



















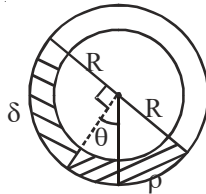
$$f = 1 - 0.6 = 0.4$$

$$f = \frac{d}{\rho_{oil}}$$

$$0.4 = \frac{0.6}{\rho_{oil}}$$

$$\rho_{oil} = 1.5$$

34. A uniform long tube is bent into a circle of radius  $R$  and it lies in vertical plane. Two liquids of same volume but densities  $\rho$  and  $\delta$  fill half the tube. The angle  $\theta$  is



- (A)  $\tan^{-1}\left(\frac{\rho - \delta}{\rho + \delta}\right)$       (B)  $\tan^{-1}\frac{\rho}{\delta}$       (C)  $\tan^{-1}\frac{\delta}{\rho}$       (D)  $\tan^{-1}\left(\frac{\rho + \delta}{\rho - \delta}\right)$

**Ans : (A)**

**Hints :**  $\delta gR (\cos \theta + \sin \theta) = \rho gR (\cos \theta - \sin \theta)$

$$\delta \cos \theta + \delta \sin \theta = \rho \cos \theta - \rho \sin \theta$$

$$\sin \theta (\delta + \rho) = \cos \theta (\rho - \delta)$$

$$\tan \theta = \frac{\rho - \delta}{\rho + \delta}$$

35. Two solid spheres of same metal but of mass  $M$  and  $8M$  fall simultaneously on a viscous liquid and their terminal velocities are  $v$  and  $nv$  then value of  $n$  is

- (A) 16      (B) 8      (C) 4      (D) 2

**Ans : (C)**

**Hints :**  $m = \frac{4}{3} \pi r^3 \times \rho$

$$m \propto r^3$$

$$\left(\frac{r_1}{r_2}\right)^3 = \frac{1}{8}$$

$$\frac{r_1}{r_2} = \frac{1}{2}$$

$$6\pi nrV = \frac{4}{3} \pi r^3 (d = \rho)$$

$$V \propto r^2, \quad \frac{V_1}{V_2} = \frac{1}{4}$$

$$n = 4$$

36. A particle is executing linear simple harmonic motion of amplitude  $A$ . At what displacement is the energy of the particle half potential and half kinetic ?

- (A)  $\frac{A}{4}$       (B)  $\frac{A}{2}$       (C)  $\frac{A}{\sqrt{2}}$       (D)  $\frac{A}{\sqrt{3}}$

**Ans : (C)**

**Hints :** Total Energy (E) =  $\frac{1}{2}m\omega^2 A^2$

P.E. =  $\frac{1}{2}m\omega^2 x^2$

As P.E. =  $\frac{E}{2}$

Then,  $\frac{1}{2}m\omega^2 A^2 \times \frac{1}{2} = \frac{1}{2}m\omega^2 x^2$

$x^2 = \frac{A^2}{2} \Rightarrow x = \frac{A}{\sqrt{2}}$

37. The equation of a progressive wave is  $y = 4 \sin(4\pi t - 0.04x + \pi/3)$  where  $x$  is in meter and  $t$  is in second. The velocity of the wave is  
 (A)  $100\pi$  m/s                      (B)  $50\pi$  m/s                      (C)  $25\pi$  m/s                      (D)  $\pi$  m/s

**Ans : (A)**

**Hints :** Velocity of wave =  $\frac{\omega}{K} = \frac{4\pi}{0.04} = 100\pi$  m/sec

38. A longitudinal wave is represented by  $x = x_0 \sin 2\pi(nt - x/\lambda)$ . The maximum particle velocity will be four times the wave velocity if:  
 (A)  $\lambda = \frac{\pi x_0}{4}$                       (B)  $\lambda = 2\pi x_0$                       (C)  $\lambda = \frac{\pi x_0}{2}$                       (D)  $\lambda = 4\pi x_0$

**Ans : (C)**

**Hints :** Maximum particle velocity ( $V_p$ ) =  $A\omega = 2\pi n x_0$

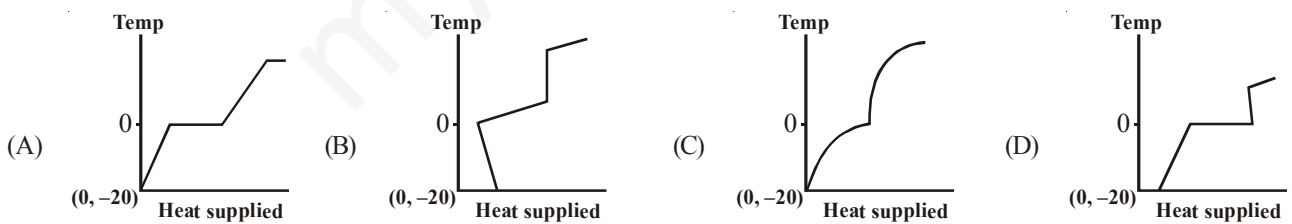
Wave velocity ( $V_w$ ) =  $n\lambda$

Here,  $V_p = 4V_w$

$2\pi n x_0 = 4n\lambda$

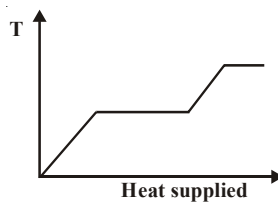
$\lambda = \frac{\pi}{2} x_0$

39. A block of ice at temperature  $-20^\circ\text{C}$  is slowly heated and converted to steam at  $100^\circ\text{C}$ . Which of the following diagram is most appropriate ?



**Ans : (A)**

**Hints :**



40. Two black bodies at temperatures 327 °C and 427 °C are kept in an evacuated chamber at 27 °C. The ratio of their rates of loss of heat are :

(A)  $\frac{6}{7}$                       (B)  $\left(\frac{6}{7}\right)^2$                       (C)  $\left(\frac{6}{7}\right)^3$                       (D)  $\frac{243}{464}$

**Ans : (D)**

**Hints :** Rate of loss of heat  $\propto (T^4 - T_0^4)$

$$\frac{E_1}{E_2} = \frac{T_1^4 - T_0^4}{T_2^4 - T_0^4} = \frac{(600)^4 - (300)^4}{(700)^4 - (300)^4} = \frac{6^4 - 3^4}{7^4 - 3^4}$$

$$\frac{E_1}{E_2} = \frac{243}{464}$$

At identical temperature and pressure, the rate of diffusion of hydrogen gas is  $3\sqrt{3}$  times that of a hydrocarbon having molecular formula  $C_nH_{2n-2}$ . What is the value of 'n' ?

(A) 1                      (B) 4                      (C) 3                      (D) 8

**Ans : (B)**


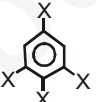
**Hints :**  $\frac{r_{H_2}}{r_{C_nH_{2n-2}}} = \sqrt{\frac{M_{C_nH_{2n-2}}}{M_{H_2}}} = \sqrt{\frac{M_{C_nH_{2n-2}}}{2}}$

$$\therefore \sqrt{\frac{M_{C_nH_{2n-2}}}{2}} = 3\sqrt{3} = \sqrt{27}$$

$$\Rightarrow M_{C_nH_{2n-2}} = 27 \times 2 = 54$$


$$\text{Hence, } 12n + (2n-2) \times 1 = 54 \Rightarrow 14n = 56 \Rightarrow n = 4$$

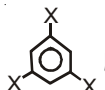
Thus Hydrocarbon is  $C_4H_6$

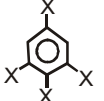
42. Dipole moment of  is 1.5D. The dipole moment of  is

(A) 1.5D                      (B) 2.25D                      (C) 1D                      (D) 3D

**Ans : (A)**

**Hints :** Given for this molecule   $\mu_1 = 1.5D$

For   $\mu = 0$  ( as it is symmetrical)

Hence for   $\mu$  will be 1.5D

43. Which of the following thermodynamic relation is correct ?

(A)  $dG = VdP - SdT$                       (B)  $dE = PdV + TdS$                       (C)  $dH = -VdP + TdS$                       (D)  $dG = VdP + SdT$

**Ans : (A)**

**Hints :**  $dG = dH - TdS - SdT$  (as  $G = H - TS$ )

again,  $H = U + PV$

$$\therefore dH = dU + PdV + VdP$$

$$\& dU = TdS - PdV$$

$$\text{Thus } dG = (TdS - PdV) + PdV + VdP - TdS - SdT = VdP - SdT$$

44. In the hydrolysis of an organic chloride in presence of large excess of water;  $\text{RCI} + \text{H}_2\text{O} \rightarrow \text{ROH} + \text{HCl}$   
 (A) Molecularity and order of reaction both are 2 (B) Molecularity is 2 but order of reaction is 1  
 (C) Molecularity is 1 but order of reaction is 2 (D) Molecularity is 1 and order of reaction is also 1

**Ans : (B)**

**Hints :** As water used is in large excess.

45. The potential of a hydrogen electrode at pH = 10 is  
 (A) 0.59 V (B) 0.00 V (C) -0.59 V (D) -0.059

**Ans : (C)**

**Hints :**  $\text{H}^+(\text{pH} = 10) | \text{H}_2(1\text{atm}) | \text{Pt}(\text{s})$

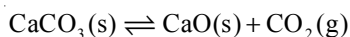
Reaction :  $2\text{H}^+(\text{pH} = 10) + 2\text{e}^- \rightarrow \text{H}_2(1\text{atm})$

$$E = E^0 - \frac{0.0591}{2} \log \left( \frac{P_{\text{H}_2}}{[\text{H}^+]^2} \right)$$

$$= 0 - \frac{0.0591}{2} \log \frac{1}{(10^{-10})^2} = -\frac{0.0591}{2} \times 2 \log \frac{1}{10^{-10}} = -0.0591 \times 10 = -0.591$$

i.e.  $E = -0.591 \text{ V}$

46. Calculate  $K_c$  for the reversible process given below if  $K_p = 167$  and  $T = 800^\circ\text{C}$



- (A) 1.95 (B) 1.85 (C) 1.89 (D) 1.60

**Ans : (C)**

**Hints :**  $K_p = K_c(\text{RT})^{\Delta n}$

for eq<sup>n</sup>  $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ ,  $\Delta n = 1$

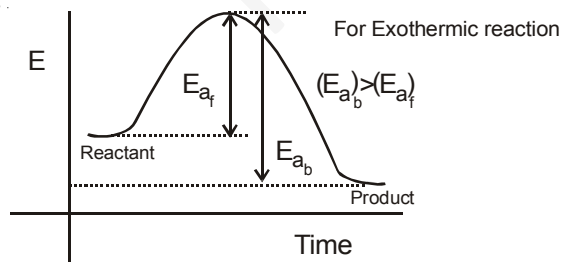
$$K_c = \frac{K_p}{(\text{RT})^{\Delta n}} = \frac{167}{(0.0821 \times 1073)^1} = 1.89$$

47. For a reversible chemical reaction where the forward process is exothermic, which of the following statements is correct ?

- (A) The backward reaction has higher activation energy than the forward reaction  
 (B) The backward and the forward processes have the same activation energy  
 (C) The backward reaction has lower activation energy  
 (D) No activation energy is required at all since energy is liberated in the process.

**Ans : (A)**

**Hints :**

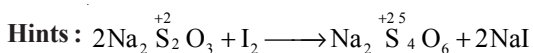


48. In Sommerfeld's modification of Bohr's theory, the trajectory of an electron in a hydrogen atom is  
 (A) a perfect ellipse  
 (B) a closed ellipse – like curve, narrower at the perihelion position and flatter at the aphelion position  
 (C) a closed loop on spherical surface  
 (D) a rosette

**Ans : (C)**

49. In the reaction of sodium thiosulphate with  $I_2$  in aqueous medium the equivalent weight of sodium thiosulphate is equal to  
 (A) molar mass of sodium thiosulphate (B) the average of molar masses of  $Na_2S_2O_3$  and  $I_2$   
 (C) half the molar mass of sodium thiosulphate (D) molar mass of sodium thiosulphate  $\times 2$

**Ans : (A)**



n-factor = 1

$$E = \frac{M}{1} = M$$

50. 0.1 (M) HCl and 0.1 (M)  $H_2SO_4$  each of volume 2ml are mixed and the volume is made up to 6 ml by adding 2ml of 0.01 (N) NaCl solution. The pH of the resulting mixture is

- (A) 1.17 (B) 1.0 (C) 0.3 (D)  $\log 2 - \log 3$

**Ans : (B)**

**Hints :** Mili moles of  $H^+ = 0.1 \times 2 + 0.1 \times 2 \times 2 = 0.6$

Total volume in ml = 6

$$pH = -\log_{10}[H^+] = -\log\left(\frac{0.6}{6}\right) = -\log 0.1 = 1$$

51. The molarity of a NaOH solution by dissolving 4 g of it in 250 ml water is

- (A) 0.4 M (B) 0.8 M (C) 0.2 M (D) 0.1 M

**Ans : (A)**

**Hints :** Molarity =  $\frac{4 / 40}{250 / 1000} = 0.4$

52. If a species has 16 protons, 18 electrons and 16 neutrons, find the species and its charge

- (A)  $S^{1-}$  (B)  $Si^{2-}$  (C)  $P^{3-}$  (D)  $S^{2-}$

**Ans : (D)**

**Hints :** 16p means  $z = 16$

$18e^-$  means, 2 unit negative charge is present.

Hence species is  $S^{2-}$

53. In a periodic table the basic character of oxides

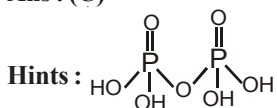
- (A) increases from left to right and decreases from top to bottom  
 (B) decreases from right to left and increases from top to bottom  
 (C) decreases from left to right and increases from top to bottom  
 (D) decreases from left to right and increases from bottom to top

**Ans : (C)**

54. Which one of the following contains P – O – P bond ?

- (A) Hypophosphorus acid (B) Phosphorus acid (C) Pyrophosphoric acid (D) Orthophosphoric acid

**Ans : (C)**



55. Which of the following orders regarding ionization energy is correct ?

- (A)  $N > O > F$  (B)  $N < O < F$  (C)  $N > O < F$  (D)  $N < O > F$

**Ans : (C)**

**Hints :** As  $IE_1$ ,  $N > O$  (because of half filled orbitals of N)

and  $O < F$  (because of smaller size of F)

56. Which of the following statements regarding ozone is not correct ?

- (A) The Ozone molecule is angular in shape  
 (B) The Ozone is a resonance hybrid of two structures  
 (C) The Oxygen– Oxygen bond length in ozone is identical with that of molecular oxygen  
 (D) Ozone is used as germicide and disinfectant for the purification of air.

**Ans : (C)**

**Hints :** Due to resonance the bond order in ozone is 1.5, hence O – O bond length in  $O_3 >$  O – O bond length in  $O_2$

57.  $P_4O_{10}$  is the anhydride of

- (A)  $H_3PO_2$  (B)  $H_3PO_3$  (C)  $H_3PO_4$  (D)  $H_4P_2O_7$

**Ans : (C)**

**Hints :**  $4H_3PO_4 \longrightarrow P_4O_{10} + 6H_2O$

58. Which of the following metals has the largest abundance in the earth's crust ?

- (A) Aluminium (B) Calcium (C) Magnesium (D) Sodium

**Ans : (A)**

59. Which of the following orbitals will have zero probability of finding the electron in the yz plane ?

- (A)  $P_x$  (B)  $P_y$  (C)  $P_z$  (D)  $d_{yz}$

**Ans : (A)**

**Hints :**  $P_x$  orbital lies along x-axis only.

60. What type of orbital hybridisation is considered on P in  $PCl_5$  ?

- (A)  $sp^3d$  (B)  $dsp^3$  (C)  $sp^3d^2$  (D)  $d^2sp^3$

**Ans : (A)**

61. For which element the inertness of the electron pair will not be observed?

- (A) Sn (B) Fe (C) Pb (D) In

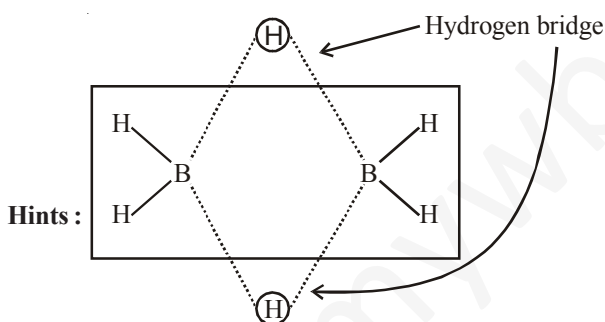
**Ans : (B)**

**Hints :** Inert pair effect is exhibited only by heavy metals of p-block elements

62. In which of the following molecules is hydrogen bridge bond present?

- (A) Water (B) Inorganic benzene (C) Diborane (D) Methanol

**Ans : (C)**



63. When a manganous salt is fused with a mixture of  $KNO_3$  and solid NaOH the oxidation number of Mn changes from +2 to

- (A) +4 (B) +3 (C) +6 (D) +7

**Ans : (C)**

**Hints :**  $Mn^{+2} + NO_3^- + OH^- \rightarrow MnO_4^{2-} + H_2O$

64. In hemoglobin the metal ion present is

- (A)  $Fe^{2+}$  (B)  $Zn^{2+}$  (C)  $Co^{2+}$  (D)  $Cu^{2+}$

**Ans : (A)**

65. Ortho-and para-hydrogens have

- (A) Identical chemical properties but different physical properties  
(B) Identical physical and chemical properties  
(C) Identical physical properties but different chemical properties  
(D) Different physical and chemical properties

**Ans : (A)**

66. The bond order of CO molecule is  
 (A) 2 (B) 2.5 (C) 3 (D) 3.5

**Ans : (C)**

**Hints :**  $\text{CO} \rightarrow \sigma(1s)^2, \sigma^*(1s)^2, \sigma(2s)^2, \sigma(2p_z)^2, \pi(2p_x)^2 = \pi(2p_y)^2, \sigma^*(2s)^2$

$$\text{B.O} = \frac{N_b - N_o}{2} = \frac{10 - 4}{2} = 3$$

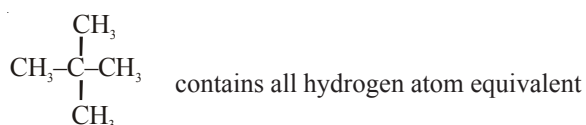
67. Vitamin C is  
 (A) Citric acid (B) Lactic acid (C) Paracetamol (D) Ascorbic acid

**Ans : (D)**

68. On mixing an alkane with chlorine and irradiating with ultra-violet light, it forms only one mono-chloro-alkane. The alkane is  
 (A) Propane (B) Pentane (C) Isopentane (D) Neopentane

**Ans : (D)**

**Hints :** Neopentane



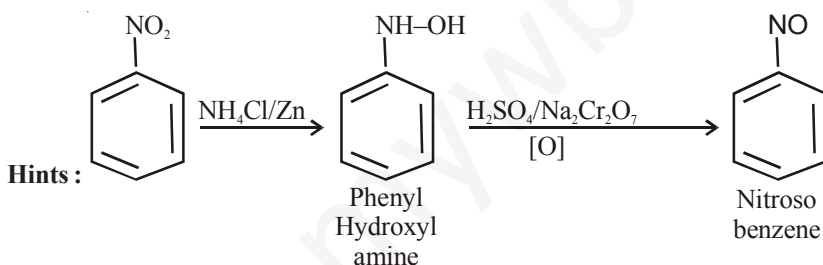
69. Keto-enol tautomerism is not observed in  
 (A)  $\text{C}_6\text{H}_5\text{COC}_6\text{H}_5$  (B)  $\text{C}_6\text{H}_5\text{COCH}=\text{CH}_2$  (C)  $\text{C}_6\text{H}_5\text{COCH}_2\text{COCH}_3$  (D)  $\text{CH}_3\text{COCH}_2\text{COCH}_3$

**Ans : (A)** as contains no  $\alpha$  - H

70. What is obtained when nitrobenzene is treated sequentially with (i)  $\text{NH}_4\text{Cl}/\text{Zn}$  dust and (ii)  $\text{H}_2\text{SO}_4/\text{Na}_2\text{Cr}_2\text{O}_7$  ?

- (A) meta-chloronitrobenzene (B) para-chloronitrobenzene  
 (C) nitrosobenzene (D) benzene

**Ans : (C)**



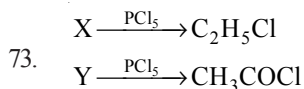
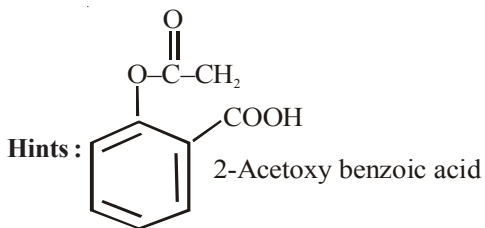
71. Boiling water reacts with  $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^-$  to give  
 (A) aniline (B) benzylamine (C) phenol (D) benzaldehyde

**Ans : (C)**

**Hints :**  $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- \xrightarrow[\text{(Boil)}]{\text{H}_2\text{O}} \text{C}_6\text{H}_5\text{OH} (\text{S}_{\text{N}}\text{Ar})$

72. Aspirin is  
 (A) Acetyl salicylic acid (B) Benzoyl salicylic acid  
 (C) Chloro benzoic acid (D) Anthranilic acid

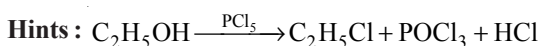
**Ans : (A)**



X and Y are

- (A)  $(\text{C}_2\text{H}_5)_2\text{O}$  and  $\text{CH}_3\text{CO}_2\text{H}$  (B)  $\text{C}_2\text{H}_5\text{I}$  and  $\text{C}_2\text{H}_5\text{CHO}$  (C)  $\text{C}_2\text{H}_5\text{OH}$  and  $\text{CH}_3\text{CO}_2\text{H}$  (D)  $\text{C}_2\text{H}_5\text{OH}$  and  $\text{C}_2\text{H}_5\text{CHO}$

Ans: (C)



74. Which of the following compounds shows evidence of the strongest hydrogen bonding?  
 (A) Propan-1-ol (B) Propan-2-ol (C) Propan-1,2-diol (D) Propan-1,2,3-triol

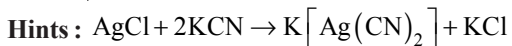
Ans: (D)

Hints: Propan-1,2,3 triol have three polar -OH group.

75. When AgCl is treated with KCN

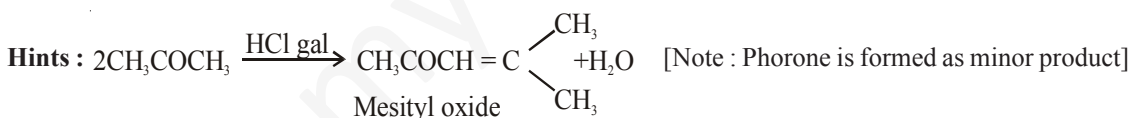
- (A) Ag is precipitated (B) a complex ion is formed  
 (C) double decomposition takes place (D) no reaction takes place

Ans: (B)



76. Which one of the following produced when acetone is saturated with HCl gas?  
 (A) Acetone alcohol (B) Phorone (C) Mesityl oxide (D) Benzene

Ans: (C)



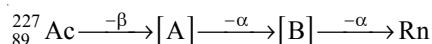
77. Which one of the following is an example of co-polymer?  
 (A) Buna-S (B) Teflon (C) PVC (D) Polypropylene

Ans: (A)

Hints: Buna-S is a co-polymer of butadiene and styrene

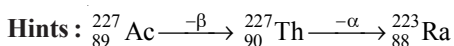


78. Identify [A] and [B] in the following



- (A) Po, Rn (B) Th, Po (C) Ra, Th (D) Th, Ra

Ans: (D)

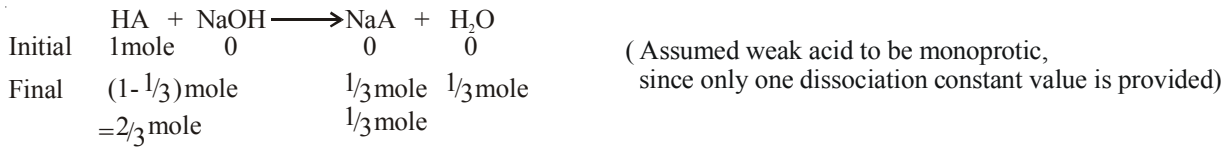




79. A weak acid of dissociation constant  $10^{-5}$  is being titrated with aqueous NaOH solution. The pH at the point of one-third neutralisation of the acid will be  
 (A)  $5 + \log 2 - \log 3$  (B)  $5 - \log 2$  (C)  $5 - \log 3$  (D)  $5 - \log 6$

**Ans : (B)**

**Hints :**  $K_a = 10^{-5} \Rightarrow pK_a = -\log K_a = -\log 10^{-5} = 5$



Final solution acts as an acidic buffer.

$$\Rightarrow \text{pH} = \text{p}K_a + \log \frac{[\text{salt}]}{[\text{Acid}]} \Rightarrow \text{pH} = 5 + \log \frac{\frac{1}{3}}{\frac{2}{3}} = 5 + \log \frac{1}{2} \Rightarrow \text{pH} = 5 - \log 2$$

80. Radioactivity of a sample ( $z=22$ ) decreases 90% after 10 years. What will be the half life of the sample?  
 (A) 5 years (B) 2 years (C) 3 years (D) 10 years

**Ans : (C)**

**Hints :**  $t = 10$  yrs     $t_{\frac{1}{2}} = ?$

$$\lambda = \frac{2.303}{t} \log \frac{N_0}{N_t}$$

Since radioactivity decreases 90% in 10 yrs.  $\Rightarrow N_0 = 100$  &  $N_t = 10$

$$\text{Thus } \lambda = \frac{2.303}{10} \log \frac{100}{10} \Rightarrow \lambda = \frac{2.303}{10}$$

$$\text{since } t_{\frac{1}{2}} = \frac{0.693}{\lambda} = \frac{2.303 \times \log 2}{\lambda} \Rightarrow t_{\frac{1}{2}} = \frac{2.303 \times \log 2}{2.303 / 10}$$

$$\Rightarrow t_{\frac{1}{2}} = (\log 2) \times 10 \approx 3 \text{ years}$$

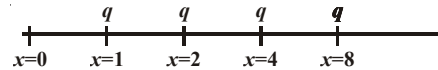
**DESCRIPTIVE TYPE QUESTIONS**  
**SUB : PHYSICS & CHEMISTRY**

- 1 A circular disc rolls down on an inclined plane without slipping. What fraction of its total energy is translational?

A. Fraction = 
$$\frac{\frac{1}{2}mV^2}{\frac{1}{2}mV^2 + \frac{1}{2}(mK^2)\frac{V^2}{R^2}} = \frac{1}{1 + \frac{K^2}{R^2}} = \frac{1}{1 + \frac{1}{2}} = \frac{2}{3}$$

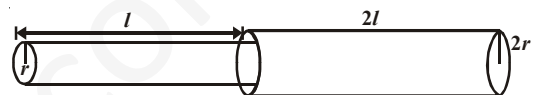
- 2 An infinite number of charges, each equal to  $q$ , are placed along the  $x$ -axis at  $x = 1, x = 2, x = 4, x = 8$  and so on. What is the potential at  $x = 0$  due to this set of charges ?

A. 
$$V = \frac{q}{4\pi\epsilon_0} \left[ \frac{1}{1} + \frac{1}{2} + \frac{1}{2^2} + \frac{1}{2^3} + \dots \right] = \frac{q}{4\pi\epsilon_0} \frac{1}{1 - \frac{1}{2}} = \frac{2q}{4\pi\epsilon_0}$$



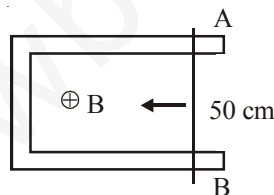
- 3 A liquid flows through two capillary tubes A and B connected in series. The length and radius of B are twice those of A. What is the ratio of the pressure difference across A to that across B?

A. 
$$Q = \frac{\pi P_1 r_1^4}{8nl_1} = \frac{\pi P_2 r_2^4}{8nl_2}$$



$$\frac{P_1}{P_2} = \left( \frac{r_2}{r_1} \right)^4 \times \frac{l_1}{l_2} = \left( \frac{2r}{r} \right)^4 \times \frac{l}{2l} = 16 \times \frac{1}{2} = 8$$

- 4 A 50 cm long conductor AB moves with a speed 4 m/s in a magnetic field  $B = 0.01 \text{ Wb/m}^2$  as shown. Find the e.m.f. generated and power delivered if resistance of the circuit is  $0.1 \Omega$ .



A. e.m.f. ( $e$ ) =  $vBl = 4 \times 0.01 \times 50 \times 10^{-2} = 200 \times 10^{-4} = 2 \times 10^{-2} \text{ V}$

Power =  $P = \frac{e^2}{R} = \frac{4 \times 10^{-4}}{0.1} = 4 \times 10^{-3} \text{ watt}$

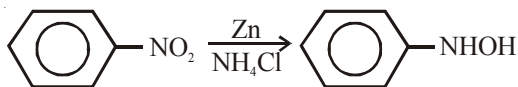
- 5 An electron is moving with a velocity  $(2\hat{i} + 2\hat{j}) \text{ m/s}$  in an electric field of intensity  $\vec{E} = \hat{i} + 2\hat{j} - 8\hat{k} \text{ Volt/m}$  and a magnetic field of  $\vec{B} = (2\hat{j} + 3\hat{k}) \text{ tesla}$ . Find the magnitude of force on the electron.

A. 
$$\vec{F} = q(\vec{E} + \vec{V} \times \vec{B}) = (1.6 \times 10^{-19})(7\hat{i} - 4\hat{j} - 4\hat{k})$$

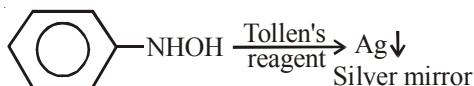
$$|\vec{F}| = 1.6 \times 10^{-19} \times 9 = 14.4 \times 10^{-19} \text{ N}$$

6. How nitrobenzene is identified using Mulliken-Barker test?

A : Nitrobenzene is reduced using Zn and  $\text{NH}_4\text{Cl}$  in alcohol medium.



The N-phenyl hydroxylamine when reacts with Tollen's reagent gives bright silver mirror.



7. Calculate the ratio of the rate of diffusion of oxygen to the rate of diffusion of hydrogen at constant temperature and pressure.

$$\text{A : } \frac{r_{\text{O}_2}}{r_{\text{H}_2}} = \sqrt{\frac{2}{32}} = \frac{1}{4}$$

8. Why  $\text{B}_2$  is paramagnetic whereas  $\text{C}_2$  is diamagnetic?

A : For  $\text{B}_2$  ( $10\bar{e}$ ) the MO configuration is  $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x^1 = \pi 2p_y^1)$

Due to presence of unpaired electron  $\{\pi 2p_x^1 = \pi 2p_y^1\}$  it shows paramagnetism.

$\text{C}_2$  ( $12\bar{e}$ ) the MO configuration is  $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x^2 = \pi 2p_y^2)$

No unpaired electrons are there in  $\text{C}_2$   $\{\pi 2p_x^2 = \pi 2p_y^2\}$ , hence it shows diamagnetism.

9. Explain briefly the cause of Lanthanoid contraction.

A : On moving in the lanthanid series from left to right successive electrons enter into ante penultimate 4f-subshell which imparts very poor shielding effect (due to its diffused nature), hence effective nuclear charge gradually increases with increase in atomic number. That is why shrinkage is observed on moving through lanthanide series, this is known as lanthanide contraction.

10. Explain why aniline is not as basic as ammonia.

A : In aniline the lone-pair over nitrogen atom is in conjugation with the  $\pi$ -electrons of the benzene ring and it takes part in resonance. That is why availability of lone-pair is not as that as in ammonia. Thus aniline is less basic than ammonia.

**by Aakash Institute & Aakash IIT-JEE**  
**MULTIPLE CHOICE QUESTIONS**  
**SUB : BIOLOGY**

1. First Genetically modified plant commercially released in India is :  
(A) Golden rice                      (B) Slow ripening tomato                      (C) Bt-brinjal                      (D) Bt-Cotton  
**Ans : (D)**  
**Hints :** Bt cotton was developed by MAHYCO (Maharashtra Hybrid Seed Company Limited) in collaboration with Monsanto.
2. Quiescent centre is found in plants at :  
(A) Root tip                      (B) Cambium                      (C) Shoot tip                      (D) Leaf tip  
**Ans : (A)**  
**Hints :** It is a zone of low mitotic activity located in the sub-apical region of root.
3. In a DNA molecule distance between two bases is  
(A) 2 nm/20Å                      (B) 0.2 nm/2Å                      (C) 3.4 nm / 34 Å                      (D) 0.34 nm/3.4 Å  
**Ans : (D)**  
**Hints :** The distance between two bases is 0.34 nm / 3.4 Å
4. Exine of pollen grain is made up of  
(A) Pectocellulose                      (B) Ligno cellulose                      (C) Sporopollenin                      (D) Pollen Kit  
**Ans : (C)**  
**Hints :** Sporopollenin is the product of oxidative polymerisation of carotenoids.
5. When the cell is fully turgid, its  
(A)  $DPD = OP$                       (B)  $DPD = \text{Zero}$                       (C)  $WP = TP$                       (D)  $OP = \text{Zero}$   
**Ans : (B)**  
**Hints :** Since  $DPD = OP - TP$   
In a fully turgid cell,  $OP = TP$   
 $\therefore DPD = \text{Zero}$
6. Which one is true for ATP ?  
(A) ATP is prosthetic part of an enzyme                      (B) ATP is an enzyme  
(C) ATP is organic ions of enzyme                      (D) ATP is a Co-enzyme  
**Ans : (D)**  
**Hints :** ATP is a multifunctional nucleotide which acts as a coenzyme.
7. Root cells of Wheat has  $2n = 42$  chromosomes. Which one of the following is the basic chromosome number of Wheat ?  
(A) 42                      (B) 21                      (C) 7                      (D) 14  
**Ans : (C)**

**Hints :** For wheat,  $2n = 6x = 42$

$\therefore x = 7$

'x' represents basic or genomic number.

8. Purines possess nitrogen at

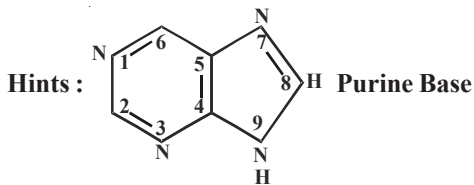
(A) 1, 2, 4 and 6 position

(B) 1, 3, 5 and 7 position

(C) 1, 3, 7 and 9 position

(D) 1, 2, 6 and 8 position

**Ans : (C)**



9. Thylakoids occur inside

(A) Mitochondria

(B) Chloroplast

(C) Golgi apparatus

(D) Endoplasmic reticulum

**Ans : (B)**

**Hints :** Thylakoid occurs in chloroplast.

10. Micropropagation is a technique

(A) for production of true to type plants

(B) for production of haploid plant

(C) for production of Somatic hybrids

(D) for production of Soma clonal plants

**Ans : (A)**

**Hints :** Raising of new plantlets through tissue culture technique producing similar plants (true type plants).

11. Test cross is a cross between

(A) Hybrid  $\times$  Dominant parent

(B) Hybrid  $\times$  Recessive parent

(C) Hybrid  $\times$  Hybrid parent

(D) Two distantly related species

**Ans : (B)**

**Hints :** Test cross -  $F_1$  hybrid is crossed with recessive parent.

12. Mitochondria are semi autonomous as they possess

(A) DNA

(B) DNA + RNA

(C) DNA + RNA Ribosomes

(D) Protein

**Ans : (C)**

**Hints :** Due to presence of 70s ribosome, RNA and *ds* circular DNA mitochondria is semiautonomous.

13. Chitin is a

(A) Polysaccharide

(B) Nitrogenous polysaccharide

(C) Lipo Protein

(D) Protein

**Ans : (B)**

**Hints :**

Polymer of N-acetylglucosamine ( $C_8H_{13}O_5N$ )<sub>n</sub> that forms exoskeleton of arthropods and cell wall of fungi.

14. Balbiani rings are the sites of

(A) DNA replication

(B) RNA and protein synthesis

(C) Synthesis of lipids

(D) Synthesis of polysaccharides

**Ans : (B)**

**Hints :** These rings contain active DNA so RNA and proteins are synthesized here.

15. Which of the cell organelle lacks membrane ?

(A) Mesosome

(B) Mitochondria

(C) Ribosome

(D) Liposome

**Ans : (C)**

**Hints :** Smallest cell organelle without cell membrane is ribosome.

16. Interfacicular cambium is a  
 (A) Primary meristematic tissue (B) Primordial meristem  
 (C) Type of Protoderm (D) Secondary meristematic tissue  
**Ans : (D)**  
**Hints :** Parenchymatous cells present between two vascular bundles give rise to interfascicular cambium after dedifferentiation.
17. Cotton fibre is basically a type of  
 (A) Trichome (B) Scale (C) Dried seed coat (D) Non glandular hair  
**Ans : (D)**  
**Hints :** Cotton fibres are epidermal out growth in form of hairs.
18. Chloroplast dimorphism is a characteristic feature of  
 (A) Plants with Calvin cycle (B) C<sub>4</sub>-Plants  
 (C) All plants (D) Only in algae  
**Ans : (B)**  
**Hints :** Two types of chloroplast are found in plant having Kranz anatomy
19. In which type of reactions related to plant photosynthesis peroxisomes are involved ?  
 (A) Glycolate cycle (B) Calvin cycle  
 (C) Bacterial photosynthesis (D) Glyoxylate cycle  
**Ans : (A)**  
**Hints :** Peroxisome perform photorespiration that is also called as glycolate cycle.
20. The term Alpha diversity refers to  
 (A) Genetic diversity (B) Community & ecosystem diversity  
 (C) Species diversity (D) Diversity among the plants  
**Ans : (B)**  
**Hints :** Alpha diversity is a type of community or ecosystem diversity
21. How many variable segments are present in the basic structure of antibody molecules ?  
 (A) One (B) Two (C) Three (D) Four  
**Ans : (D)**  
**Hints :** 2 present in heavy chain and 2 present in light chain.
22. Which one is diaminodicarboxylic amino acid ?  
 (A) Cystine (B) Lysine (C) Cysteine (D) Aspartic Acid  
**Ans : (a)**  
**Hints :** The chemical formula is (SCH<sub>2</sub> – CH (NH<sub>2</sub>) CO<sub>2</sub>H)<sub>2</sub>
23. Which one is the cofactor of carbonic anhydrase ?  
 (A) Fe (B) Zn (C) Cu (D) Mg  
**Ans : (B)**  
**Hints :** 'Zn' acts as cofactor for carbonic anhydrase
24. Vitamin – D is produced in human body in –  
 (A) Muscles (B) Nerves (C) Skin (D) Bone-marrow  
**Ans : (C)**  
**Hints :** Vitamin D is synthesized in the skin in presence of sunlight
25. Bacteriophages kill  
 (A) Fungi (B) Parasites (C) Bacteria (D) Viruses  
**Ans : (C)**  
**Hints :** A virus that is parasite over bacteria is called Bacteriophage
26. What is mitoplast ?  
 (A) Membraneless mitochondria (B) Another name of mitochondria  
 (C) Mitochondria without outer membrane (D) Mitochondria without inner membrane  
**Ans : (C)**  
**Hints :** Mitochondria without outer membrane is called as mitoplast.

27. Transposons are –  
 (A) House - keeping genes (B) Jumping genes  
 (C) Transporting genes (D) Stationary genes  
**Ans : (B)**
28. Which of the following is not a conjugated protein ?  
 (A) Peptone (B) Phosphoprotein (C) Lipoprotein (D) Chromoprotein  
**Ans : (A)**  
**Hints :** Peptone is a derived protein. Others are conjugated proteins.
29. The outer covering of cartilage is called  
 (A) Peritonium (B) Periosteum (C) Endosteum (D) Perichondrium  
**Ans : (D)**  
**Hints :** Perichondrium is the outer covering of cartilage.
30. The blood does not clot inside the body because of :  
 (A) Oxygenation of blood (B) Movement of blood  
 (C) Heparin in blood (D) Absence of fibrinogen in blood  
**Ans : (C)**  
**Hints :** Heparin prevent clotting of blood inside the body.
31. Red cell count is carried out by –  
 (A) Haemocytometer (B) Haemoglobinometer  
 (C) Sphygmomanometer (D) Electrocardiogram  
**Ans : (A)**  
**Hints :** Blood corpuscle counting is done by this instrument.
32. Rh factor can produce disease  
 (A) AIDS (B) Turner's Syndrome (C) Erythroblastosis foetalis (D) Sickle - cell anaemia  
**Ans : (C)**  
**Hints :** During second pregnancy it may rupture foetal RBC due to antibody agglutination if the father is Rh<sup>+</sup> ve and the mother is Rh<sup>-</sup> ve.
33. Name the hormone that stimulates the secretion of gastric juice  
 (A) Renin (B) Enterokinase (C) Enterogastrone (D) Gastrin  
**Ans : (D)**  
**Hints :** Gastric glands are activated by this secretion of Argentaffin cell.
34. Bile salts act as activator of which enzyme ?  
 (A) Pepsinogen (B) Trypsinogen (C) Lipase (D) Pancreatic amylase  
**Ans : (C)**  
**Hints :** Bile salt activates lipase & also emulsifies the fat
35. Heparin is produced by –  
 (A) Kidney Cells (B) Blood Cells (C) Bone marrow (D) Liver cell  
**Ans : (D)**  
**Hints :** Heparin is produced by liver cells mainly.
36. Which of the following cells produce HCl ?  
 (A)  $\beta$ -Cell (B)  $\alpha$ -Cell (C) Oxyntic Cell (D) Chief Cell  
**Ans : (C)**  
**Hints :** Oxyntic or parietal cell of stomach secretes HCl.
37. Which ribs show "bucket - handle" type of movement ?  
 (A) Rib No. 1 – 2 (B) Rib No. 3 – 5 (C) Rib No. 6 – 10 (D) Rib No. 11 – 12  
**Ans : (C)**  
**Hints :** The upward and downward movement of the shaft of the rib no 6 - 10 has been likened to raising the handle from the side of a bucket. Therefore, they show bucket handle movement

38. In which of the following subjects the dead space is highest ?  
 (A) Old man (B) Old woman (C) Young man (D) Young woman  
**Ans : (A)**  
**Hints :** Old man having high dead space volume due to low supply of blood to lungs
39. Which one has the thickest wall ?  
 (A) Right auricle (B) Right Ventricle (C) Left auricle (D) Left ventricle  
**Ans : (D)**  
**Hints :** The thickest wall of heart is found in left ventricle.
40. The cardiac cycle in normal subject is about  
 (A) 0.5 second (B) 0.8 second (C) 1.0 second (D) 1.2 second  
**Ans : (B)**  
**Hints :** One cardiac cycle is completed in 0.8 sec.
41. What is glycosuria ?  
 (A) Low amount of sugar in urine (B) Low amount of fat in urine  
 (C) Average amount of carbohydrate in urine (D) High amount of sugar in urine  
**Ans : (D)**  
**Hints :** Glycosuria is the high amount of sugar in urine mainly due to insulin deficiency.
42. Volume of urine is regulated by –  
 (A) Aldosterone (B) Aldosterone and testosterone  
 (C) ADH (D) Aldosterone and ADH  
**Ans : (D)**  
**Hints :** Volume of urine is regulated by Aldosterone and ADH via RAAS involving juxta medullary nephron.
43. Skin is an accessory organ of respiration in –  
 (A) Human (B) Frogs (C) Rabbit (D) Lizard  
**Ans : (B)**  
**Hints :** Skin is an accessory respiratory organ in amphibians.
44. Name the condition when the concentration of Ketone body increases in urine  
 (A) Acromegaly (B) Diabetes mellitus (C) Diabetes insipidus (D) Cushing's disease  
**Ans : (B)**  
**Hints :** In diabetes mellitus ketone body synthesis increases due to cellular starvation.
45. Hormone responsible for the secretion of milk after parturition  
 (A) ICSH (B) Prolactin (C) ACTH (D) LH  
**Ans : (B)**  
**Hints :** Prolactin secreted from pituitary is responsible for secretion of milk after parturition.
46. Endemic goitre is a state of  
 (A) Increased thyroid function (B) Normal thyroid function  
 (C) Decreased thyroid function (D) Moderate thyroid function  
**Ans : (C)**  
**Hints :** Endemic goitre is due to low iodine in soil and water in hilly areas.
47. Islets of Langerhans are found in  
 (A) Anterior Pituitary (B) Kidney Cortex (C) Spleen (D) Endocrine pancreas  
**Ans : (D)**  
**Hints :** Islets of Langerhans are the endocrine part of pancreas.
48. Which of the following is the function of Adrenaline ?  
 (A) Helps in gastric juice secretion (B) Increases heart rate and blood pressure  
 (C) Increases blood calcium (D) Helps in milk secretion  
**Ans : (B)**  
**Hints :** Adrenaline is released in stress condition and is responsible for increased heart rate and blood pressure.



49. Which of the following is not related to the autonomic nervous system ?  
 (A) Peristalsis (B) Digestion (C) Excretion (D) Memory and learning  
**Ans : (D)**  
**Hints :** Autonomic nervous system controls involuntary functions of the visceral organs.
50. Comprehension of spoken and written words take place in the region of  
 (A) Association Area (B) Motor Area (C) Wernicke's Area (D) Broca's Area  
**Ans : (C)**  
**Hints :** Wernicke's area is responsible for understanding speech.
51. Which one of the following cranial nerves is carrying the nerve fibres originating from the Edinger-Westphal nucleus ?  
 (A) Oculomotor (B) Trochlear (C) Abducens (D) Vagus  
**Ans : (A)**  
**Hints :** Oculomotor nerve has oculomotor nucleus and Edinger-Westphal nucleus.
52. How many laminae are present in the grey matter of spinal cord ?  
 (A) Four (B) Six (C) Eight (D) Ten  
**Ans : (D)**  
**Hints :** Rexed, based on the cyto architectural pattern as well as on the density of neuronal packing, identified several groups of arrangement which are 10 in number and now called Rexed laminae.
53. Colour blindness is due to defect in  
 (A) Cones (B) Rods (C) Rods and cones (D) Rhodopsin  
**Ans : (A)**  
**Hints :** Cones are related with coloured vision.
54. MRI is not allowed in the following conditions except one. Identify the exception.  
 (A) Presence of pacemaker in the body  
 (B) Pregnant women  
 (C) Person suffering from stroke  
 (D) Presence of metallic plate in the body for treatment of broken bones  
**Ans : (B)**  
**Hints :** It uses no ionizing radiation, but uses a powerful magnetic field to align the nuclear magnetization of Hydrogen atom in water inside body.
55. Which of the following diseases is related to cadmium pollution ?  
 (A) Minamata (B) Pneumoconiosis (C) Anaemia (D) Itai-itai  
**Ans : (D)**  
**Hints :** Itai-Itai (ouch-ouch disease) is due to Cd poisoning in the drinking water result into skeletal deformity.
56. Percentage composition of Fibroin and Sericin in silk is  
 (A) 50 : 40 (B) 80 : 20 (C) 30 : 70 (D) 40 : 60  
**Ans : (B)**  
**Hints :** Fibroin is the core silk protein and sericin is the surface gum-like compound.
57. Which one of the following is used as biological insecticide ?  
 (A) Tiger beetle (B) Caterpillar (C) Silkworm (D) Mazra Poka  
**Ans : (A)**  
**Hints :** Caterpillar - larval stage of insects, silkworm is used in silk culture and Mazra poka is the paddy pest.
58. Which one of the following diseases is spread by Housefly ?  
 (A) Dengue fever (B) Encephalitis (C) Filariasis (D) Typhoid  
**Ans : (D)**  
**Hints :** Others are spread by mosquito.
59. Water-Vascular system is found in  
 (A) Sea-anemone (B) Sea-pen (C) Sea-cucumber (D) Sea-horse  
**Ans : (C)**  
**Hints :** Water vascular system is found in echinoderms.

60. Nutrient enrichment of a lake will cause  
 (A) Eutrophication (B) Stratification (C) Biomagnification (D) Bioaccumulation  
**Ans : (A)**  
**Hints :** Eutrophication or nutrient enrichment of water body is basically due to excessive presence of nitrates & phosphates.
61. Lichens are described as indicator of  
 (A) Air pollution (B) Water pollution (C) Soil pollution (D) Agriculture productivity  
**Ans : (A)**  
**Hints :** Lichens are indicator plant of air pollution particularly of SO<sub>2</sub>
62. Most abundant mineral of animal body is  
 (A) Iron (B) Sodium (C) Potassium (D) Calcium  
**Ans : (D)**  
**Hints :** Primary component of bones and also present in muscles and blood.
63. Retrogressive metamorphosis occurs in  
 (A) Hemichordata (B) Cephalochordata (C) Urochordata (D) Vertebrata  
**Ans : (C)**  
**Hints :** Larva is more developed and has notochord and locomotory organ
64. 'Organ of Jacobson' helps in  
 (A) Touch (B) Vision (C) Smell (D) Hear  
**Ans : (C)**  
**Hints :** Also called vomeronasal organ. It is an olfactory sense organ. Commonly found in reptiles.
65. Cysticercus stage is formed in  
 (A) *Taenia* (B) *Plasmodium* (C) *Leishmania* (D) *Wuchereria*  
**Ans : (A)**  
**Hints :** Formed in the life-cycle of pork tapeworm (*Taenia solium*)
66. Which one of the following viruses contains both DNA and RNA ?  
 (A) Cyanophage (B) Herpes Virus (C) Leuko Virus (D) Polio Virus  
**Ans : (C)**  
**Hints :** Lenko virus (a Retro virus) possess both DNA & RNA in life cycle.
67. The hormone responsible for "Fight and Flight" response is  
 (A) Adrenalin (B) Thyroxine (C) ADH (D) Oxytocin  
**Ans : (A)**  
**Hints :** Fight and flight response is due to adrenalin released from adrenal medulla.
68. Tuberculosis is caused by :  
 (A) *Mycobacterium sp.* (B) *Aspergillus sp.* (C) *Clostridium sp.* (D) *Vibrio sp.*  
**Ans : (A)**  
**Hints :** T. B. is caused by *Mycobacterium tuberculi*.
69. Which of the following is a catadromous fish ?  
 (A) *Hilsa sp.* (B) *Mystus sp.* (C) *Anguilla sp.* (D) *Channa sp.*  
**Ans : (C)**  
**Hints :** *Anguilla sp.* (Eel) is a catadromous fish that lives in freshwater and breeds in sea.
70. Which animal of the following belongs to class crustacea ?  
 (A) Cockroach (B) Cyclops (C) Grasshopper (D) Mosquito  
**Ans : (B)**  
**Hints :** Class crustacea includes *cyclops*. Other options are from class insecta.
71. Radula is found in :  
 (A) *Pila sp.* (B) *Chiton sp.* (C) *Lamellidens sp.* (D) *Pinctada sp.*  
**Ans : (A)**  
**Hints :** Radula is found in gastropods.

72. The scientific name of Java man is

- (A) *Homo habilis* (B) *Homo sapiens neanderthalensis*  
(C) *Homo erectus erectus* (D) *Australopithecus boisei*

**Ans : (C)**

**Hints :** Scientific name *Homo erectus erectus* was given by Ernst Mayr.

73. Which phase comes in between the G<sub>1</sub> and G<sub>2</sub> phases of cell cycle ?

- (A) M-phase (B) Go-phase (C) S-phase (D) Interphase

**Ans : (C)**

**Hints :** The sequence of Interphase (I-phase) is G<sub>1</sub> → S → G<sub>2</sub>

74. How many effective codons are there for the synthesis of twenty amino acids ?

- (A) 64 (B) 32 (C) 60 (D) 61

**Ans : (D)**

**Hints :** Out of 64 codons, 61 codons code for amino acids & the rest three - UAG, UAA & UGA are stop codons (i.e do not specify any amino acid)

75. Which of the following condition is called monosomic ?

- (A) 2n+1 (B) 2n+2 (C) n+1 (D) 2n-1

**Ans : (D)**

**Hints :** Monosomy (2n-1) is a kind of aneuploidy where one chromosome is devoid of its homologue.

76. Chromosome is made up of

- (A) DNA + pectin (B) RNA + DNA (C) DNA + Histone (D) Only histone

**Ans : (C)**

**Hints :** Chemical composition of a typical chromosome : DNA=40%, Histone = 50%, Non histone = 8.5%, RNA=1.5%

77. Cell division can not be stopped in which phase of the cell cycle ?

- (A) G<sub>1</sub>-phase (B) G<sub>2</sub>-phase (C) S-phase (D) Prophase

**Ans : (C)**

**Hints :** The check points are basically present in the interphase.

78. Which of the following is structural subunit of DNA ?

- (A) Protein (B) Carbohydrate (C) RNA (D) Nucleotides

**Ans : (D)**

**Hints :** DNA is the polymer of deoxyribonucleotides.

79. Cell theory is not applicable for

- (A) Bacteria (B) Fungus (C) Algae (D) Virus

**Ans : (D)**

**Hints :** Since virus lacks cellular organization so, cell theory is not applicable.

80. The difference between systolic and diastolic pressure in human is

- (A) 120 mmHg (B) 80 mmHg (C) 40 mmHg (D) 200 mmHg

**Ans : (C)**

**Hints :** This is called as pulse pressure. Normal systolic pressure = 120 mm Hg

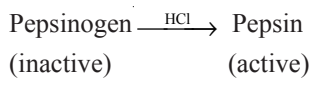
Normal Diastolic pressure = 80 mm Hg

***DESCRIPTIVE TYPE QUESTIONS***  
**SUB : BIOLOGY**

1. What is Cochlear microphonics ?
  - A. It is the electrical potential generated in the hair cells of organ of Corti in response to acoustic stimulation, called as cochlear microphonic.
2. What is axon reflex ?
  - A. Axon reflex is a response brought on by peripheral nerve stimulation. It is also known as Hunter reflex reaction as it causes vasodilation and loss of body heat from extremities.
3. What is enterohepatic circulation of bile salt ? Mention its significance .
  - A. Enterohepatic recirculation operates between ileum and liver in which bile salts are absorbed from ileum and re-enters into liver for the reutilisation of bile salts.
4. Mention the location and function of juxtaglomerular apparatus .
  - A. JGA is found between the vascular pole of the renal corpuscle and the returning DCT of the same nephron.  
Function of JGA : It secretes renin & erythropoietin. Renin controls RAAS and is responsible for osmoregulation.
5. What is telomere ? State its function .
  - A. Telomere is a region of repetitive DNA at the end of a chromosome. It protects the end of the chromosome from deterioration.
6. Name two internal characteristic features of class Mammalia.
  - A. Internal characteristic of class mammalia
    - Presence of corpus callosum in brain.
    - Presence of Sertoli cells in testis.
    - Presence of diaphragm.
    - Presence of spongy lungs.
    - Presence of corpus luteum
7. State the advantages of composite fish culture.
  - A. Advantage of composite fish culture are
    1. Different type of carps reared in the same pond.
    2. It is economical and highly productive.
    3. Carps reared in different strata of pond habitat utilise different types of food.
8. What is ribophorin ?
  - A. Ribophorins are ribosome receptor proteins that aid in the binding 60S subunit of ribosomes to the rough endoplasmic reticulum. Two kinds of Ribophorins are Ribophorin I and Ribophorin II.

9. What is Pro-enzyme ?

A. These are inactive forms of enzymes which are activated in presence of activators.



10. Name two sulphur containing and two basic amino acids .

A. The sulphur containing amino acids are

– Methionine

– Cysteine

– Cystine

Basic amino acids are :

– Lysine

– Arginine

– Histidine

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**MULTIPLE CHOICE QUESTIONS**  
**SUB : MATHEMATICS**

1. The value of  $\frac{\cot x - \tan x}{\cot 2x}$  is  
(A) 1 (B) 2 (C) -1 (D) 4

**Ans : (B)**

**Hints :**  $\frac{\cos^2 x - \sin^2 x}{\sin x \cos x} \times \frac{\sin 2x}{\cos 2x} = \frac{2 \cos 2x}{\sin 2x} \times \frac{\sin 2x}{\cos 2x} = 2$

2. The number of points of intersection of  $2y = 1$  and  $y = \sin x$ , in  $-2\pi \leq x \leq 2\pi$  is  
(A) 1 (B) 2 (C)  $\infty^3 = 4^3$  (D) 4

**Ans : (D)**

**Hints :**  $y = \frac{1}{2} = \sin x$

$-2\pi \leq x \leq 2\pi$

$x = \frac{\pi}{6}, \frac{5\pi}{6}, -\frac{7\pi}{6}, -\frac{11\pi}{6}$

No. of sol<sup>n</sup> 4

3. Let  $R$  be the set of real numbers and the mapping  $f : R \rightarrow R$  and  $g : R \rightarrow R$  be defined by  $f(x) = 5 - x^2$  and  $g(x) = 3x - 4$ , then the value of  $(f \circ g)(-1)$  is  
(A) -44 (B) -54 (C) -32 (D) -64

**Ans : (A)**

**Hints :**  $f(g(-1)) = f(-3-4) = f(-7) = 5 - 49 = -44$

4.  $A = \{1, 2, 3, 4\}$ ,  $B = \{1, 2, 3, 4, 5, 6\}$  are two sets, and function  $f : A \rightarrow B$  is defined by  $f(x) = x + 2 \forall x \in A$ , then the function  $f$  is  
(A) bijective (B) onto (C) one-one (D) many-one

**Ans : (C)**

**Hints :**  $f(x) = f(y) \Rightarrow x + 2 = y + 2 \Rightarrow x = y \therefore$  one-one

5. If the matrices  $A = \begin{bmatrix} 2 & 1 & 3 \\ 4 & 1 & 0 \end{bmatrix}$  and  $B = \begin{bmatrix} 1 & -1 \\ 0 & 2 \\ 5 & 0 \end{bmatrix}$ , then  $AB$  will be

(A)  $\begin{bmatrix} 17 & 0 \\ 4 & -2 \end{bmatrix}$

(B)  $\begin{bmatrix} 4 & 0 \\ 0 & 4 \end{bmatrix}$

(C)  $\begin{bmatrix} 17 & 4 \\ 0 & -2 \end{bmatrix}$

(D)  $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

**Ans : (A)**

**Hints:**  $AB = \begin{bmatrix} 2 & 1 & 3 \\ 4 & 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 0 & 2 \\ 5 & 0 \end{bmatrix} = \begin{bmatrix} 17 & 0 \\ 4 & -2 \end{bmatrix}$

6.  $\omega$  is an imaginary cube root of unity and  $\begin{vmatrix} x + \omega^2 & \omega & 1 \\ \omega & \omega^2 & 1 + x \\ 1 & x + \omega & \omega^2 \end{vmatrix} = 0$  then one of the values of  $x$  is

- (A) 1 (B) 0 (C) -1 (D) 2

**Ans: (B)**

**Hints:**  $\xrightarrow{C_1 \rightarrow C_1 + C_2 + C_3} \begin{vmatrix} x & \omega & 1 \\ x & \omega^2 & 1 + x \\ x & x + \omega & \omega^2 \end{vmatrix} = x \begin{vmatrix} 1 & \omega & 1 \\ 1 & \omega^2 & 1 + x \\ 1 & x + \omega & \omega^2 \end{vmatrix}$

$= x \begin{vmatrix} 1 & \omega & 1 \\ 0 & \omega^2 - \omega & x \\ 0 & x & \omega^2 - 1 \end{vmatrix} = x \{ (\omega^2 - \omega)(\omega^2 - 1) - x^2 \} = 0 \Rightarrow x = 0$  One value of  $x = 0$

7. If  $A = \begin{bmatrix} 1 & 2 \\ -4 & -1 \end{bmatrix}$  then  $A^{-1}$  is

- (A)  $\frac{1}{7} \begin{bmatrix} -1 & -2 \\ 4 & 1 \end{bmatrix}$  (B)  $\frac{1}{7} \begin{bmatrix} 1 & 2 \\ -4 & -1 \end{bmatrix}$  (C)  $\frac{1}{7} \begin{bmatrix} -1 & -2 \\ 4 & 1 \end{bmatrix}$  (D) Does not exist

**Ans: Both (A) & (C)**

**Hints:**  $|A| = -1 + 8 = 7$

$\text{adj}(A) = \begin{bmatrix} +(-1) & -(2) \\ -(-4) & +(1) \end{bmatrix} = \begin{bmatrix} -1 & -2 \\ 4 & 1 \end{bmatrix}$

$A^{-1} = \frac{1}{7} \begin{bmatrix} -1 & -2 \\ 4 & 1 \end{bmatrix}$  Both (A and C)

8. The value of  $\frac{2}{3!} + \frac{4}{5!} + \frac{6}{7!} + \dots$  is

- (A)  $e^{\frac{1}{2}}$  (B)  $e^{-1}$  (C)  $e$  (D)  $e^{\frac{1}{3}}$

**Ans: (B)**

**Hints:**  $t_n = \frac{2n}{(2n+1)!} = \frac{2n+1}{(2n+1)!} - \frac{1}{(2n+1)!} = \frac{1}{(2n)!} - \frac{1}{(2n+1)!}$

$\sum_{n=1}^{\infty} t_n = \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \frac{1}{5!} + \dots = e^{-1}$

9. If sum of an infinite geometric series is  $\frac{4}{5}$  and its 1st term is  $\frac{3}{4}$ , then its common ratio is

- (A)  $\frac{7}{16}$  (B)  $\frac{9}{16}$  (C)  $\frac{1}{9}$  (D)  $\frac{7}{9}$

**Ans: (A)**

**Hints:**  $\frac{a}{1-r} = \frac{4}{3}$       Then  $\frac{\frac{3}{4}}{1-r} = \frac{4}{3} \Rightarrow r = 1 - \frac{9}{16} = \frac{7}{16}$

10. The number of permutations by taking all letters and keeping the vowels of the word COMBINE in the odd places is  
 (A) 96                                      (B) 144                                      (C) 512                                      (D) 576

**Ans: (D)**

**Hints:** Vowels : O, I, E

No. of Odd place : 4

No of ways =  ${}^4P_3 \times 4! = 576$

11. If  ${}^{n-1}C_3 + {}^{n-1}C_4 > {}^nC_3$ , then n is just greater than integer  
 (A) 5                                      (B) 6                                      (C) 4                                      (D) 7

**Ans: (D)**

**Hints:**  ${}^{n-1}C_3 + {}^{n-1}C_4 > {}^nC_3$

$$\Rightarrow {}^nC_4 > {}^nC_3 \Rightarrow \frac{n!}{4!(n-4)!} > \frac{n!}{3!(n-3)!} \Rightarrow \frac{1}{4} > \frac{1}{(n-3)} \Rightarrow n-3 > 4 \Rightarrow n > 7$$

12. If in the expansion of  $(a - 2b)^n$ , the sum of the 5th and 6th term is zero, then the value of  $\frac{a}{b}$  is

- (A)  $\frac{n-4}{5}$                                       (B)  $\frac{2(n-4)}{5}$                                       (C)  $\frac{5}{n-4}$                                       (D)  $\frac{5}{2(n-4)}$

**Ans: (B)**

**Hints:**  $(a - 2b)^n = \sum_{r=0}^n {}^nC_r (a)^{n-r} (-2b)^r$

$$t_5 + t_6 = 0$$

$$\Rightarrow {}^nC_4 (a)^{n-4} (-2b)^4 + {}^nC_5 (a)^{n-5} (-2b)^5 = 0 \Rightarrow \frac{n!}{4!(n-4)!} a^{n-4} (-2b)^4 = -\frac{n!}{5!(n-5)!} (a)^{n-5} (-2b)^5$$

$$\Rightarrow \frac{1}{(n-4)} \times a = \frac{-1}{5} (-2b) \Rightarrow \frac{a}{b} = \frac{2(n-4)}{5}$$

13.  $(2^{3n} - 1)$  will be divisible by  $(\forall n \in \mathbb{N})$   
 (A) 25                                      (B) 8                                      (C) 7                                      (D) 3

**Ans: (C)**

**Hints:**  $2^{3n} = (8)^n = (1 + 7)^n = {}^nC_0 + {}^nC_1 7 + {}^nC_2 7^2 + \dots + {}^nC_n 7^n$

$$\Rightarrow 2^{3n} - 1 = 7 [ {}^nC_1 + {}^nC_2 7 + \dots + {}^nC_n 7^{n-1} ]$$

$\therefore$  divisible by 7

14. Sum of the last 30 coefficients in the expansion of  $(1 + x)^{59}$ , when expanded in ascending powers of x is  
 (A)  $2^{59}$                                       (B)  $2^{58}$                                       (C)  $2^{30}$                                       (D)  $2^{29}$

**Ans: (B)**

**Hints:** Total terms = 60

$$\text{Sum of first 30 terms} = \frac{\text{Sum of all the terms}}{2} = \frac{2^{59}}{2} = 2^{58}$$

15. If  $(1 - x + x^2)^n = a_0 + a_1x + \dots + a_{2n}x^{2n}$ , then the value of  $a_0 + a_2 + a_4 + \dots + a_{2n}$  is

- (A)  $3^n + \frac{1}{2}$                                       (B)  $3^n - \frac{1}{2}$                                       (C)  $\frac{3^n - 1}{2}$                                       (D)  $\frac{3^n + 1}{2}$

**Ans: (D)**



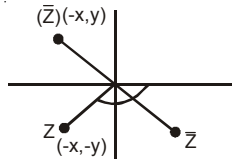


20. If  $-\pi < \arg(z) < -\frac{\pi}{2}$  then  $\arg \bar{z} - \arg(-\bar{z})$  is

- (A)  $\pi$  (B)  $-\pi$  (C)  $\frac{\pi}{2}$  (D)  $-\frac{\pi}{2}$

**Ans : (A)**

**Hints :**



if  $\arg(z) = -\pi + \theta$

$\Rightarrow \arg(\bar{z}) = \pi - \theta$

$\arg(-\bar{z}) = -\theta$

$\arg(\bar{z}) - \arg(-\bar{z}) = \pi - \theta - (-\theta) = \pi - \theta + \theta = \pi$

21. Two dice are tossed once. The probability of getting an even number at the first die or a total of 8 is

- (A)  $\frac{1}{36}$  (B)  $\frac{3}{36}$  (C)  $\frac{11}{36}$  (D)  $\frac{23}{36}$

**Ans : (D)**

**Hints :** A = getting even no on 1st dice

B = getting sum 8

So  $|A| = 18$   $|B| = 5$   $|A \cap B| = 3$

So  $P(A \cup B) = \frac{18 + 5 - 3}{36} = \frac{20}{36}$  (No option matches)

22. The probability that at least one of A and B occurs is 0.6 . If A and B occur simultaneously with probability 0.3, then  $P(A') + P(B')$  is

- (A) 0.9 (B) 0.15 (C) 1.1 (D) 1.2

**Ans : (C)**

**Hints :**  $P(A \cup B) = 0.6$

$P(A) + P(B) = P(A \cup B) + P(A \cap B) = 0.9$

$P(A \cap B) = 0.3$

$P(A') + P(B') = 2 - 0.9 = 1.1$

23. The value of  $\frac{\log_3 5 \times \log_{25} 27 \times \log_{49} 7}{\log_{81} 3}$  is

- (A) 1 (B) 6 (C)  $\frac{2}{3}$  (D) 3

**Ans : (D)**

**Hints :**  $\frac{\left(\frac{\log 5}{\log 3} \times \frac{3 \log 3}{2 \log 5} \times \frac{\log 7}{2 \log 7}\right)}{\left(\frac{\log 3}{4 \log 3}\right)} = 3$

24. In a right-angled triangle, the sides are a, b and c, with c as hypotenuse, and  $c-b \neq 1, c+b \neq 1$ . Then the value of  $(\log_{c+b} a + \log_{c-b} a) / (2 \log_{c+b} a \times \log_{c-b} a)$  will be

(A) 2 (B) -1 (C)  $\frac{1}{2}$  (D) 1

**Ans : (D)**

**Hints :**  $c^2 = a^2 + b^2$

$\Rightarrow c^2 - b^2 = a^2$

$$\frac{\frac{\log a}{\log(c+b)} + \frac{\log a}{\log(c-b)}}{2 \log a \times \log a} = \frac{\log a (\log(c^2 - b^2))}{2 \log a \log a} = \frac{\log a^2}{\log a^2} = 1$$

25. Sum of n terms of the following series  $1^3 + 3^3 + 5^3 + 7^3 + \dots$  is

(A)  $n^2(2n^2 - 1)$  (B)  $n^3(n - 1)$  (C)  $n^3 + 8n + 4$  (D)  $2n^4 + 3n^2$

**Ans : (A)**

**Hints :**  $\sum (2n-1)^3$

$$\begin{aligned} & \sum \{(8n^3 - 3.4n^2 + 3.2n - 1)\} \\ & = 2n^2(n+1)^2 - 2n(n+1)(2n+1) + 3n(n+1) - n \\ & = 2n^4 + 4n^3 + 2n^2 - 2n[2n^2 + 3n + 1] + 3n^2 + 3n - n \\ & = 2n^4 + 4n^3 + 2n^2 - 4n^3 - 6n^2 - 2n + 3n^2 + 3n - n \\ & = 2n^4 - n^2 \\ & = n^2(2n^2 - 1) \end{aligned}$$

26. G. M. and H. M. of two numbers are 10 and 8 respectively. The numbers are :

(A) 5, 20 (B) 4, 25 (C) 2, 50 (D) 1, 100

**Ans : (A)**

**Hints :**  $\sqrt{ab} = 10 \Rightarrow ab = 100$

$$\frac{2ab}{a+b} = 8$$

$$a+b=25$$

So  $a=5, b=20$

27. The value of n for which  $\frac{x^{n+1} + y^{n+1}}{x^n + y^n}$  is the geometric mean of x and y is

(A)  $n = -\frac{1}{2}$  (B)  $n = \frac{1}{2}$  (C)  $n = 1$  (D)  $n = -1$

**Ans : (A)**

**Hints :**  $\frac{x^{n+1} + y^{n+1}}{x^n + y^n} = \sqrt{xy} \Rightarrow x^{n+1} + y^{n+1} = \sqrt{xy}(x^n + y^n)$

$$x^{n+\frac{1}{2}} \left( x^{\frac{1}{2}} - y^{\frac{1}{2}} \right) = y^{n+\frac{1}{2}} \left( x^{\frac{1}{2}} - y^{\frac{1}{2}} \right), \left( \frac{x}{y} \right)^{n+\frac{1}{2}} = 1 \quad n = -\frac{1}{2}$$

28. If angles A, B and C are in A.P., then  $\frac{a+c}{b}$  is equal to

- (A)  $2 \sin \frac{A-C}{2}$       (B)  $2 \cos \frac{A-C}{2}$       (C)  $\cos \frac{A-C}{2}$       (D)  $\sin \frac{A-C}{2}$

**Ans : (B)**

**Hints :**  $2B = A + C$

$$= \frac{\sin A + \sin C}{\sin B} = \frac{2 \sin \left( \frac{A+C}{2} \right) \cos \left( \frac{A-C}{2} \right)}{\sin B} = \frac{2 \sin B}{\sin B} \cos \left( \frac{A-C}{2} \right) = 2 \cos \left( \frac{A-C}{2} \right)$$

29. If  $\frac{\cos A}{3} = \frac{\cos B}{4} = \frac{1}{5}$ ,  $-\frac{\pi}{2} < A < 0$ ,  $-\frac{\pi}{2} < B < 0$  then value of  $2 \sin A + 4 \sin B$  is

- (A) 4      (B) -2      (C) -4      (D) 0

**Ans : (C)**

**Hints :**  $\cos A = \frac{3}{5}$        $\sin A = -\frac{4}{5}$

$\cos B = \frac{4}{5}$        $\sin B = -\frac{3}{5}$

$= 2 \left( -\frac{4}{5} \right) + 4 \left( -\frac{3}{5} \right) = -\frac{20}{5} = -4$

30. The value of  $\frac{\cot 54^\circ}{\tan 36^\circ} + \frac{\tan 20^\circ}{\cot 70^\circ}$  is

- (A) 0      (B) 2      (C) 3      (D) 1

**Ans : (B)**

**Hints :**  $\frac{\cot 54^\circ}{\tan 36^\circ} + \frac{\tan 20^\circ}{\cot 70^\circ} = \frac{\tan 36^\circ}{\tan 36^\circ} + \frac{\tan 20^\circ}{\tan 20^\circ} = 1 + 1 = 2$

31. If  $\sin 6\theta + \sin 4\theta + \sin 2\theta = 0$  then the general value of  $\theta$  is

- (A)  $\frac{n\pi}{4}, n\pi \pm \frac{\pi}{3}$       (B)  $\frac{n\pi}{4}, n\pi \pm \frac{\pi}{6}$       (C)  $\frac{n\pi}{4}, 2n\pi \pm \frac{\pi}{3}$       (D)  $\frac{n\pi}{4}, 2n\pi \pm \frac{\pi}{6}$

**Ans : (A)**

**Hints :**  $2 \sin 4\theta \cos 2\theta + \sin 4\theta = 0$

$\sin 4\theta = 0$        $2 \cos 2\theta = -1$

$4\theta = n\pi$        $\cos 2\theta = -\frac{1}{2} = \cos \frac{2\pi}{3}$

$\theta = \frac{n\pi}{4}$        $2\theta = 2n\pi \pm \frac{2\pi}{3}, \Rightarrow \theta = n\pi \pm \frac{\pi}{3}$

32. In a  $\Delta ABC$ ,  $2ac \sin \frac{A-B+C}{2}$  is equal to

- (A)  $a^2 + b^2 - c^2$       (B)  $c^2 + a^2 - b^2$       (C)  $b^2 - a^2 - c^2$       (D)  $c^2 - a^2 - b^2$

**Ans : (B)**

**Hints :**  $2ac \sin \left( \frac{A+C-B}{2} \right) \left[ \frac{A+C}{2} = \frac{\pi}{2} - \frac{B}{2} \right], = 2ac \sin \left( \frac{\pi}{2} - B \right) = 2ac \cos B = a^2 + c^2 - b^2$

33. Value of  $\tan^{-1}\left(\frac{\sin 2-1}{\cos 2}\right)$  is
- (A)  $\frac{\pi}{2}-1$                       (B)  $1-\frac{\pi}{4}$                       (C)  $2-\frac{\pi}{2}$                       (D)  $\frac{\pi}{4}-1$

**Ans : (B)**

**Hints :**  $\tan^{-1}\left(\frac{\sin 2-1}{\cos 2}\right) = \tan^{-1}\left(\frac{-(\sin 1-\cos 1)^2}{(\cos 1-\sin 1)(\cos 1+\sin 1)}\right) = -\tan^{-1}\left(\frac{\cos 1-\sin 1}{\cos 1+\sin 1}\right) = 1-\frac{\pi}{4}$

34. The straight line  $3x+y=9$  divides the line segment joining the points (1,3) and (2,7) in the ratio
- (A) 3 : 4 externally                      (B) 3 : 4 internally                      (C) 4 : 5 internally                      (D) 5 : 6 externally

**Ans : (B)**

**Hints :** Ratio =  $-\frac{3+3-9}{6+7-9} = \frac{3}{4}$  internally

35. If the sum of distances from a point P on two mutually perpendicular straight lines is 1 unit, then the locus of P is
- (A) a parabola                      (B) a circle                      (C) an ellipse                      (D) a straight line

**Ans : (D)**

**Hints :**  $|x| + |y| = 1$

36. The straight line  $x + y - 1 = 0$  meets the circle  $x^2 + y^2 - 6x - 8y = 0$  at A and B. Then the equation of the circle of which AB is a diameter is

(A)  $x^2 + y^2 - 2y - 6 = 0$                       (B)  $x^2 + y^2 + 2y - 6 = 0$                       (C)  $2(x^2 + y^2) + 2y - 6 = 0$                       (D)  $3(x^2 + y^2) + 2y - 6 = 0$

**Ans : (A)**

**Hints :**  $x^2 + y^2 - 6x - 8y + \lambda(x + y - 1) = 0$

Centre =  $\left(3 - \frac{\lambda}{2}, 4 - \frac{\lambda}{2}\right)$  Lie on  $x + y - 1 = 0$

$3 - \frac{\lambda}{2} + 4 - \frac{\lambda}{2} - 1 = 0, \lambda = 6$

$x^2 + y^2 - 6x - 8y + 6x + 6y - 6 = 0; \quad x^2 + y^2 - 2y - 6 = 0$

37. If  $t_1$  and  $t_2$  be the parameters of the end points of a focal chord for the parabola  $y^2 = 4ax$ , then which one is true?

(A)  $t_1 t_2 = 1$                       (B)  $\frac{t_1}{t_2} = 1$                       (C)  $t_1 t_2 = -1$                       (D)  $t_1 + t_2 = -1$

**Ans : (C)**

**Hints :**  $t_1 t_2 = -1$  Fact

38. S and T are the foci of an ellipse and B is end point of the minor axis. If STB is an equilateral triangle, the eccentricity of the ellipse is

(A)  $\frac{1}{4}$                       (B)  $\frac{1}{3}$                       (C)  $\frac{1}{2}$                       (D)  $\frac{2}{3}$

**Ans : (C)**

**Hints :**  $\frac{b}{ae} = \sqrt{3}; \quad b = \sqrt{3}ae$

$e^2 = \frac{a^2 - 3a^2 e^2}{a^2} = 1 - 3e^2; \quad 4e^2 = 1 \Rightarrow e = \frac{1}{2}$

39. For different values of  $\alpha$ , the locus of the point of intersection of the two straight lines  $\sqrt{3}x - y - 4\sqrt{3}\alpha = 0$  and  $\sqrt{3}\alpha x + \alpha y - 4\sqrt{3} = 0$  is

- (A) a hyperbola with eccentricity 2  
 (B) an ellipse with eccentricity  $\sqrt{\frac{2}{3}}$   
 (C) a hyperbola with eccentricity  $\sqrt{\frac{19}{16}}$   
 (D) an ellipse with eccentricity  $\frac{3}{4}$

**Ans : (A)**

**Hints :**  $\sqrt{3}x - y = 4\sqrt{3}\alpha \dots(1)$ ;  $\sqrt{3}\alpha x + \alpha y = \frac{4\sqrt{3}}{\alpha} \dots(2)$

$$(1) \times (2) \Rightarrow 3x^2 - y^2 = 48 \Rightarrow \frac{x^2}{16} - \frac{y^2}{48} = 1$$

$$e = \sqrt{\frac{48+16}{16}} = 2$$

40. The area of the region bounded by  $y^2 = x$  and  $y = |x|$  is

- (A)  $\frac{1}{3}$  sq. unit  
 (B)  $\frac{1}{6}$  sq. unit  
 (C)  $\frac{2}{3}$  sq. unit  
 (D) 1 sq. unit

**Ans : (B)**

**Hints :**  $y^2 = x$

$$\int_0^1 (\sqrt{x} - x) dx = \left[ \frac{x^{\frac{3}{2}}}{\frac{3}{2}} - \frac{x^2}{2} \right]_0^1 = \frac{2}{3} - \frac{1}{2} = \frac{4-3}{6} = \frac{1}{6}$$

41. If the displacement, velocity and acceleration of a particle at time,  $t$  be  $x$ ,  $v$  and  $f$  respectively, then which one is true?

- (A)  $f = v^3 \frac{d^2t}{dx^2}$   
 (B)  $f = -v^3 \frac{d^2t}{dx^2}$   
 (C)  $f = v^2 \frac{d^2t}{dx^2}$   
 (D)  $f = -v^2 \frac{d^2t}{dx^2}$

**Ans : (B)**

**Hints :**  $\frac{d^2t}{dx^2} = \frac{d\left(\frac{dt}{dx}\right)}{dx} = \frac{d\left(\frac{1}{v}\right)}{dx} = -\frac{1}{v^2} \frac{dv}{dt} \times \frac{1}{v}$

$$\Rightarrow f = -v^3 f \frac{d^2t}{dx^2}$$

42. The displacement  $x$  of a particle at time  $t$  is given by  $x = At^2 + Bt + C$  where  $A, B, C$  are constants and  $v$  is velocity of a particle, then the value of  $4Ax - v^2$  is

- (A)  $4AC + B^2$   
 (B)  $4AC - B^2$   
 (C)  $2AC - B^2$   
 (D)  $2AC + B^2$

**Ans : (B)**

**Hints :**  $x = At^2 + Bt + c$

$$v = 2At + B \Rightarrow v^2 = 4A^2t^2 + 4ABt + B^2$$

$$4Ax = 4A^2t^2 + 4ABt + 4AC$$

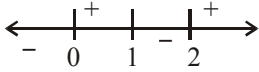
$$\Rightarrow v^2 - 4ax = B^2 - 4AC$$

$$\Rightarrow 4Ax - v^2 = 4AC - B^2$$

43. For what values of  $x$ , the function  $f(x) = x^4 - 4x^3 + 4x^2 + 40$  is monotone decreasing?  
 (A)  $0 < x < 1$  (B)  $1 < x < 2$  (C)  $2 < x < 3$  (D)  $4 < x < 5$

**Ans : (B)**

**Hints :**  $f'(x) = 4x^3 - 12x^2 + 8x = 4x(x^2 - 3x + 2)$   
 $= 4x(x-1)(x-2)$



$\therefore x$  is decreasing for  $x \in (1, 2)$

44. The displacement of a particle at time  $t$  is  $x$ , where  $x = t^4 - kt^3$ . If the velocity of the particle at time  $t = 2$  is minimum, then  
 (A)  $k = 4$  (B)  $k = -4$  (C)  $k = 8$  (D)  $k = -8$

**Ans : (A)**

**Hints :**  $\frac{dx}{dt} = 4t^3 - 3kt^2$

$\frac{dv}{dt} = 12t^2 - 6kt$  at  $t = 2$

$\Rightarrow \frac{dv}{dt} = 0, 48 - 12k = 0 \quad ; k = 4$

45. The point in the interval  $[0, 2\pi]$ , where  $f(x) = e^x \sin x$  has maximum slope, is

- (A)  $\frac{\pi}{4}$  (B)  $\frac{\pi}{2}$  (C)  $\pi$  (D)  $\frac{3\pi}{2}$

**Ans : (B)**

**Hints :**  $f'(x) = e^x(\sin x + \cos x)$

$f''(x) = e^x(\sin x + \cos x + \cos x - \sin x) \Rightarrow f''(x) = e^x \cos x = 0$

$\Rightarrow x = \frac{\pi}{2}$

46. The minimum value of  $f(x) = e^{(x^4 - x^3 + x^2)}$  is  
 (A)  $e$  (B)  $-e$  (C)  $1$  (D)  $-1$

**Ans : (C)**

**Hints :**  $f(x) = e^{(x^4 - x^3 + x^2)}, f'(x) = e^{x^4 - x^3 + x^2}$

$e^{x^4 - x^3 + x^2} (4x^3 - 3x^2 + 2x) x (4x^2 - 3x + 2)$

$\Rightarrow f(x)$  is decreasing for  $x < 0$ , increasing for  $x > 0$

$\therefore$  Minimum is at  $x = 0 \quad \therefore f(0) = e^0 = 1$

47.  $\int \frac{\log \sqrt{x}}{3x} dx$  is equal to

- (A)  $\frac{1}{3}(\log \sqrt{x})^2 + C$  (B)  $\frac{2}{3}(\log \sqrt{x})^2 + C$  (C)  $\frac{2}{3}(\log x)^2 + C$  (D)  $\frac{1}{3}(\log x)^2 + C$

**Ans : (A)**

**Hints :**  $x = t^2 \Rightarrow \int \frac{\log t}{3t^2} (2t dt) = \frac{2}{3} \int \frac{\log t}{t} dt = \frac{2}{3} \frac{(\log t)^2}{2} + c = \frac{(\log \sqrt{x})^2}{3} + c$

48.  $\int e^x \left( \frac{2}{x} - \frac{2}{x^2} \right) dx$  is equal to

- (A)  $\frac{e^x}{x} + C$       (B)  $\frac{e^x}{2x^2} + C$       (C)  $\frac{2e^x}{x} + C$       (D)  $\frac{2e^x}{x^2} + C$

**Ans : (C)**

**Hints :**  $\int e^x \left( \frac{2}{x} - \frac{2}{x^2} \right) dx = 2 \int e^x \left( \frac{1}{x} - \frac{1}{x^2} \right) dx = \frac{2e^x}{x} + c$

49. The value of the integral  $\int \frac{dx}{(e^x + e^{-x})^2}$  is

- (A)  $\frac{1}{2}(e^{2x} + 1) + C$       (B)  $\frac{1}{2}(e^{-2x} + 1) + C$       (C)  $-\frac{1}{2}(e^{2x} + 1)^{-1} + C$       (D)  $\frac{1}{4}(e^{2x} - 1) + C$

**Ans : (C)**

**Hints :**  $\int \frac{e^{2x} dx}{(e^{2x} + 1)^2}$      $e^x = t$  ;  $e^x dx = dt$

$$= \frac{1}{2} \int \frac{2t dt}{(t^2 + 1)^2} = \frac{1}{2} \left\{ -\frac{1}{(t^2 + 1)} \right\} + c = -\frac{1}{2(e^{2x} + 1)} + c$$

50. The value of  $\lim_{x \rightarrow 0} \frac{\sin^2 x + \cos x - 1}{x^2}$  is

- (A) 1      (B)  $\frac{1}{2}$       (C)  $-\frac{1}{2}$       (D) 0

**Ans : (B)**

**Hints :**  $\lim_{x \rightarrow 0} \frac{\sin^2 x + \cos x - 1}{x^2} = \lim_{x \rightarrow 0} \frac{\cos x - \cos^2 x}{x^2} = \lim_{x \rightarrow 0} \left( \frac{1 - \cos x}{x^2} \right) \cos x$

$$= \lim_{x \rightarrow 0} \frac{2 \sin^2 \frac{x}{2}}{\left( \frac{x}{2} \right)^2 \times 4} = \frac{1}{2}$$

51. The value of  $\lim_{x \rightarrow 0} \left( \frac{1+5x^2}{1+3x^2} \right)^{\frac{1}{x^2}}$  is

- (A)  $e^2$       (B)  $e$       (C)  $\frac{1}{e}$       (D)  $\frac{1}{e^2}$

**Ans : (A)**

**Hints :**  $\lim_{x \rightarrow 0} \left( \frac{1+5x^2}{1+3x^2} \right)^{\frac{1}{x^2}} = e^{\lim_{x \rightarrow 0} \frac{1}{x^2} \left( \frac{1+5x^2}{1+3x^2} - 1 \right)} = e^{\lim_{x \rightarrow 0} \frac{2x^2}{x^2(1+3x^2)}} = e^2$



52. In which of the following functions, Rolle's theorem is applicable?

(A)  $f(x) = |x|$  in  $-2 \leq x \leq 2$

(B)  $f(x) = \tan x$  in  $0 \leq x \leq \pi$

(C)  $f(x) = 1 + (x-2)^{\frac{2}{3}}$  in  $1 \leq x \leq 3$

(D)  $f(x) = x(x-2)^2$  in  $0 \leq x \leq 2$

**Ans : (D)**

**Hints :** (A)  $f(x) = |x|$  not differentiable at  $x = 0$

(B)  $f(x) = \tan x$  discontinuous at  $x = \frac{\pi}{2}$

(C)  $f(x) = 1 + (x-2)^{\frac{3}{2}}$  not differentiable at  $x = 2$

(D)  $f(x) = x(x-2)^2$  polynomial  $\therefore$  differentiable  $\forall x \in \mathbb{R}$

Hence Rolle's theorem is applicable

53. If  $f(5) = 7$  and  $f'(5) = 7$  then  $\lim_{x \rightarrow 5} \frac{xf(5) - 5f(x)}{x-5}$  is given by

(A) 35

(B) -35

(C) 28

(D) -28

**Ans : (D)**

**Hints :**  $\lim_{x \rightarrow 5} \frac{xf(5) - tf(x)}{x-5} = \lim_{x \rightarrow 5} \frac{f(5) - 5f'(x)}{1} = f(5) - 5f'(5) = 7 - 5 \times 7 = -28$

54. If  $y = (1+x)(1+x^2)(1+x^4) \dots (1+x^{2^n})$  then the value of  $\left(\frac{dy}{dx}\right)_{x=0}$  is

(A) 0

(B) -1

(C) 1

(D) 2

**Ans : (C)**

**Hints :** T-log & Differentiate

$\frac{dy}{dx} = y \left[ \frac{1}{1+x} + \frac{2x}{1+x^2} + \dots \right]$  Put  $x = 0$

$\frac{dy}{dx} = 1$

55. The value of  $f(0)$  so that the function  $f(x) = \frac{1 - \cos(1 - \cos x)}{x^4}$  is continuous everywhere is

(A)  $\frac{1}{2}$

(B)  $\frac{1}{4}$

(C)  $\frac{1}{6}$

(D)  $\frac{1}{8}$

**Ans : (D)**

**Hints :**  $\lim_{x \rightarrow 0} \frac{1 - \cos(1 - \cos x)}{x^4}$

$$\lim_{x \rightarrow 0} \frac{2 \sin^2 \left( \frac{2 \sin^2 \left( \frac{x}{2} \right)}{2} \right)}{x^4} = 2 \lim_{x \rightarrow 0} \frac{\sin^2 \left( \sin^2 \left( \frac{x}{2} \right) \right) \left( \sin^2 \left( \frac{x}{2} \right) \right)^2}{x^4 \left( \sin^2 \left( \frac{x}{2} \right) \right)^2} = 2 \lim_{x \rightarrow 0} \frac{\sin^4 \left( \frac{x}{2} \right)}{\left( \frac{x}{2} \right)^4 2^4} = \frac{1}{2^3} = \frac{1}{8}$$

56.  $\int \sqrt{1 + \cos x} \, dx$  is equal to

- (A)  $2\sqrt{2} \cos \frac{x}{2} + C$       (B)  $2\sqrt{2} \sin \frac{x}{2} + C$       (C)  $\sqrt{2} \cos \frac{x}{2} + C$       (D)  $\sqrt{2} \sin \frac{x}{2} + C$

**Ans : (B)**

**Hints :**  $\int \sqrt{1 + \cos x} \, dx = \sqrt{2} \int \cos \left( \frac{x}{2} \right) dx = 2\sqrt{2} \sin \left( \frac{x}{2} \right) + c$

57. The function  $f(x) = \sec \left[ \log \left( x + \sqrt{1 + x^2} \right) \right]$  is

- (A) odd      (B) even      (C) neither odd nor even      (D) constant

**Ans : (B)**

**Hints :**  $f(x) = \sec \left( \ln \left( x + \sqrt{1 + x^2} \right) \right) = \sec (\text{odd function}) = \text{even function}$

$\therefore \sec$  is an even function

58.  $\lim_{x \rightarrow 0} \frac{\sin |x|}{x}$  is equal to

- (A) 1      (B) 0      (C) positive infinity      (D) does not exist

**Ans : (D)**

**Hints :**  $\lim_{x \rightarrow 0} \frac{\sin |x|}{x}$

LHL = -1    RHL = 1

Limit does not exist

59. The co-ordinates of the point on the curve  $y = x^2 - 3x + 2$  where the tangent is perpendicular to the straight line  $y = x$  are

- (A) (0, 2)      (B) (1, 0)      (C) (-1, 6)      (D) (2, -2)

**Ans : (B)**

**Hints :**  $y = x^2 - 3x + 2$

$\frac{dy}{dx} = 2x - 3 = -1 \Rightarrow x = 1$  at  $x = 1, y = 0$

$\therefore$  Point is (1, 0)

60. The domain of the function  $f(x) = \sqrt{\cos^{-1} \left( \frac{1 - |x|}{2} \right)}$  is

- (A) (-3, 3)      (B) [-3, 3]      (C)  $(-\infty, -3) \cup (3, \infty)$       (D)  $(-\infty, -3] \cup [3, \infty)$

**Ans : (B)**

**Hints :**  $f(x) = \sqrt{\cos^{-1} \left( \frac{1 - |x|}{2} \right)}$

$-1 \leq \frac{1 - |x|}{2} \leq 1 \Rightarrow -2 - 1 \leq -|x| \leq 2 - 1 \Rightarrow -3 \leq -|x| \leq 1 \Rightarrow -1 \leq |x| \leq 3 \Rightarrow x \in [-3, 3]$

61. If the line  $ax + by + c = 0$  is a tangent to the curve  $xy = 4$ , then

- (A)  $a < 0, b > 0$       (B)  $a \leq 0, b > 0$       (C)  $a < 0, b < 0$       (D)  $a \leq 0, b < 0$

**Ans : (C)**

**Hints :** Slope of line =  $-\frac{a}{b}$

$$y = \frac{4}{x} = 1, \quad \frac{dy}{dx} = -\frac{4}{x^2}, \quad -\frac{a}{b} = -\frac{4}{x^2} \Rightarrow \frac{a}{b} = \frac{4}{x^2} > 0$$

$$a < 0, \quad b < 0$$

62. If the normal to the curve  $y = f(x)$  at the point  $(3, 4)$  make an angle  $3\pi/4$  with the positive x-axis, then  $f'(3)$  is

- (A) 1                                      (B) -1                                      (C)  $-\frac{3}{4}$                                       (D)  $\frac{3}{4}$

**Ans : (A)**

**Hints :**  $\frac{dy}{dx} = f'(x)$ , Slope of normal =  $-\frac{1}{f'(x)}$ ,  $-\frac{1}{f'(3)} = \tan \frac{3\pi}{4} = -1$

$$f'(3) = 1$$

63. The general solution of the different equation  $100\frac{d^2y}{dx^2} - 20\frac{dy}{dx} + y = 0$  is

- (A)  $y = (c_1 + c_2x)e^x$                       (B)  $y = (c_1 + c_2x)e^{-x}$                       (C)  $y = (c_1 + c_2x)e^{\frac{x}{10}}$                       (D)  $y = c_1e^x + c_2e^{-x}$

**Ans : (C)**

**Hints :**  $100p^2 - 20p + 1 = 0$

$$(10P - 1)^2 = 0, \quad P = \frac{1}{10}$$

$$y = (c_1 + c_2x)e^{\frac{x}{10}}$$

64. If  $y'' - 3y' + 2y = 0$  where  $y(0) = 1, y'(0) = 0$ , then the value of  $y$  at  $x = \log_e 2$  is

- (A) 1                                      (B) -1                                      (C) 2                                      (D) 0

**Ans : (D)**

**Hints :**  $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = 0$

$$m^2 - 3m + 2 = 0, \quad y = Ae^x + Be^{2x}$$

$$m = 1, \quad m = 2, \quad y' = Ae^x + 2Be^{2x}$$

$$y = 0, \quad A + B = 1 \quad A + 2B = 0, \quad A = 2, \quad B = -1$$

$$y = 2e^x - e^{2x}$$

$$y = 0 \quad \text{at } x = \ln 2$$

65. The degree of the differential equation  $x = 1 + \left(\frac{dy}{dx}\right) + \frac{1}{2!}\left(\frac{dy}{dx}\right)^2 + \frac{1}{3!}\left(\frac{dy}{dx}\right)^3 + \dots$

- (A) 3                                      (B) 2                                      (C) 1                                      (D) not defined

**Ans : (C)**

**Hints :**  $x = e^{\frac{dy}{dx}}, \quad \frac{dy}{dx} = \log_e x$

66. The equation of one of the curves whose slope at any point is equal to  $y + 2x$  is

- (A)  $y = 2(e^x + x - 1)$                       (B)  $y = 2(e^x - x - 1)$                       (C)  $y = 2(e^x - x + 1)$                       (D)  $y = 2(e^x + x + 1)$

**Ans : (B)**

**Hints :**  $\frac{dy}{dx} = y + 2x$  Put  $y + 2x = z \Rightarrow \frac{dy}{dx} + z = \frac{dz}{dx}$

$\frac{dz}{dx} - z = 2, \quad \frac{dz}{dx} = z + 2 \Rightarrow \int \frac{dz}{z+2} = \int dx$

$\log(z+2) = x + c, \quad \log(y + 2x + 2) = x + c$

$y + 2x + 2 = x + c, \quad y = 2(e^x - x - 1)$

67. Solution of the differential equation  $xdy - ydx = 0$  represents a  
 (A) parabola (B) circle (C) hyperbola (D) straight line

**Ans : (D)**

**Hints :**  $x \cdot dy - y \cdot dx = 0 \Rightarrow xdy = ydx$

$\frac{dy}{y} = \frac{dx}{x} \Rightarrow \log y = \log x + \log c$

$y = xc$

68. The value of the integral  $\int_0^{\pi/2} \sin^5 x dx$  is

- (A)  $\frac{4}{15}$  (B)  $\frac{8}{5}$  (C)  $\frac{8}{15}$  (D)  $\frac{4}{5}$

**Ans : (C)**

**Hints :**  $I = \int_0^{\pi/2} \sin^4 x dx \quad \cos x = f, \quad \sin x = dt$

$= -\int_1^0 (1-t^2)^2 dt = \int_0^1 (t^4 - 2t^2 + 1) dt$

$= \frac{1}{5}(t^5)_0^1 - \frac{2}{3}(t^3)_0^1 + (t)_0^1 = \frac{1}{5} - \frac{2}{3} + 1 = \frac{3-10+15}{15} = \frac{8}{15}$

69. If  $\frac{d}{dx}\{f(x)\} = g(x)$ , then  $\int_a^b f(x)g(x)dx$  is equal to

- (A)  $\frac{1}{2}[f^2(b) - f^2(a)]$  (B)  $\frac{1}{2}[g^2(b) - g^2(a)]$  (C)  $f(b) - f(a)$  (D)  $\frac{1}{2}[f(b^2) - f(a^2)]$

**Ans : (A)**

**Hints :**  $f(x) = \int g(x)dx$

$\int_a^b f(x) \cdot g(x) \cdot dx = (f(x) f(x))_a^b - \int_a^b g(x) f(x) dx$   
 a I II

$I = f^2(b) - f^2(a) - I$

$I = \frac{1}{2}(f^2(b) - f^2(a))$

70. If  $I_1 = \int_0^{3\pi} f(\cos^2 x) dx$  and  $I_2 = \int_0^{\pi} f(\cos^2 x) dx$ , then

- (A)  $I_1 = I_2$                       (B)  $3I_1 = I_2$                       (C)  $I_1 = 3I_2$                       (D)  $I_1 = 5I_2$

**Ans : (C)**

**Hints :**  $I_1 = 3 \int_0^{\pi} f(\cos^2 x) dx = 3I_2$  [ period is  $\pi$ ]

71. The value of  $I = \int_{-\pi/2}^{\pi/2} |\sin x| dx$  is

- (A) 0                                      (B) 2                                      (C) -2                                      (D)  $-2 < I < 2$

**Ans : (B)**

**Hints :**  $I = 2 \int_0^{\pi/2} \sin x dx = 2(1) = 2$

72. If  $I = \int_0^1 \frac{dx}{1+x^{\pi/2}}$ , then

- (A)  $\log_e 2 < I < \pi/4$                       (B)  $\log_e 2 > I$                       (C)  $I = \pi/4$                       (D)  $I = \log_e 2$

**Ans : (A)**

**Hints :**  $x^2 < x^{\pi/2} < x$ ,  $1+x^2 < 1+x^{\pi/2} < 1+x$

$$\frac{1}{1+x^2} > \frac{1}{1+x^{\pi/2}} > \frac{1}{1+x}$$

$$\frac{\pi}{4} > I > (\log(1+x)), \quad \frac{\pi}{4} > I > \log 2$$

73. The area enclosed by  $y = 3x - 5$ ,  $y = 0$ ,  $x = 3$  and  $x = 5$  is

- (A) 12 sq. units                      (B) 13 sq. units                      (C)  $13\frac{1}{2}$  sq. units                      (D) 14 sq. units

**Ans : (D)**

**Hints :**  $A = \int_3^5 (3x - 5) dx$

$$= \frac{3}{2} (x^2)_3^5 - 5(x)_3^5, = \frac{3}{2} [25 - 9] - 5(5 - 3)$$

$$\frac{3}{2} \cdot 16 - 5(2) = 24 - 10 = 14$$

74. The area bounded by the parabolas  $y = 4x^2$ ,  $y = \frac{x^2}{9}$  and the line  $y = 2$  is

- (A)  $\frac{5\sqrt{2}}{3}$  sq. units                      (B)  $\frac{10\sqrt{2}}{3}$  sq. units                      (C)  $\frac{15\sqrt{2}}{3}$  sq. units                      (D)  $\frac{20\sqrt{2}}{3}$  sq. units

**Ans : (D)**

**Hints :**  $y = 4x^2$  ..... (i)

$$y = \frac{x^2}{4} \text{ ..... (ii)}$$

$$A = \int_1^2 \left[ \frac{\sqrt{y}}{2} - 3\sqrt{y} \right] dy = \left( \frac{1}{2} - 3 \right) \int_0^2 \sqrt{y} dy$$

$$= \left( \frac{-\sqrt{y}}{2} \right) \frac{5}{3} (y^{3/2})_0^2 = -\frac{5}{3} (2\sqrt{2} - 0)$$

$$= \left| -\frac{\sqrt{2}}{3} \right| = \frac{10\sqrt{2}}{3}, \text{ Area of bounded figure} = 2A = \frac{20\sqrt{2}}{3}$$

75. The equation of normal of  $x^2 + y^2 - 2x + 4y - 5 = 0$  at  $(2, 1)$  is

- (A)  $y = 3x - 5$  (B)  $2y = 3x - 4$  (C)  $y = 3x + 4$  (D)  $y = x + 1$

**Ans : (A)**

**Hints :**  $O(1, -2)$  A  $(2, 1)$

$$\text{Slope } A \rightarrow \frac{y-1}{-2-1} = \frac{x-2}{1-2}, \frac{y-1}{-3} = \frac{x-2}{-1} = 1, y - 1 = 3(x - 2)$$

$$y = 3x - 5$$

76. If the three points  $(3q, 0)$ ,  $(0, 3p)$  and  $(1, 1)$  are collinear then which one is true ?

- (A)  $\frac{1}{p} + \frac{1}{q} = 1$  (B)  $\frac{1}{p} + \frac{1}{q} = 1$  (C)  $\frac{1}{p} + \frac{1}{q} = 3$  (D)  $\frac{1}{p} + \frac{3}{q} = 1$

**Ans : (C)**

**Hints :** A  $(3q, 0)$  B  $(0, 3p)$  C  $(1, 1)$

Slope = 1 AC = 5 log BC

$$\frac{1-0}{1-3q} = \frac{1-3p}{1-0} = 3, \frac{1}{1-3q} = \frac{1-3p}{1}$$

$$1 = (1-3p)(1-3q), 1 = 1 - 3q - 3p + 9pq$$

$$\Rightarrow 3p + 3q = 9pq, \frac{1}{q} + \frac{1}{p} = 3$$

77. The equations  $y = \pm\sqrt{3x}$ ,  $y = 1$  are the sides of

- (A) an equilateral triangle (B) a right angled triangle (C) an isosceles triangle (D) an obtuse angled triangle

**Ans : (A)**

**Hints :**  $y = \tan 60^\circ x$ ,  $y = -\tan 60^\circ x$

$y = 1$ , equilateral

78. The equations of the lines through  $(1, 1)$  and making angles of  $45^\circ$  with the line  $x + y = 0$  are

- (A)  $x - 1 = 0, x - y = 0$  (B)  $x - y = 0, y - 1 = 0$   
(C)  $x + y - 2 = 0, y - 1 = 0$  (D)  $x - 1 = 0, y - 1 = 0$

**Ans : (D)**

$$\text{Hints : } m = 1, y - 1 = \frac{m \pm \tan 45}{1 \mp m \tan 45} (x - 1), y - 1 = \frac{(-1) \pm 1}{1 \pm 1} (x - 1)$$

$$y = 1, x = 1$$

79. In a triangle PQR,  $\angle R = \pi/2$ . If  $\tan\left(\frac{P}{2}\right)$  and  $\tan\left(\frac{Q}{2}\right)$  are roots of  $ax^2 + bx + c = 0$ , where  $a \neq 0$ , then which one is true ?

(A)  $c = a + b$

(B)  $a = b + c$

(C)  $b = a + c$

(D)  $b = c$

**Ans : (A)**

**Hints :**  $\frac{P}{2} + \frac{Q}{2} = \frac{\pi}{2} - \frac{P}{2} = \frac{\pi}{2} - \frac{\pi}{4} = \frac{\pi}{4}$

$$\tan\left(\frac{P}{2} + \frac{Q}{2}\right) = 1, \quad \frac{-b/a}{1 - c/a} = 1 \Rightarrow \frac{-b}{a - c} = 1$$

$$-b = a - c \Rightarrow a + b = c$$

80. The value of  $\frac{\sin 55^\circ - \cos 55^\circ}{\sin 10^\circ}$  is

(A)  $\frac{1}{\sqrt{2}}$

(B) 2

(C) 1

(D)  $\sqrt{2}$

**Ans : (D)**

**Hints :**  $\frac{\sin 55 - \sin 35}{\sin 10} = \frac{2 \cos 45 \cdot \sin 10}{\sin 10} = \sqrt{2}$

**DESCRIPTIVE TYPE QUESTIONS**  
**SUB : MATHEMATICS**

1. Prove that the equation  $\cos 2x + a \sin x = 2a - 7$  possesses a solution if  $2 \leq a \leq 6$ .

A.  $\Rightarrow \cos 2x + a \sin x = 2a - 7$

$\Rightarrow 2\sin^2 x - a \sin x + (2a - 8) = 0$

Since  $\sin x \in \mathbb{R}$ ,  $\sin x = \frac{a \pm (a-8)}{4}$ ,  $= \frac{a-4}{2}$ ,  $2 \cdot -1 \leq \sin x \leq 1$

$\therefore$  Given equation has solution of  $2 \leq a \leq 6$ .

2. Find the values of  $x$ , ( $-\pi < x < \pi$ ,  $x \neq 0$ ) satisfying the equation,  $8^{1+|\cos x|+|\cos^2 x|+\dots} = 4^3$

A.  $(8)^{1+|\cos x|+|\cos^2 x|+\dots} = 4^3$

$\Rightarrow 8^{\frac{1}{1-|\cos x|}} = 2^6$ ,  $\Rightarrow \frac{3}{1-|\cos x|} = 6 \Rightarrow \cos = \pm \frac{1}{2}$

$\Rightarrow x = \frac{\pi}{3}, -\frac{\pi}{3}, \frac{2\pi}{3}, -\frac{2\pi}{3}$

3. Prove that the centre of the smallest circle passing through origin and whose centre lies on  $y = x + 1$  is  $\left(-\frac{1}{2}, \frac{1}{2}\right)$

A. Let centre be  $c(h, h + 1)$ ,  $O(0, 0)$

$r = oc = \sqrt{h^2 + (h+1)^2} = \sqrt{2h^2 + 2h + 1}$

$= \sqrt{2\left(h + \frac{1}{2}\right)^2 + \frac{1}{2}}$  for min radius  $r$ ,  $h + \frac{1}{2} = 0$ ,  $h = -\frac{1}{2}$

Centre  $\left(-\frac{1}{2}, \frac{1}{2}\right)$

4. Prove by induction that for all  $n \in \mathbb{N}$ ,  $n^2 + n$  is an even integer ( $n \geq 1$ )

A.  $x = 1$ ,  $x^2 + x = 2$  is an even integer

Let for  $n = k$ ,  $k^2 + k$  is even

Now for  $n = k + 1$ ,  $(k + 1)^2 + (k + 1) - (k^2 + k)$

$= k^2 + 2k + 1 + k + 1 - k^2 - k = 2k + 2$  which is even integer also  $k^2 + k$  is even integer

Hence  $(k + 1)^2 + (k + 1)$  is also an even integer



Hence  $n^2 + n$  is even integer for all  $n \in \mathbb{N}$ .

5. If A, B are two square matrices such that  $AB = A$  and  $BA = B$ , then prove that  $B^2 = B$

A.  $B^2 = B.B = (BA)B = B(AB) = B(A) = BA = B$  (Proved)

6. If  $N = n!$  ( $n \in \mathbb{N}, n > 2$ ), then find  $\lim_{N \rightarrow \infty} [(\log_2 N)^{-1} + (\log_3 N)^{-1} + \dots + (\log_n N)^{-1}]$

A.  $\lim_{N \rightarrow \infty} [\log_N 2 + \log_N 3 + \dots + \log_N n]$

$= \lim_{N \rightarrow \infty} \log_N (2.3 \dots n) = \lim_{N \rightarrow \infty} \log_{n!}^{n!} [\because N = n!] = \lim_{N \rightarrow \infty} 1 = 1$

7. Use the formula  $\lim_{x \rightarrow 0} \frac{a^x - 1}{x} = \log_e a$ , to compute  $\lim_{x \rightarrow 0} \frac{2^x - 1}{\sqrt{1+x} - 1}$

A.  $\lim_{x \rightarrow 0} \frac{2^x - 1}{\sqrt{1+x} - 1}$

$= \lim_{x \rightarrow 0} \left( \frac{2^x - 1}{x} \right) \times \lim_{x \rightarrow 0} (\sqrt{1+x} + 1)$

$= \log_e 2 \times 2 = \log_e 4$

8. If  $\frac{dy}{dx} + \sqrt{\frac{1-y^2}{1-x^2}} = 0$  prove that,  $x\sqrt{1-y^2} + y\sqrt{1-x^2} = A$  where A is constant

A.  $\frac{dy}{dx} = -\sqrt{\frac{1-y^2}{1-x^2}}$

$\Rightarrow \frac{dy}{\sqrt{1-y^2}} = -\frac{dx}{\sqrt{1-x^2}} \Rightarrow \sin^{-1} y = -\sin^{-1} x + c$  [c is a constant]

$\Rightarrow \sin^{-1} x + \sin^{-1} y = c$

$= \sin^{-1} [x\sqrt{1-y^2} + y\sqrt{1-x^2}] = c$  where A is a  $x\sqrt{1-y^2} + y\sqrt{1-x^2} = \sin c = A$  constant

9. Evaluate the following integral  $\int_{-1}^2 |x \sin \pi x| dx$

$$\text{A. } I = \int_{-1}^2 |x \sin \pi x| dx = \int_{-1}^0 |x \sin \pi x| dx + \int_0^2 |x \sin \pi x| dx$$

$$= 2 \int_0^1 |x \sin \pi x| dx + \int_1^2 |x \sin \pi x| dx$$

$$= 2 \int_0^1 x \sin \pi x dx - \int_1^2 x \sin \pi x dx = 2I_1 - I_2$$

$$I_1 = \int_0^1 x \sin \pi x dx = -x \frac{\cos \pi x}{\pi} + \int \frac{\cos \pi x}{\pi} dx$$

$$= -x \frac{\cos \pi x}{\pi} + \frac{\sin \pi x}{\pi^2} \Big|_0^1 = \frac{1}{\pi}$$

$$I_2 = \int_1^2 x \sin \pi x dx = -x \frac{\cos \pi x}{\pi} + \frac{\sin \pi x}{\pi^2} \Big|_1^2 = \frac{-2}{\pi} + 0 + \left( \frac{1}{\pi} \right)$$

$$= -\frac{3}{\pi} \text{ So, } 2I_1 - I_2 = \frac{2}{\pi} + \frac{3}{\pi} = \frac{5}{\pi}$$

10. If  $f(a) = 2, f'(a) = 1, g(a) = -1$  and  $g'(a) = 2$ , find the value of  $\lim_{x \rightarrow a} \frac{g(a)f(a) - g(a)f(x)}{x - a}$ .

$$\text{A. } \lim_{x \rightarrow a} \frac{g'(a)f(a) - g(a)f'(x)}{1} \quad [\text{using L' Hospital Rule}]$$

$$= g'(a) f(a) - g(a) f'(a)$$

$$= (2)(2) - (-1)(1) = 4 + 1 = 5$$