FINAL JEE–MAIN EXAMINATION – APRIL,2019

(Held On Monday 08th APRIL, 2019) TIME : 2 : 30 PM To 5 : 30 PM

CHEMISTRY — TEST PAPER WITH ANSWER & SOLUTION

1. Calculate the standard cell potential in(V) of the cell in which following reaction takes place : $Fe^{2+}(aq) + Ag^{+}(aq) \rightarrow Fe^{3+}(aq) + Ag(s)$

Given that

$E^{o}_{Ag^{+}/Ag} = xV$

$E^{o}_{Fe^{2+}/Fe} = yV$

$E^{o}_{Fe^{3+}/Fe} = zV$

(1) x + 2y – 3z (2) x – z

(3) x – y (4) x + y – z

Official Ans. by NTA (1)

Sol. $Fe^{+2}(aq) + Ag^{+}(aq) \rightarrow Fe^{+3}(aq) + Ag(s)$

Cell reaction

anode : $Fe^{+2}(aq) \rightarrow Fe^{+3}(aq) + e^{\ominus}$;

$E^{o}_{Fe^{+2}/Fe^{+3}} = mV$

cathode : $Ag^{+}(aq) + e^{\ominus} \rightarrow Ag(s)$;

$E^{o}_{Ag^{+}/Ag} = xV$

$\Rightarrow$ cell standard potential = (m + x)V

$\therefore$ to find 'm';

$Fe^{+2} + 2e^{\ominus} \rightarrow Fe$;

$E^{o}_{1} = yV \Rightarrow \Delta_1^{o}G = -(2Fy)$

$Fe^{+3} + 3e^{\ominus} \rightarrow Fe$;

$E^{o}_{2} = zV \Rightarrow \Delta_2^{o}G = -(3Fz)$

$Fe^{+2}(aq) \rightarrow Fe^{+3}(aq) + e^{\ominus}$;

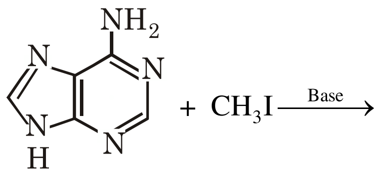
$E^{o}_{3} = mV \Rightarrow \Delta_3^{o}G = -(1Fm)$

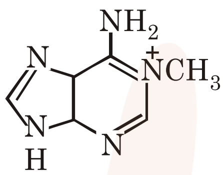
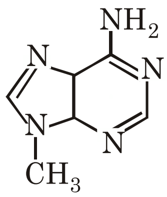
$\Delta_3^{o}G = \Delta G_1^{o} - \Delta G_2^{o} = (-2Fy + 3Fz) = -Fm$

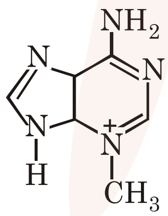
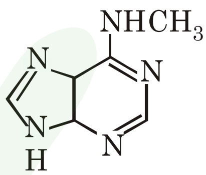
$\Rightarrow m = (2y - 3z)$

$\Rightarrow E^{o}_{cell} = (x + 2y - 3z)V$

2. The major product in the following reaction is :



(1)  (2) 

(3)  (4) 

Official Ans. by NTA (2)

ALLEN Ans. (Bonus)

Sol. because one double bond is missing in all given option. So aromaticity is lost in both the ring.

3. For the following reactions, equilibrium constants are given :

$S(s) + O_2(g) \rightleftharpoons SO_2(g)$; $K_1 = 10^{52}$

$2S(s) + 3O_2(g) \rightleftharpoons 2SO_3(g)$; $K_2 = 10^{129}$

The equilibrium constant for the reaction, $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ is :

(1) 10^{181} (2) 10^{154} (3) 10^{25} (4) 10^{77}

Official Ans. by NTA (3)

Sol. $S(s) + O_2(g) \rightleftharpoons SO_2(g)$ $K_1 = 10^{52}$ ...(1)

$2S(s) + 3O_2(g) \rightleftharpoons 2SO_3(g)$ $K_2 = 10^{129}$ ...(2)

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $K_3 = x$

multiplying equation (1) by 2;

$2SO(s) + 2O_2(g) \rightleftharpoons 2SO_2(g)$ $K_1' = 10^{104}$ ...(3)

$\Rightarrow$ Substracting (3) from (2); we get

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$;

$K_{eq} = 10^{(129-104)} = 10^{25}$

4. The ion that has sp^3d^2 hybridization for the central atom, is :

(1) $[ICl_2]^-$ (2) $[IF_6]^-$

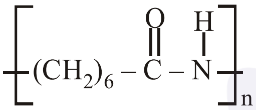
(3) $[ICl_4]^-$ (4) $[BrF_2]^-$

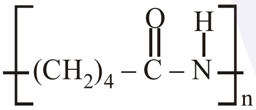
Official Ans. by NTA (3)

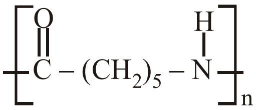
Sol.

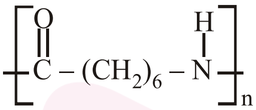
Chemical species	Hybridisation of central atom
ICl_2^-	sp^3d
IF_6^-	sp^3d^3
ICl_4^-	sp^3d^2
BrF_2^-	sp^3d

5. The structure of Nylon-6 is :

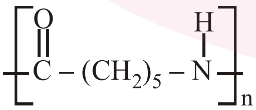
(1) 

(2) 

(3) 

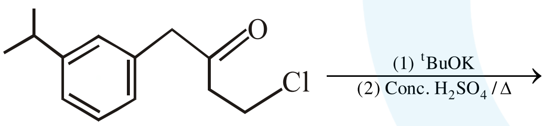
(4) 

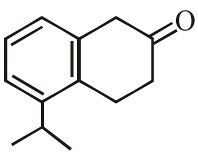
Official Ans. by NTA (3)

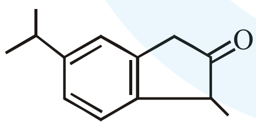
Sol. 

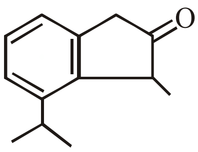
Nylon-6

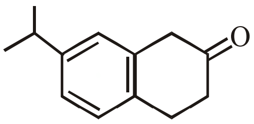
6. The major product of the following reaction is:



(1) 

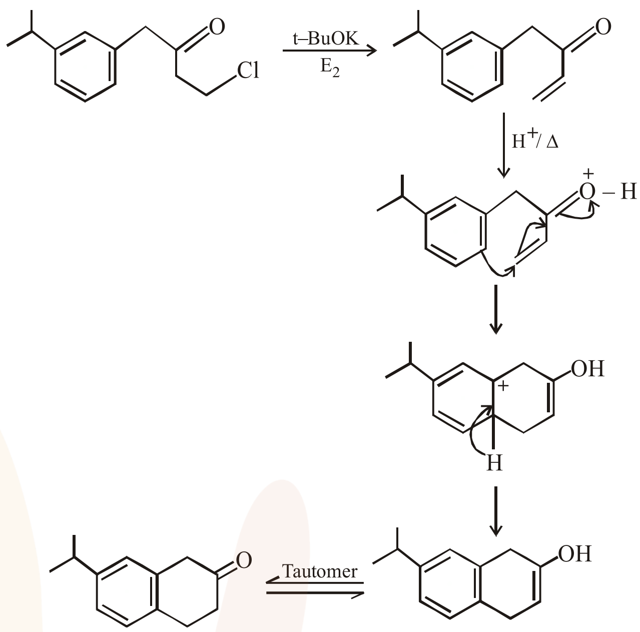
(2) 

(3) 

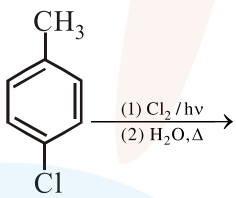
(4) 

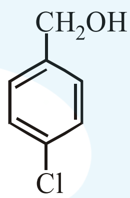
Official Ans. by NTA (4)

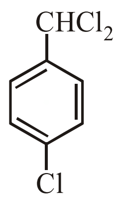
Sol.

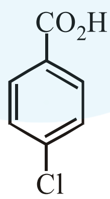


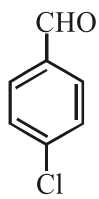
7. The major product of the following reaction is:



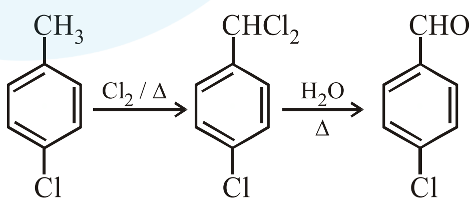
(1) 

(2) 

(3) 

(4) 

Official Ans. by NTA (4)

Sol. 

8. The percentage composition of carbon by mole in methane is :

(1) 80% (2) 25% (3) 75% (4) 20%

Official Ans. by NTA (4)

Sol. CH_4

$$\% \text{ by mole of carbon} = \frac{1\,\text{mol atom}}{5\,\text{mol atom}} \times 100$$

$$= 20\%$$

9. The IUPAC symbol for the element with atomic number 119 would be :

(1) unh (2) uun (3) une (4) uue

Official Ans. by NTA (4)

Sol.

Symbol	Atomic number
unh	106
uun	110
une	109
uue	119

10. The compound that inhibits the growth of tumors is :

(1) cis-$[Pd(Cl)_2(NH_3)_2]$

(2) cis-$[Pt(Cl)_2(NH_3)_2]$

(3) trans-$[Pt(Cl)_2(NH_3)_2]$

(4) trans-$[Pd(Cl)_2(NH_3)_2]$

Official Ans. by NTA (2)

Sol. cis–$[PtCl_2(NH_3)_2]$ is used in chemotherapy to inhibits the growth of tumors.

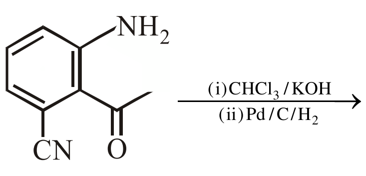
11. The covalent alkaline earth metal halide (X = Cl, Br, I) is :

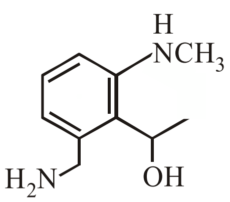
(1) CaX_2 (2) SrX_2 (3) BeX_2 (4) MgX_2

Official Ans. by NTA (3)

Sol. All halides of Be are predominantly covalent in nature.

12. The major product obtained in the following reaction is :



(1)


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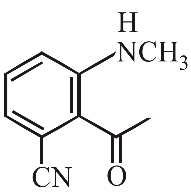

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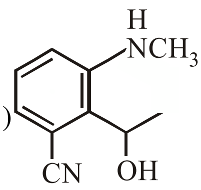

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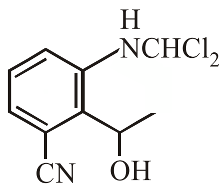
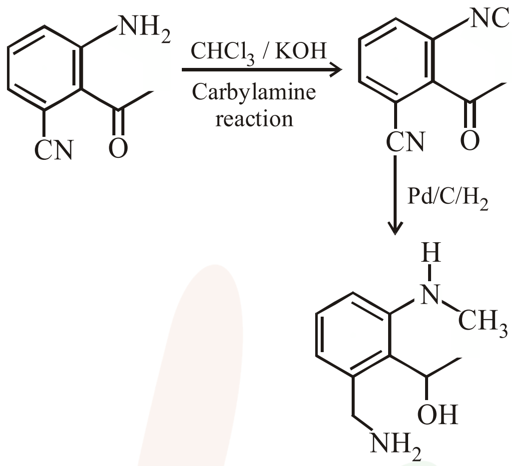


Official Ans. by NTA (1)

Sol.



13. The statement that is **INCORRECT** about the interstitial compounds is :

(1) They have high melting points

(2) They are chemically reactive

(3) They have metallic conductivity

(4) They are very hard

Official Ans. by NTA (2)

Sol. Generally interstitial compounds are chemicaly inert.

14. The maximum prescribed concentration of copper in drinking water is:

(1) 5 ppm (2) 0.5 ppm

(3) 0.05 ppm (4) 3 ppm

Official Ans. by NTA (4)

Sol. The maximum prescribed concentration of Cu in drinking water is 3 ppm.

15. The calculated spin-only magnetic moments (BM) of the anionic and cationic species of $[Fe(H_2O)_6]_2$ and $[Fe(CN)_6]$, respectively, are :

(1) 4.9 and 0 (2) 2.84 and 5.92

(3) 0 and 4.9 (4) 0 and 5.92

Official Ans. by NTA (3)

Sol. Complex is $[Fe\ (H_2O)_6]_2\ [Fe(CN)_6]$

Complex ion	Configuration	No. of unpaired electrons	Magnetic moment
$[Fe(H_2O)_6]^{2+}$	$t_{2g}^4\ e_g^2$	4	4.9 BM
$[Fe(CN)_6]^{4-}$	$t_{2g}^6 e_g^0$	0	0

16. 0.27 g of a long chain fatty acid was dissolved in 100 cm^3 of hexane. 10 mL of this solution was added dropwise to the surface of water in a round watch glass. Hexane evaporates and a monolayer is formed. The distance from edge to centre of the watch glass is 10 cm. What is the height of the monolayer?

[Density of fatty acid = 0.9 g cm^{-3}, π = 3]

(1) 10^{-8} m (2) 10^{-6} m

(3) 10^{-4} m (4) 10^{-2} m

Official Ans. by NTA (2)

Sol. Radius of watchglass= 10 cm

$\Rightarrow$ surface area = $\pi r^2 = 3 \times (10\ cm)^2$

$= 300\ cm^2$

mass of fatty acid in 10 ml solution

$$= \frac{10\times0.27}{100} = 0.027\,gm$$

$$\text{volume of fatty acid} = \frac{0.027\,g}{0.9\,g/ml} = 0.03\ cm^3$$

$$\Rightarrow \text{Height} = \frac{\text{volume of fatty acid}}{\text{surface area of watch glass}}$$

$$= \frac{0.03\ cm^3}{300\ cm^2} = 0.0001\ cm = 10^{-6}\ m$$

17. Among the following molecules / ions,

$C_2^{2-}, N_2^{2-}, O_2^{2-}, O_2$

which one is diamagnetic and has the shortest bond length?

(1) C_2^{2-} (2) N_2^{2-} (3) O_2 (4) O_2^{2-}

Official Ans. by NTA (1)

Sol.

Chemical Species	Bond Order	Magnetic behaviour
C_2^{2-}	3	diamagnetic
N_2^{2-}	2	paramagnetic
O_2	2	paramagnetic
O_2^{2-}	1	diamagnetic

$$\text{B.O.} \propto \frac{1}{\text{bond length}}$$

18. 5 moles of an ideal gas at 100 K are allowed to undergo reversible compression till its temperature becomes 200 K.

If C_V = 28 $JK^{-1}mol^{-1}$, calculate ΔU and ΔpV for this process. (R = 8.0 JK^{-1} mol^{-1}]

(1) ΔU = 14 kJ; $\Delta(pV)$ = 4 kJ

(2) ΔU = 14 kJ; $\Delta(pV)$ = 18 kJ

(3) ΔU = 2.8 kJ; $\Delta(pV)$ = 0.8 kJ

(4) ΔU = 14 kJ; $\Delta(pV)$ = 0.8 kJ

Official Ans. by NTA (1)

Sol. n = 5; T_i = 100 K; T_f = 200 K;

C_V = 28 J/mol K; Ideal gas

$\Delta U = nC_V\Delta T$

= 5 mol × 28 J/mol K × (200 – 100) K

= 14,000 J = 14 kJ

$\Rightarrow C_p = C_v + R$ = (28 + 8) J/mol K

= 36 J/mol K

$\Rightarrow \Delta H = nC_p\Delta T$ = 5 mol × 36 J/mol K × 100 K

= 18000 J = 18 kJ

$\Delta H = \Delta U + \Delta(PV)$

$\Rightarrow \Delta(PV) = \Delta H - \Delta U$ = (18 – 14) kJ = 4 kJ

19. Which one of the following alkenes when treated with HCl yields majorly an anti Markovnikov product?

(1) $F_3C - CH = CH_2$

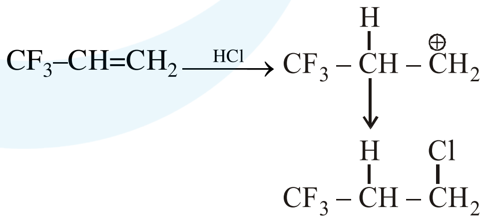
(2) $Cl - CH = CH_2$

(3) $CH_3O - CH = CH_2$

(4) $H_2N - CH = CH_2$

Official Ans. by NTA (1)

Sol.



Due to higher e^- withdrawing nature of CF_3 group.

It follow anti markovnikoff product

20. For a reaction scheme $A \xrightarrow{k_1} B \xrightarrow{k_2} C$, if the rate of formation of B is set to be zero then the concentration of B is given by :

(1) $\left(\frac{k_1}{k_2}\right)[A]$ (2) $(k_1 + k_2)$ [A]

(3) $k_1k_2[A]$ (4) $(k_1 - k_2)$ [A]

Official Ans. by NTA (1)

Sol. $A \xrightarrow{K_1} B \xrightarrow{K_2} C$

$$\frac{d[B]}{dt} = 0 = K_1[A] - K_2[B]$$

$$\Rightarrow [B] = \frac{K_1}{K_2}[A]$$

21. Which of the following compounds will show the maximum enol content?

(1) $CH_3COCH_2COCH_3$

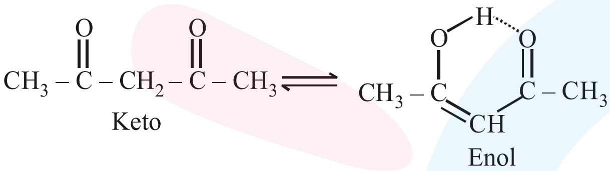
(2) CH_3COCH_3

(3) $CH_3COCH_2CONH_2$

(4) $CH_3COCH_2COOC_2H_5$

Official Ans. by NTA (1)

Sol. Solution



Due to intramolecular H-bonding and resonance stabilisation enol content is maximum

22. The correct statement about ICl_5 and ICl_4^- is

(1) ICl_5 is trigonal bipyramidal and ICl_4^- is tetrahedral.

(2) ICl_5 is square pyramidal and ICl_4^- is tetrahedral.

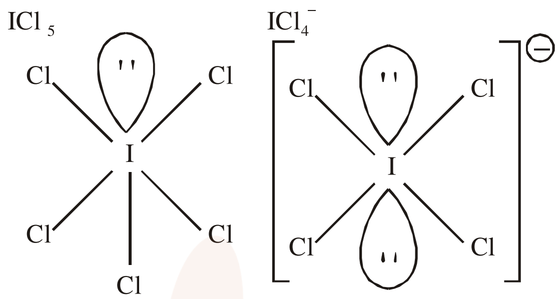
(3) ICl_5 is square pyramidal and ICl_4^- is square planar.

(4) Both are isostructural.

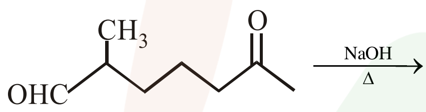
Official Ans. by NTA (3)

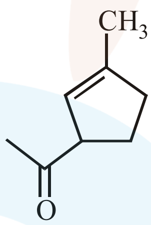
Sol.

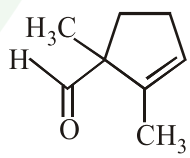
Chemical species	Hybridisation	Shape
ICl_5	sp^3d^2	Square pyramidal
ICl_4^-	sp^3d^2	Square planar

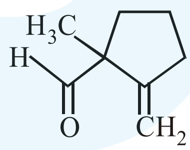


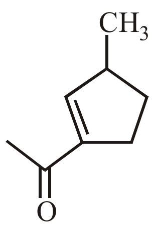
23. The major product obtained in the following reaction is



(1) 

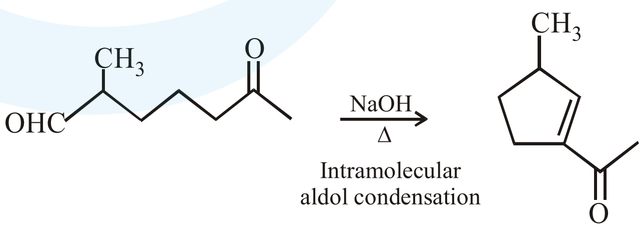
(2) 

(3) 

(4) 

Official Ans. by NTA (4)

Sol.



24. Fructose and glucose can be distinguished by :

(1) Fehling's test

(2) Barfoed's test

(3) Benedict's test

(4) Seliwanoff's test

Official Ans. by NTA (4)

Sol. Seliwanoff's test is used to distinguished aldose and ketose group.

25. If p is the momentum of the fastest electron ejected from a metal surface after the irradiation of light having wavelength λ, then for 1.5 p momentum of the photoelectron, the wavelength of the light should be:

(Assume kinetic energy of ejected photoelectron to be very high in comparison to work function)

(1) $\frac{1}{2}\lambda$ (2) $\frac{3}{4}\lambda$

(3) $\frac{2}{3}\lambda$ (4) $\frac{4}{9}\lambda$

Official Ans. by NTA (4)

Sol. $h\nu - \phi = KE$

$$\Rightarrow \left(\frac{hc}{\lambda}\right)_{incident} = KE + \phi$$

$$\left(\frac{hc}{\lambda}\right)_{incident} \simeq KE$$

$$KE = \frac{p^2}{2m} = \frac{hc}{\lambda_{incident}} = \frac{hc}{\lambda} \quad ...(1)$$

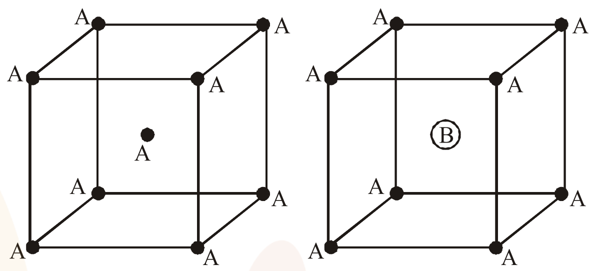
$$\Rightarrow \frac{p^2 \times (1.5)^2}{2m} = \frac{hc}{\lambda'} \quad ...(2)$$

divide (1) and (2)

$$(1.5)^2 = \frac{\lambda}{\lambda'}$$

$$\Rightarrow \lambda' = \frac{4\lambda}{9}$$

26. Consider the bcc unit cells of the solids 1 and 2 with the position of atoms as shown below. The radius of atom B is twice that of atom A. The unit cell edge length is 50% more in solid 2 than in 1. What is the approximate packing efficiency in solid 2?



Solid 1 Solid 2

(1) 45% (2) 65% (3) 90% (4) 75%

Official Ans. by NTA (3)

Sol.
$$p.f. = \frac{\left(z_{eff} \times \frac{4}{3}\pi r_A^3\right)_A + \left(z_{eff} \times \frac{4}{3}\pi r_B^3\right)_B}{a^3}$$

$$2(r_A + r_B) = \sqrt{3}a$$

$$\Rightarrow 2(r_A + 2r_A) = \sqrt{3}a$$

$$\Rightarrow 2\sqrt{3}\, r_A = a$$

$$\Rightarrow p.f. = \frac{1 \times \frac{4}{3}\pi r_A^3 + \frac{4}{3}\pi\left(8r_A^3\right)}{8 \times 3\sqrt{3}\, r_A^3} = \frac{9 \times \frac{4}{3}\pi}{8 \times 3\sqrt{3}} = \frac{\pi}{2\sqrt{3}}$$

$$p.\ efficiency = \frac{\pi}{2\sqrt{3}} \times 100 \simeq 90\%$$

27. Polysubstitution is a major drawback in:

(1) Reimer Tiemann reaction

(2) Friedel Craft's acylation

(3) Friedel Craft's alkylation

(4) Acetylation of aniline

Official Ans. by NTA (3)

Sol. In Friedal crafts alkylation product obtained is more activated and hence polysubtitution will take place.

28. The Mond process is used for the

(1) extraction of Mo

(2) Purification of Ni

(3) Purification of Zr and Ti

(4) Extraction of Zn

Official Ans. by NTA (2)

Sol. Mond's process is used for the purification of Nickel.

29. The strength of 11.2 volume solution of H_2O_2 is : [Given that molar mass of H = 1 g mol^{-1} and O = 16 g mol^{-1}]

(1) 13.6% (2) 3.4%

(3) 34% (4) 1.7%

Official Ans. by NTA (2)

Sol. Volume strength = 11.2 × molarity = 11.2

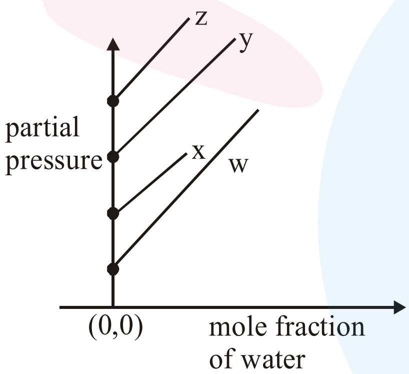
$\Rightarrow$ molarity = 1 M

$\Rightarrow$ strength = 34 g/L

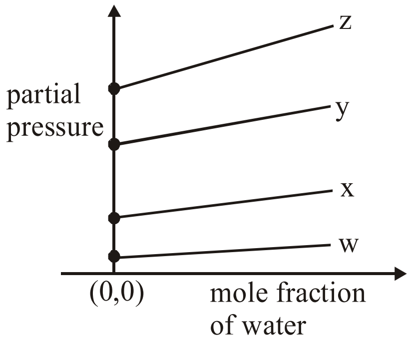
$$\Rightarrow \% \text{ w/w} = \frac{34}{1000} \times 100 = 3.4\%$$

30. For the solution of the gases w, x, y and z in water at 298K, the Henrys law constants (K_H) are 0.5, 2, 35 and 40 kbar, respectively. The correct plot for the given data is :-

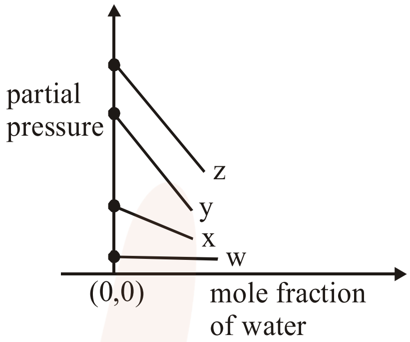
(1)



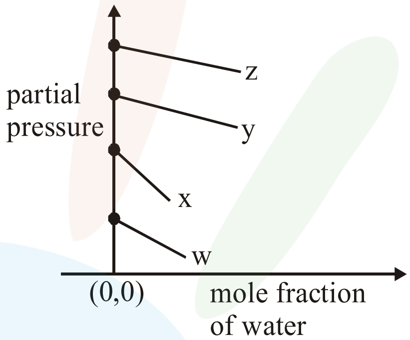
(2)



(3)



(4)



Official Ans. by NTA (3)

Sol. $p = k_H \times \left(\frac{n_{gas}}{n_{H_2O} + n_{gas}}\right)$

$$= k_H \left(1 - \frac{n_{H_2O}}{n_{H_2O} + n_{gas}}\right)$$

$\Rightarrow p = k_H - k_H \times \chi_{H_2O}$

$p = (-k_H) \times \chi_{H_2O} + k_H$