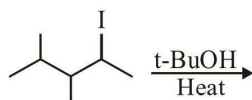
(3) (II) > (III) > (I) > (IV)

(4) (III) > (II) > (IV) > (I)

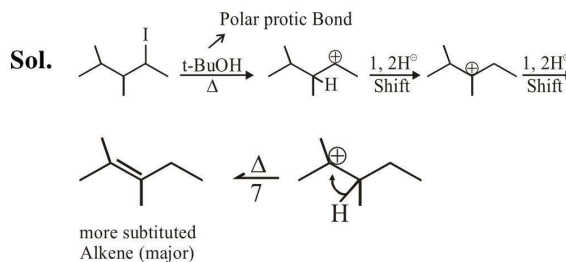
Official Ans. by NTA (2)



12. The major product in the following reaction is :



Official Ans. by NTA (4)



13. The increasing order of the reactivity of the following compound in nucleophilic addition reaction is :

Propanal, Benzaldehyde, Propanone, Butanone

(1) Butanone < Propanone < Benzaldehyde < Propanal

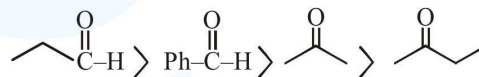
(2) Benzaldehyde < Butanone < Propanone < Propanal

(3) Propanal < Propanone < Butanone < Benzaldehyde

(4) Benzaldehyde < Propanal < Propanone < Butanone

Official Ans. by NTA (1)

Sol. Reactivity order of various carbonyl compounds \rightarrow Aldehydes > Ketones



14. The incorrect statement is :

(1) In manganate and permanganate ions, the π -bonding takes place by overlap of p-orbitals of oxygen and d-orbitals of manganese

(2) Manganate ion is green in colour and permanganate ion in purple in colour

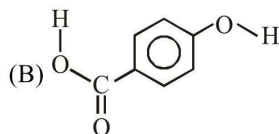
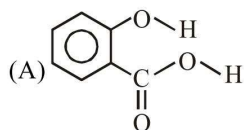
(3) Manganate and permanganate ions are paramagnetic

(4) Manganate and permanganate ions are tetrahedral

Official Ans. by NTA (3)



16. Consider the following molecules and statements related to them :



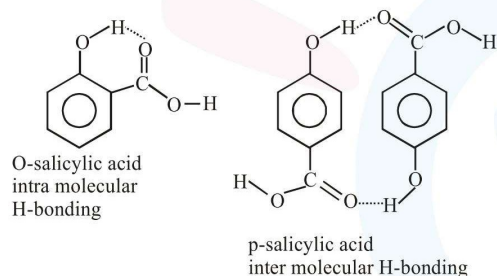
- (a) (B) is more likely to be crystalline than (A)
 (b) (B) has higher boiling point than (A)
 (c) (B) dissolves more readily than (A) in water

Identify the correct option from below :

- (1) only (a) is true (2) (a) and (c) are true
 (3) (b) and (c) are true (4) (a) and (b) are true

Official Ans. by NTA (3)

Sol.



(a) B will be more crystalline due to more inter molecular interactions hence more efficient packing.

(b) B will have higher boiling point due to higher intermolecular interactions.

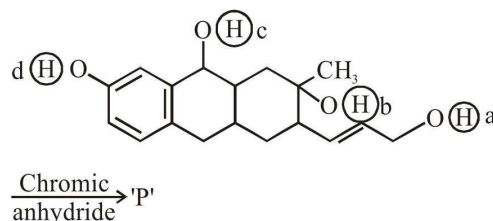
(c) B will be more soluble in water than A as B will have more extent of H-bonding in water

So all three statements are correct

{Solubility date \Rightarrow O-salicylic acid = 2g/L

P-salicylic acid = 5g/L}

17. Consider the following reaction :

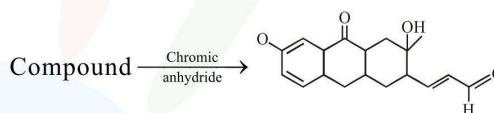


The product 'P' gives positive ceric ammonium nitrate test. This is because of the presence of which of these -OH group(s) ?

- (1) (c) and (d)
 (2) (b) only
 (3) (d) only
 (4) (b) and (d)

Official Ans. by NTA (2)

Sol.



due to presence of b

18. Match the following drugs with their therapeutic actions :

- | | |
|-----------------------|--------------------|
| (i) Ranitidine | (a) Antidepressant |
| (ii) Nardil | (b) Antibiotic |
| (iii) Chloramphenicol | (c) Antihistamine |
| (iv) Dimetane | (d) Antacid |
| (Brompheniramine) | (e) Analgesic |

- (1) (i)-(a); (ii)-(c); (iii)-(b); (iv)-(e)
 (2) (i)-(e); (ii)-(a); (iii)-(c); (iv)-(d)
 (3) (i)-(d); (ii)-(a); (iii)-(b); (iv)-(c)
 (4) (i)-(d); (ii)-(c); (iii)-(a); (iv)-(e)

Official Ans. by NTA (3)

Sol.

Ranitidine \rightarrow Antacid

Nardil \rightarrow Antidepressant

Chloramphenicol \rightarrow Antibiotic

Dimetane \rightarrow Antihistamine



19. For the reaction $2A + 3B + \frac{3}{2}C \rightarrow 3P$, which statement is correct ?

(1) $\frac{dn_A}{dt} = \frac{dn_B}{dt} = \frac{dn_C}{dt}$

(2) $\frac{dn_A}{dt} = \frac{2}{3} \frac{dn_B}{dt} = \frac{3}{4} \frac{dn_C}{dt}$

(3) $\frac{dn_A}{dt} = \frac{3}{2} \frac{dn_B}{dt} = \frac{3}{4} \frac{dn_C}{dt}$

(4) $\frac{dn_A}{dt} = \frac{2}{3} \frac{dn_B}{dt} = \frac{4}{3} \frac{dn_C}{dt}$

Official Ans. by NTA (4)

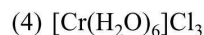
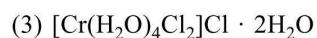
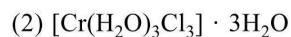
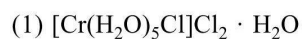
Sol. For $aA + bB \rightarrow cC$;

$$\frac{-1}{a} \frac{d[A]}{dt} = \frac{-1}{b} \frac{d[B]}{dt} = \frac{1}{c} \frac{d[C]}{dt}$$

$$\therefore \frac{-1}{2} \frac{d[A]}{dt} = \frac{-1}{3} \frac{d[B]}{dt} = \frac{-2}{3} \frac{d[C]}{dt} = \frac{1}{3} \frac{d[P]}{dt}$$

20. Complex A has a composition of $H_{12}O_6Cl_3Cr$. If the complex on treatment with conc. H_2SO_4 loses 13.5% of its original mass, the correct molecular formula of A is :

[Given : atomic mass of Cr = 52 amu and Cl = 35 amu]



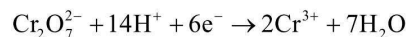
Official Ans. by NTA (3)

Sol. % mass of water

$$= \frac{x \times 18}{(12 + 6 \times 16 + 35 \times 3 + 52)} \times 100 = 13.5$$

$$\Rightarrow x = \frac{265 \times 13.5}{18 \times 100} \approx 2$$

21. An acidic solution of dichromate is electrolyzed for 8 minutes using 2A current. As per the following equation



The amount of Cr^{3+} obtained was 0.104 g. The efficiency of the process(in%) is
(Take : $F = 96000$ C, At. mass of chromium = 52)

Official Ans. by NTA (60)

Sol. Moles of $e^- = \left(\frac{8 \times 60 \times 2}{96000} \right)$

Using stoichiometry; theoretically

$$\frac{n_{e^- \text{ used}}}{6} = \frac{n_{Cr^{3+} \text{ produced}}}{2}$$

$$\Rightarrow n_{Cr^{3+} \text{ produced}} = \frac{2}{6} \times \frac{8 \times 60 \times 2}{96000}$$

$$= \frac{0.02}{6}$$

\Rightarrow wt $_{Cr^{3+}}$ theoretically produced

$$= \left(\frac{0.02}{6} \times 52 \right) \text{g}$$

$$\Rightarrow \% \text{ efficiency} = \frac{0.104 \text{g}}{\left(\frac{0.02 \times 52}{6} \right) \text{g}} \times 100$$

$$= 60\%$$

22. 6.023×10^{22} molecules are present in 10 g of a substance 'x'. The molarity of a solution containing 5 g of substance 'x' in 2 L solution is _____ $\times 10^{-3}$.

Official Ans. by NTA (25)

$$\text{moles} = \frac{\text{number of molecules}}{6 \times 10^{23}} = \frac{\text{given mass}}{\text{molar mass}}$$

$$\Rightarrow \text{molar mas} = \frac{10 \times 6.023 \times 10^{23}}{6.023 \times 10^{22}} = 100 \text{g/mol}$$

$$\Rightarrow \text{molarity} = \frac{\text{moles of solute}}{\text{volume of sol}^n(\ell)} = \frac{(5/100)}{2}$$

$$= 0.025$$



23. The volume (in mL) of 0.1 N NaOH required to neutralise 10 mL of 0.1 N phosphinic acid is _____ .

Official Ans. by NTA (10)

Sol. $\text{H}_3\text{PO}_2 + \text{NaOH} \rightarrow \text{NaH}_2\text{PO}_2 + \text{H}_2\text{O}$

$$\frac{n_{\text{H}_3\text{PO}_2 \text{ reacted}}}{1} = \frac{n_{\text{NaOH} \text{ reacted}}}{1}$$

$$\Rightarrow \frac{0.1 \times 10}{1} = 0.1 \times V_{\text{NaOH}}$$

$$\Rightarrow V_{\text{NaOH}} = 10 \text{ ml.}$$

24. If 250 cm³ of an aqueous solution containing 0.73 g of a protein A is isotonic with one litre of another aqueous solution containing 1.65 g of a protein B, at 298 K, the ratio of the molecular masses of A and B is _____ $\times 10^{-2}$ (to the nearest integer).

Official Ans. by NTA (177)

Sol. Let molar mass of protein A = x g/mol
Let molar mass of protein B = y g/mol

$$\pi_A = \text{osmotic pressure of protein A} = \frac{\left(\frac{0.73}{x}\right)}{0.25} RT$$

$$\pi_B = \text{osmotic pressure of protein B} = \frac{\left(\frac{1.65}{y}\right)}{1} RT$$

$$\pi_A = \pi_B$$

$$\Rightarrow \left(\frac{0.73}{x \times 0.25}\right) RT = \left(\frac{1.65}{y}\right) RT$$

$$\Rightarrow \left(\frac{x}{y}\right) = \frac{0.73}{0.25 \times 1.65} = 1.769 \approx 1.77$$

25. The number of >C=O groups present in a tripeptide Asp - Glu - Lys is _____ .

Official Ans. by NTA (5)

Sol. Structure of Tri peptide Asp - Glu - Lys

