CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. The minimum energy that must be possessed by photons in order to produce the photoelectric effect with platinum metal is

[Given The threshold frequency of platinum is $1.3 \times 10^{15}\ s^{-1}$ and $h = 6.6 \times 10^{-34}$ Js.]

(A) 3.21×10^{-14} J (B) 6.24×10^{-16} J

(C) 8.58×10^{-19} J (D) 9.76×10^{-20} J

Answer (C)

Sol.: The minimum energy possessed by photons will be equal to the work function of the metal.

Hence,

$w_0 = h\nu_0$

$= 6.6 \times 10^{-34} \times 1.3 \times 10^{15}$

$= 8.58 \times 10^{-19}$ J

2. At 25°C and 1 atm pressure, the enthalpy of combustion of benzene (l) and acetylene (g) are –3268 kJ mol^{-1} and –1300 kJ mol^{-1}, respectively. The change in enthalpy for the reaction $3C_2H_2(g) \rightarrow C_6H_6(l)$, is

(A) +324 kJ mol^{-1} (B) +632 kJ mol^{-1}

(C) –632 kJ mol^{-1} (D) –732 kJ mol^{-1}

Answer (C)

Sol.: I. $C_6H_6(\ell) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(g)$

$\Delta H_1 = -3268$ kJ/mol

II. $C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(g)$

$\Delta H_2 = -1300$ kJ/mol

III. $3C_2H_2(g) \rightarrow C_6H_6(\ell)$ ΔH_3

Applying Hess's law of constant heat summation

$\Delta H_3 = 3 \times \Delta H_2 - \Delta H_1$

$= 3 \times (-1300) - (-3268)$

$= -632$ kJ/mol

3. Solute A associates in water. When 0.7 g of solute A is dissolved in 42.0 gof water, it depresses the freezing point by 0.2°C. The percentage association of solute A in water is :

[Given : Molar mass of A = 93 g mol^{-1}. Molal depression constant of water is 1.86 K kg mol^{-1}.]

(A) 50%

(B) 60%

(C) 70%

(D) 80%

Answer (D)

Sol.: Since, $\Delta T_f = ik_fm$

$$m = \frac{0.7}{93} \times \frac{1000}{42}$$

$$0.2 = i \times 1.86 \times \frac{0.7 \times 1000}{93 \times 42}$$

$i = 0.6$

$$\alpha = \frac{i-1}{\frac{1}{n}-1} = \frac{0.6-1}{\frac{1}{2}-1} = 0.8$$

Hence, percentage association of solute A is 80%.

4. The Ksp for bismuth sulphide (Bi_2S_3) is 1.08×10^{-73}. The solubility of Bi_2S_3 in mol L^{-1} at 298 K is

(A) 1.0×10^{-15}

(B) 2.7×10^{-12}

(C) 3.2×10^{-10}

(D) 4.2×10^{-8}

Answer (A)

Sol.: $Bi_2S_3 \rightleftharpoons \underset{2s}{2Bi^{3+}} + \underset{3s}{3S^{2-}}$

$K_{sp} = (2s)^2(3s)^3 = 108s^5$

$108s^5 = 108 \times 10^{-75}$

$s = 1.0 \times 10^{-15}$ mol/L

5. Match List I with List II.

List I		List II	
A	Zymase	I	Stomach
B	Diastase	II	Yeast
C	Urease	III	Malt
D	Pepsin	IV	Soyabean

Choose the correct answer from the options given below

(A) A-II, B-III, C-I, D-IV

(B) A-II, B-III, C-IV, D-I

(C) A-III, B-II, C-IV, D-I

(D) A-III, B-II, C-I, D-IV

Answer (B)

Sol.:

Enzyme		**Source**
Zymase	$\rightarrow$	Yeast
Diastase	$\rightarrow$	Malt
Urease	$\rightarrow$	Soyabean
Pepsin	$\rightarrow$	Stomach

Hence, A-II, B-III, C-IV, D-I

6. The correct order of electron gain enthalpies of Cl, F, Te and Po is

(1) F < Cl < Te < Po

(2) Po < Te < F < Cl

(3) Te < Po < Cl < F

(4) Cl < F < Te < Po

Answer (B)

Sol. Te $\rightarrow$ –190 kJ mol^{-1}

Po $\rightarrow$ –174 kJ mol^{-1}

F $\rightarrow$ –333 kJ mol^{-1}

Cl $\rightarrow$ –349 kJ mol^{-1}

Hence, correct order is Cl > F > Te > Po

7. Given below are two statements.

Statement-I: During electrolytic refining, blister copper deposits precious metals.

Statement-II: In the process of obtaining pure copper by electrolysis method, copper blister is used to make the anode.

In the light of the above statements, choose the correct answer from the options given below.

(1) Both Statement-I and Statement-II are **true**.

(2) Both Statement-I and Statement-II are **false**.

(3) Statement-I is **true** but Statement II is **false**.

(4) Statement-I is **false** but Statement-II is **true**

Answer (A)

Sol. Copper is refined using an electrolytic method. Anodes are of impure copper and pure copper strips are taken as cathode

Impurities from the blister copper deposit as anode mud which contains antimony, selenium, tellurium, silver, gold and platinum.

Hence both statements are true

8. Given below are two statements one is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: The amphoteric nature of water is explained by using Lewis acid/base concept

Reason R: Water acts as an acid with NH3 and as a base with H_2S.

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

(1) Both A and R are true and R is the correct explanation of A.

(2) Both A and R are true but R is NOT the correct explanation of A.

(3) A is true but R is false.

(4) A is false but R is true.

Answer (D)

Sol. The amphoteric nature of water is explained by using Bronsted-Lowry acid base concept

$$\underset{\text{(acid)}}{H_2O} + NH_3 \rightleftharpoons OH^- + NH_4^+$$

$$\underset{\text{(base)}}{H_2O} + H_2S \rightleftharpoons H_3O^+ + HS^-$$

Hence, A is false but R is true

9. The correct order of reduction potentials of the following pairs is

(A) Cl_2/Cl^- (B) I_2/I^-

(C) Ag^+/Ag (D) Na^+/Na

(E) Li^+/Li

Choose the correct answer from the options given below:

(1) A > C > B > D > E

(2) A > B > C > D > E

(3) A > C > B > E > D

(4) A > B > C > E > D

Answer (A)

Sol. Standard Reduction Potential

(A) Cl_2/Cl	1.36 V
(B) I_2/I^-	0.54 V
(C) Ag^+/Ag	0.80 V
(D) Na^+/Na	–2.71 V
(E) Li^+/Li	–3.05 V

Hence, correct order is A > C > B > D > E

10. The number of bridged oxygen atoms present in compound B formed from the following reactions is

$$Pb(NO_3)_2 \xrightarrow{673\text{ K}} A + PbO + O_2$$

$$A \xrightarrow{\text{Dimerise}} B$$

(1) 0

(2) 1

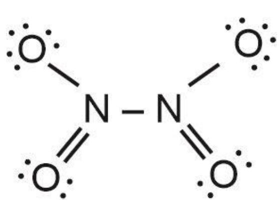
(3) 2

(4) 3

Answer (A)

Sol. $2Pb(NO_3)_2 \xrightarrow{673\text{ K}} \underset{A}{4NO_2} + 2PbO + O_2$

$$\underset{A}{NO_2} \xrightarrow{\text{Dimerise}} \underset{B}{N_2O_4}$$



Hence no bridged oxygen atom is present in N_2O_4.

11. The metal ion (in gaseous state) with lowest spin-only magnetic moment value is

(A) V^{2+}

(B) Ni^{2+}

(C) Cr^{2+}

(D) Fe^{2+}

Answer (B)

Sol.

		Valence shell Configuration	Unpaired electrons
V^{2+}	$\rightarrow$	$3d^3 4s^0$	$n = 3$
Ni^{2+}	$\rightarrow$	$3d^8 4s^0$	$n = 2$
Cr^{2+}	$\rightarrow$	$3d^4 4s^0$	$n = 4$
Fe^{2+}	$\rightarrow$	$3d^6 4s^0$	$n = 4$

Since Ni^{2+} has least number of unpaired electrons. Hence Ni^{2+} will have lowest spin only magnetic moment Value.

12. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A: Polluted water may have a value of BOD of the order of 17 ppm.

Reason R: BOD is a measure of oxygen required to oxidise both the bio-degradable and non-biodegradable organic material in water.

In the light of the above statements, choose the ***most appropriate*** answer from the options given below.

(A) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

(B) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**.

(C) **A** is correct but **R** is not correct.

(D) **A** is not correct but **R** is correct.

Answer (C)

Sol. Highly polluted water could have a BOD value of 17 ppm or more.

The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water is called Biochemical Oxygen demand (BOD).

Hence **A** is correct but **R** is not correct.

13. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A: A mixture contains benzoic acid and naphthalene. The pure benzoic acid can be separated out by the use of benzene.

Reason R: Benzoic acid is soluble in hot water.

In the light of the above statements, choose the ***most appropriate*** answer from the options given below.

(A) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(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) **A** is false but **R** is true.

Answer (D)

Sol. Since, both benzoic acid and naphthalene will dissolve in benzene. Hence assertion is wrong.

Benzoic acid is almost insoluble in cold water but soluble in hot water. Hence Reason is true

14. During halogen test, sodium fusion extract is boiled with concentrated HNO_3 to

(A) remove unreacted sodium

(B) decompose cyanide or sulphide of sodium

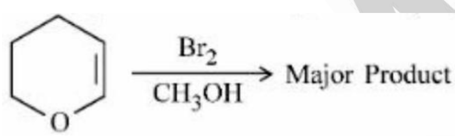
(C) extract halogen from organic compound

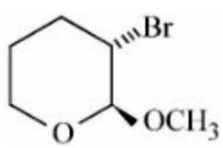
(D) maintain the pH of extract.

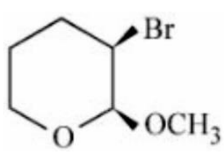
Answer (B)

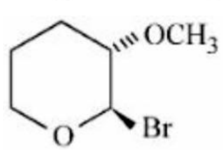
Sol. During test for halogen, if nitrogen or sulphur is also present in the compound, then sodium fusion extract is first boiled with concentrated nitric acid to decompose cyanide or sulphide of sodium formed during Lassaigne's test.

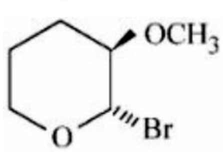
15. Amongst the following, the major product of the given chemical reaction is



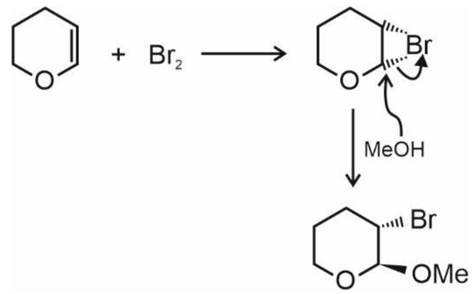
(A) 

(B) 

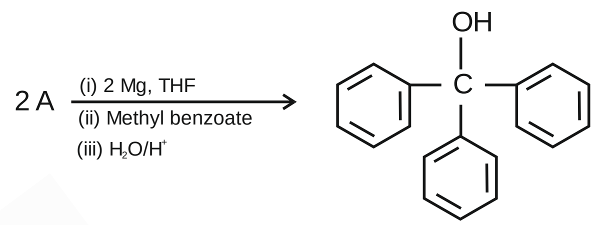
(C) 

(D) 

Answer (A)

Sol. 

16. In the given reaction



'A' can be

(A) Benzyl bromide

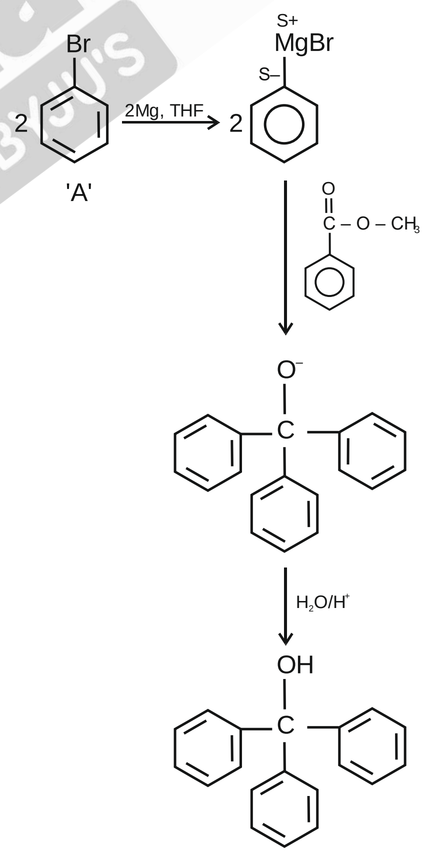
(B) Bromo benzene

(C) Cyclohexyl bromide

(D) Methyl bromide

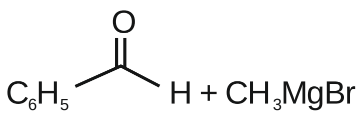
Answer (B)

Sol.

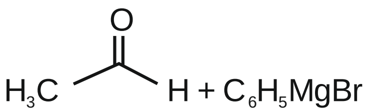


Hence 'A' is bromobenzene.

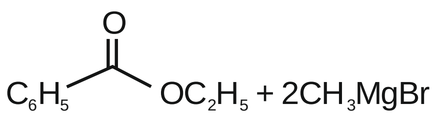
17. Which of the following conditions or reaction sequence will NOT give acetophenone as the major product?

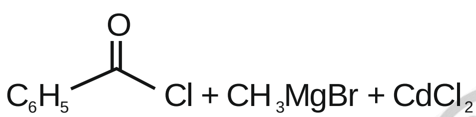
(A) (a) 

(b) $Na_2Cr_2O_7$, H+

(B) (a) 

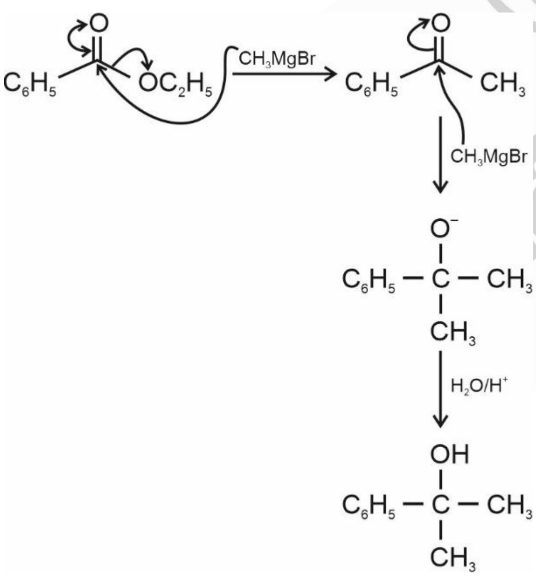
(b) PCC, DCM

(C) 

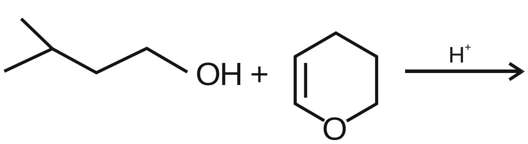
(D) 

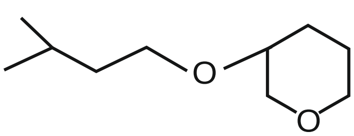
Answer (C)

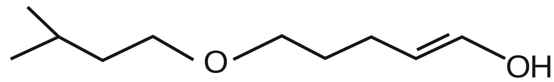
Sol. C will not give acetophenone

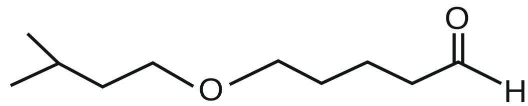


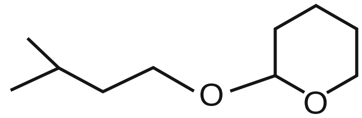
18. The major product formed in the following reaction, is



(A) 

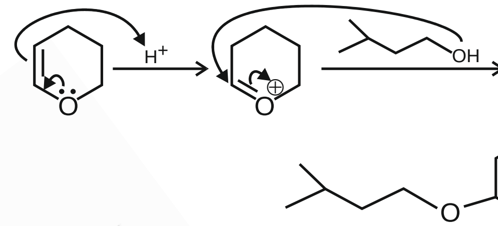
(B) 

(C) 

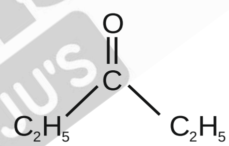
(D) 

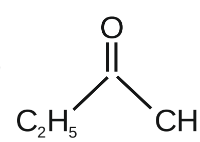
Answer (D)

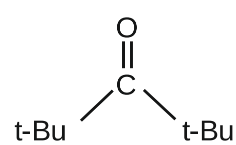
Sol.

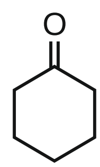


19. Which of the following ketone will NOT give enamine on treatment with secondary amines? [where t-Bu is $–C(CH_3)_3$]

(A) 

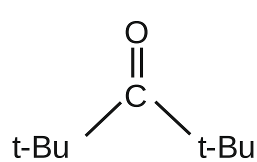
(B) 

(C) 

(D) 

Answer (C)

Sol. In order to form enamine from the reaction of carbonyl compound with 2º amine, the carbonyl compound must have α-hydrogen.

In  No α-hydrogen is present.

Along with this, due to steric **crowding** by t-Bu group, it is difficult for 2º amine to attack on this compound.

20. An antiseptic Dettol is a mixture of two compounds 'A' and 'B' where A has 6π electrons and B has 2π electrons. What is 'B'?

(A) Bithionol

(B) Terpineol

(C) Chloroxylenol

(D) Chloramphenicol

Answer (B)

Sol. Dettol is a mixture of chloroxylenol and terpineol. Chloroxylenol has 6π electrons and terpineol has 2π electrons.

Hence B is terpineol.

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

1. A protein 'A' contains 0.30% of glycine (molecular weight 75). The minimum molar mass of the protein 'A' is ________ $\times 10^3$ g mol^{-1} [nearest integer]

Answer (25)

Sol. 0.3% glycine means

100 g protein 'A' contains 0.3 g glycine.

Since, molar mass of glycine is 75

75 g glycine will be present in $\frac{100}{0.3} \times 75$ g protein

Minimum molar mass of protein A is 25×10^3 g/mol

2. A rigid nitrogen tank stored inside a laboratory has a pressure of 30 atm at 06:00 am when the temperature is 27°C. At 03:00 pm, when the temperature is 45°C, the pressure in the tank will be ________ atm. [nearest integer]

Answer (32)

Sol. Since

$P \propto T$

Hence, $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\left(\begin{array}{l} P_1 \text{ is pressure at 6 am} \\ P_2 \text{ is pressure at 3 pm} \end{array}\right)$

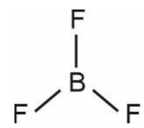
$$\frac{30}{300} = \frac{P_2}{318}$$

$P_2 \simeq 32$ atm

3. Amongst BeF_2, BF_3, H_2O, NH_3, CCl_4 and HCl, the number of molecules with non-zero net dipole moment is ______.

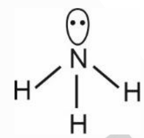
Answer (3)

Sol. F – Be – F $\mu = 0$

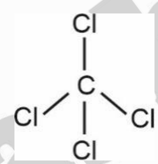


$\mu = 0$

$\mu \neq 0$



$\mu \neq 0$



$\mu = 0$

H – Cl $\mu \neq 0$

4. At 345 K, the half life for the decomposition of a sample of a gaseous compound initially at 55.5 kPa was 340 s. When the pressure was 27.8 kPa, the half life was found to be 170 s. The order of the reaction is ________. [integer answer]

Answer (0)

Sol. $t_{1/2} \propto \frac{1}{[P_0]^{n-1}}$

$$\frac{(t_{1/2})_1}{(t_{1/2})_2} = \frac{[P_0]_2^{n-1}}{[P_0]_1^{n-1}}$$

$$\frac{340}{170} = \left(\frac{27.8}{55.5}\right)^{n-1}$$

$$2 = \left(\frac{1}{2}\right)^{n-1}$$

$2 = (2)^{1-n}$

$1 - n = 1$

$n = 0$

5. A solution of $Fe_2(SO_4)_3$ is electrolyzed for 'x' min with a current of 1.5 A to deposit 0.3482 g of Fe. The value of x is _______. [nearest integer]

Given : 1 F = 96500 C mol^{-1}

Atomic mass of Fe = 56 g mol^{-1}

Answer (20)

Sol. $Fe^{3+} + 3e^- \rightarrow Fe$

Moles of Fe deposited = $\frac{0.3482}{56} = 6.2 \times 10^{-3}$

For 1 mole Fe, charge required is 3 F

For 6.2×10^{-3} mole Fe, charge required is $3 \times 6.2 \times 10^{-3}$ F

Since, charge required $= 18.6 \times 10^{-3} \times 96500$ C

$= 1794.9$ C

And,

$1.5 \times t = 1794.9$

$t = \frac{1794.9}{1.5 \times 60}$ min

$t \simeq 20$ min

6. Consider the following reactions:

$PCl_3 + H_2O \rightarrow A + HCl$

$A + H_2O \rightarrow B + HCl$

The number of ionisable protons present in the product B is

Answer (2)

Sol. $PCl_3 + H_2O \longrightarrow \underset{A}{P(OH)Cl_2} + HCl$

$\underset{A}{P(OH)Cl_2} + H_2O \longrightarrow \underset{B}{P(OH)_2Cl} + HCl$

Hydrogen attached with oxygen are ionisable. Hence number of ionisable protons present in compound B are 2.

7. Amongst $FeCl_3.3H_2O$, $K_3[Fe(CN)_6)]$ and $[Co(NH_3)_6]Cl_3$, the spin-only magnetic moment value of the inner-orbital complex that absorbs light at shortest wavelength is_______B.M. [nearest integer]

Answer (2)

Sol. $[Fe(H_2O)_3Cl_3] \rightarrow$ Outer-orbital complex

$K_3[Fe(CN)_6] \rightarrow$ Inner-orbital complex

$[Co(NH_3)_6]Cl_3 \rightarrow$ Inner-orbital complex

Since CN^- is a strong field ligand than NH_3. Hence $K_3[Fe(CN)_6]$ is the inner-orbital complex that absorbs light at shortest wavelength.

Fe(III) $\rightarrow$ valence shell configuration $3d^5$

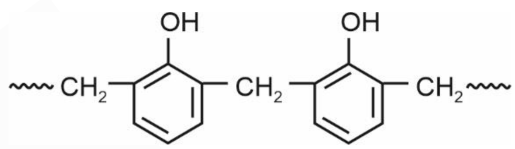
Since CN^- will do pairing, so unpaired electron = 1

$\mu = \sqrt{1(1+2)} = \sqrt{3}$ BM $\simeq 2$ BM

8. The Novolac polymer has mass of 963 g. The number of monomer units present in it are

Answer (9)

Sol. Novolac is



Molar mass of monomer is 107 g/mol

$n = \frac{963}{107} = 9$

Number of monomer units present in it are 9.

9. How many of the given compounds will give a positive Biuret test_________? Glycine, Glycylalanine, Tripeptide, Biuret.

Answer (2)

Sol. Since dipeptides and free amino acids do not give biuret test. Hence glycine and glycylalanine do not give this test.

10. The neutralization occurs when 10 mL of 0.1M acid 'A' is allowed to react with 30 mL of 0.05 M base $M(OH)_2$. The basicity of the acid 'A' is_________.

[M is a metal]

Answer (3)

Sol. Milieq of acid A = Milieq of base $M(OH)_2$

$(M \times V \times n - Factor)_A = (M \times V \times n - Factor)_{M(OH)_2}$

[n-Factor of $M(OH)_2$ = 2]

$0.1 \times 10 \times$ n-Factor $= 0.05 \times 30 \times 2$

$(n\text{-Factor})_A = 3$

Hence basicity of acid A is 3.