

## SAMPLE PAPER - 15

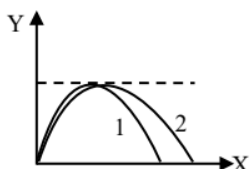
### Physics

#### Section A

**Q. 1.** A pebble is thrown vertically upwards from bridge with an initial velocity of 4.9 m/s. It strikes the water after 2 s. If acceleration due to gravity is  $9.8 \text{ m/s}^2$ . The height of the bridge and velocity with which the pebble strike the water will respectively be :

- (1) 4.9 m, 1.47 m/s    (2) 9.8 m, 14.7 m/s  
 (3) 49 m, 1.47 m/s    (4) 1.47 m, 4.9 m/s

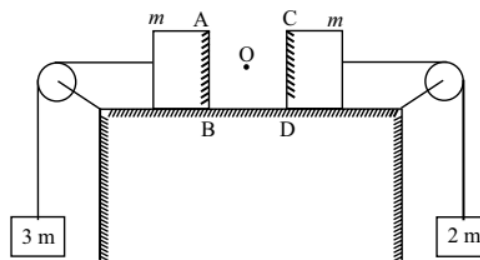
**Q. 2.** Trajectories of two projectiles are shown in the figure. Let  $T_1$  and  $T_2$  be the time periods and  $u_1$  and  $u_2$  be their speeds of projection. Then :



- (1)  $T_2 > T_1$             (2)  $T_1 > T_2$   
 (3)  $u_1 > u_2$             (4)  $u_1 < u_2$

**Q. 3.** Two blocks each of mass  $m$  lie on a smooth table. They are attached to two other masses as shown in the figure. The pulleys and strings are light. An object  $O$  is kept at rest on the table. The sides  $AB$  and  $CD$  of the two blocks are plane and made reflecting. The acceleration of two images formed in those

two reflecting surfaces with respect to each other is :



- (1)  $\frac{13g}{6}$                     (2)  $\frac{11g}{6}$   
 (3)  $\frac{17g}{6}$                     (4)  $\frac{19g}{6}$

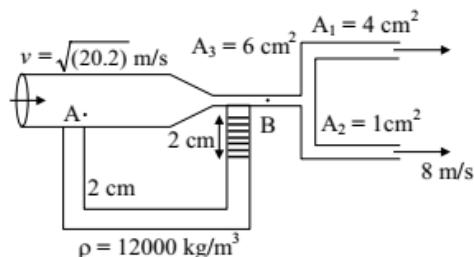
**Q. 4.** Starting from rest, a body slides down a  $45^\circ$  inclined plane in twice the time it takes to slide down the same distance in the absence of friction. The coefficient of friction between the body and the inclined plane is :

- (1) 0.33                    (2) 0.25  
 (3) 0.75                    (4) 0.80

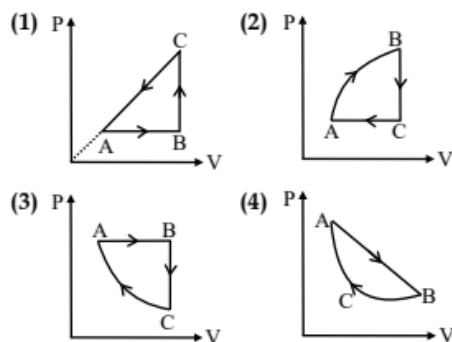
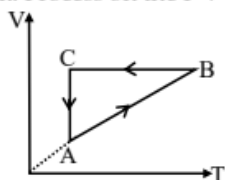
**Q. 5.** A uniform metal rod of  $2 \text{ mm}^2$  cross section is heated from  $0^\circ\text{C}$  to  $20^\circ\text{C}$ . The coefficient of linear expansion of the rod is  $12 \times 10^{-6}/^\circ\text{C}$ , its Young's modulus is  $10^{11} \text{ N/m}^2$ . The energy stored per unit volume of the rod is :

- (1)  $2880 \text{ J/m}^3$             (2)  $1500 \text{ J/m}^3$   
 (3)  $5760 \text{ J/m}^3$             (4)  $1440 \text{ J/m}^3$

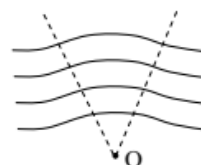
- Q. 6. Calculate the velocity with which the liquid gushes out of the  $4 \text{ cm}^2$  outlet, if the liquid flowing in the tube is water and liquid in U tube has a specific gravity 12. Velocity of liquid at point A is  $\sqrt{20.2} \text{ m/s}$  :



- (1) 2.5 m/s                      (2) 5.5 m/s  
 (3) 8 m/s                        (4) 10 m/s
- Q. 7. In a U-tube the radii of two columns are respectively  $r_1$  and  $r_2$ . When a liquid of density  $\rho$  ( $\theta = 0^\circ$ ) is filled in it, a level difference of  $h$  is observed on two arms, then the surface tension of the liquid is :
- (1)  $\frac{\rho g h r_1 r_2}{2(r_2 - r_1)}$                       (2)  $h \rho g (r_2 - r_1)$   
 (3)  $\frac{h \rho g (r_2 - r_1)}{2}$                                       (4)  $\frac{h \rho g}{2(r_2 - r_1)}$
- Q. 8. A solid ball of density  $\rho_1$  and radius  $r$  falls vertically through a liquid of density  $\rho_2$ . Assume that the viscous force acting on the ball is  $F = k r v$ , where  $k$  is a constant and  $v$  its velocity. What is the terminal velocity of the ball ?
- (1)  $\frac{4 \pi r^2 (\rho_1 - \rho_2)}{3k}$                       (2)  $\frac{2 \pi r (\rho_1 - \rho_2)}{3gk}$   
 (3)  $\frac{2 \pi g (\rho_1 + \rho_2)}{3g r^2 k}$                                       (4) None of these
- Q. 9. The average energy for molecules in one degree of freedom is :
- (1)  $\frac{3}{2} kT$                                       (2)  $\frac{kT}{2}$   
 (3)  $\frac{3}{4} kT$                                       (4)  $kT$
- Q. 10. A cyclic process ABCA is shown in the V-T diagram. Process on the P-V diagram is :



- Q. 11. A cylinder of radius  $R$  made of material of thermal conductivity  $K_1$  is surrounded by a cylindrical shell of inner radius  $R$  and outer radius  $3R$  made of a material of thermal conductivity  $K_2$ . The two ends of the combined system are maintained at two different temperature. What is the effective thermal conductivity of the system ?
- (1)  $K_1 + K_2$                       (2)  $\frac{K_1 + 8K_2}{9}$   
 (3)  $\frac{K_1 K_2}{K_1 + K_2}$                       (4)  $\frac{8K_1 + K_2}{9}$
- Q. 12. The speed of a wave in a string is 20 m/s and frequency is 50 Hz. The phase difference between two points on the string 10 cm apart will be :
- (1)  $\pi/2$                                       (2)  $\pi$   
 (3)  $3\pi/2$                                       (4)  $2\pi$
- Q. 13. If the magnetic lines of force are shaped like arcs of concentric circles with their centre at point O in a certain section of a magnetic field:

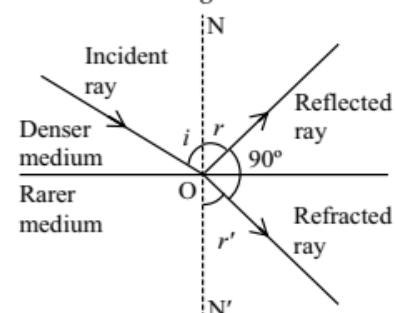


- (1) The intensity of the field in this section should at each point be inversely proportional to its distance from point O  
 (2) The intensity of the field in this section should at each point be inversely proportional to square of its distance from point O  
 (3) The intensity of the field in this section should at each point be inversely proportional to cube of its distance from point O  
 (4) Nothing can be said

Q. 14. A 6 volt battery is connected to the terminals of a three metre long wire of uniform thickness and resistance of 100 ohm. The difference of potential between two points on the wire separated by a distance of 50 cm will be :

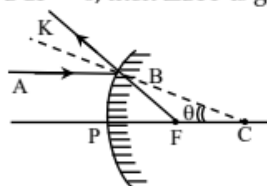
- (1) 2 volt                      (2) 3 volt  
(3) 1 volt                      (4) 1.5 volt

Q. 15. A ray of light from a denser medium strikes a rarer medium at an angle of incidence  $i$  as shown in figure. Refracted and reflected rays make an angle of  $90^\circ$  with each other. Angle of reflection and refraction are  $r$  and  $r'$ . Then critical angle is :



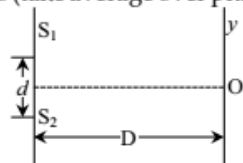
- (1)  $\sin^{-1}(\sin i)$             (2)  $\sin^{-1}(\sin r)$   
(3)  $\sin^{-1}(\tan i)$             (4)  $\sin^{-1}(\tan r)$

Q. 16. In the adjoining figure, AB represents the incident ray and BK the reflected ray. If angle  $BCF = \theta$ , then  $\angle BFP$  is given by :



- (1)  $\theta$                               (2)  $2\theta$   
(3)  $3\theta$                             (4)  $2.5\theta$

Q. 17. Consider a usual set-up of Young's double slit experiment with slits of equal intensity as shown in the figure. Take 'O' as origin and the Y axis as indicated. If average intensity between  $y_1 = \frac{\lambda D}{4d}$  and  $y_2 = \frac{\lambda D}{4d}$  equals  $n$  times the intensity of maximum, then  $n$  equal is (take average over phase difference):

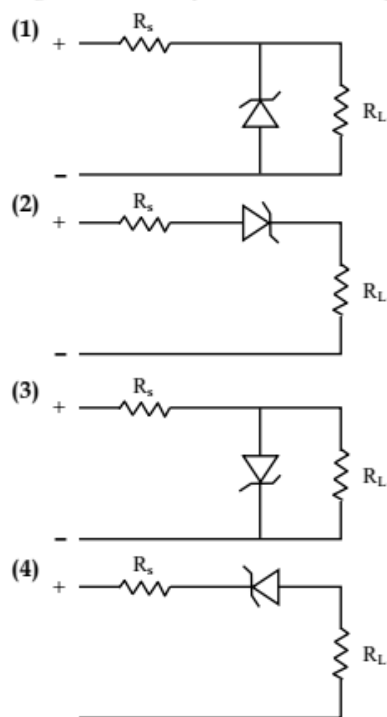


- (1)  $\frac{1}{2}\left(1 + \frac{2}{\pi}\right)$             (2)  $2\left(1 + \frac{2}{\pi}\right)$   
(3)  $\left(1 + \frac{2}{\pi}\right)$                 (4)  $\frac{1}{2}\left(1 - \frac{2}{\pi}\right)$

Q. 18. A camera objective has an aperture diameter  $d$ . If the aperture is reduced to diameter  $d/2$ , the exposure time under identical conditions of light should be made :

- (1)  $\sqrt{2}$  fold                    (2) 2 fold  
(3)  $2\sqrt{2}$  fold                (4) 4 fold

Q. 19. A zener diode is to be used as a voltage regulator. Identify the correct set up :



Q. 20. If the zero of the vernier lies on the right hand side and fourth division coincide with the main scale division when the jaws are in contacts so the correction will be :

- (1) + 0.04 cm                (2) + 0.06 cm  
(3) - 0.04 cm                (4) - 0.06 cm

### Section B

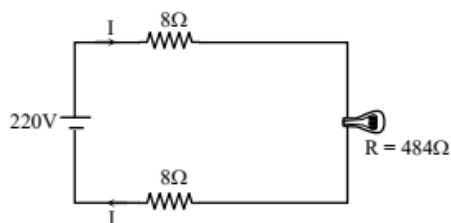
Q. 21. A 100 eV electron collides with a stationary helium ion ( $\text{He}^+$ ) in its ground state and exits to a higher level. After the collision,  $\text{He}^+$  ions emits two photons in succession with wavelength  $1085 \text{ \AA}$  and  $304 \text{ \AA}$ . The energy of the electron after the collision will be ..... eV. Given  $h = 6.63 \times 10^{-34} \text{ Js}$ .

Q. 22. The radioactivity of an old sample of whisky due to tritium (half life 12.5 years) was found to be only about 4% of that measured in a recently purchased bottle marked 10 years old. The age of sample is ..... years.

Q. 23. The wavelength of  $K_{\alpha}$  line is ..... Pm in copper ( $Z = 29$ ) if the wavelength of  $K_{\alpha}$  = line in iron ( $Z = 26$ ) is known to be equal to 193 picometer.

Q. 24. A charged dust particle of radius  $5 \times 10^{-7}$  m is located in a horizontal electric field having an intensity of  $6.28 \times 10^5$  V/m. The surrounding medium is air with coefficient of viscosity  $\eta = 1.6 \times 10^{-5}$  N-s/m<sup>2</sup>. If the particle moves with a uniform horizontal speed 0.02 m/s, the number of electrons on it is.....

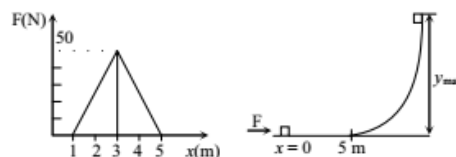
Q. 25. Using a long extension cord in which each conductor has a resistance  $8\Omega$ , a bulb marked as '100 W, 200 V' is connected to a 220 V dc supply of negligible internal resistance as shown in figure. Power delivered to the bulb is ..... W.



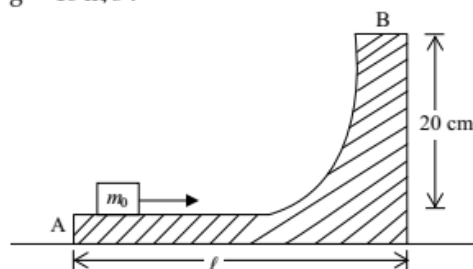
Q. 26. An inductor coil, capacitor and an A.C. source of rms voltage 24 V are connected in series. When the frequency of the source is varied, a maximum rms current of 6.0 A is observed. If this inductor coil is connected to a battery of emf 12 V and of internal resistance  $4\Omega$ , the current will be ..... Amp.

Q. 27. A force shown in the  $F-x$  graph is applied to a 5 kg cart, which then coast up a ramp

as shown. The maximum height,  $y_{\max}$  is ..... m, at which cart can reach. ( $g = 10 \text{ m/s}^2$ )



Q. 28. A wedge of mass  $M = 2m_0$  rests on a smooth horizontal plane. A small block of mass  $m_0$  rests over it at left end A as shown in figure. A sharp impulse is applied on the block, due to which it starts moving to the right with velocity  $v_0 = 6$  m/s. At highest point of its trajectory, the block collides with a particle of same mass  $m_0$  moving vertically downwards with velocity  $v = 2$  m/s and gets stuck with it. If the combined mass lands at the end point A of the body of mass M, the length  $\ell$  is ..... cm. Neglect friction, take  $g = 10 \text{ m/s}^2$ .

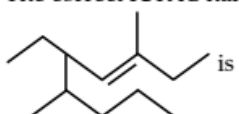


Q. 29. A cubical block of mass 6 kg and side 16.1 cm is placed on frictionless horizontal surface. It is hit by a cue at the top as to impart impulse in horizontal direction. Minimum impulse imparted to topple the block must be greater than ..... kg m/s.

Q. 30. The missing number is ..... in the expression given below  $A = se^{\frac{at^x}{A}}$  where  $s$ : displacement,  $t$ : time,  $a$ : acceleration.

## Chemistry

### Section A

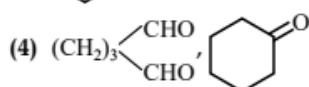
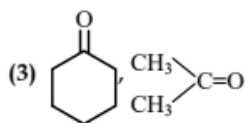
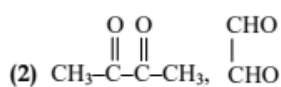
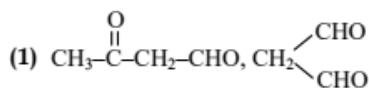
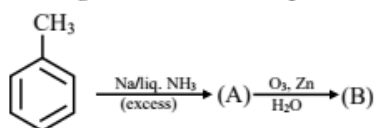
- Q. 31.** Which of the following ions acts as a typical transition metal ion ?  
 (1)  $\text{Cu}^+$  (2)  $\text{Sc}^+$   
 (3)  $\text{Ti}^{4+}$  (4)  $\text{Cr}^{6+}$
- Q. 32.** The observed dipole-moment of HCl molecule is 1.03D. If H—Cl bond distance is 1.275 Å and electronic charge is  $4.8 \times 10^{-10}$  esu. What is the percent polarity of HCl :  
 (1)  $1.275 \text{ Å} \times 1.03$   
 (2)  $\frac{4.8 \times 10^{-10} \times 1.275 \times 10^{-8}}{1.03}$   
 (3)  $\frac{1.03 \times 100 \times 10^{-18}}{4.8 \times 10^{-10} \times 1.275 \times 10^{-8}}$   
 (4)  $\frac{4.8 \times 10^{-10}}{1.03} \times 10$
- Q. 33.** For the equilibrium  
 $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}(s) \rightleftharpoons \text{SrCl}_2 \cdot 2\text{H}_2\text{O}(s) + 4\text{H}_2\text{O}(g)$   
 the equilibrium constant  $K_p = 16 \times 10^{-12} \text{ atm}^4$  at  $1^\circ\text{C}$ . If one litre of air saturated with water vapour at  $1^\circ\text{C}$  is exposed to a large quantity of  $\text{SrCl}_2 \cdot 2\text{H}_2\text{O}(s)$ , what weight of water vapour will be absorbed ? Saturated vapour pressure of water at  $1^\circ\text{C} = 7.6$  torr.  
 (1) 6 g (2) 6.4 mg  
 (3) 2.3 g (4) 8.5 g
- Q. 34.** pH of  $10^{-15}$  M HCl solution is :  
 (1) 7 (2) 6.8  
 (3) 7.2 (4) 6.5
- Q. 35.** The correct IUPAC name of the compound  
 is :  
 (1) 5-ethyl-3, 6-dimethyl non -3-ene  
 (2) 5-ethyl-4, 7-dimethyl non-3-ene  
 (3) 4-methyl-5, 7-diethyl oct -2-ene  
 (4) 2,4-ethyl-5-methyl oct-2-ene
- Q. 36.** How many structural isomers possible of the molecular formula  $\text{C}_3\text{H}_6\text{O}$  (excluding enol form)  
 (1) 5 (2) 7  
 (3) 8 (4) 9
- Q. 37.** A given solution of  $\text{H}_2\text{O}_2$  is 30 volumes. Its concentration in terms of molarity is:  
 (1) 9.1 M (2) 2.68 M  
 (3) 2.5 M (4) 26.8 M
- Q. 38.** Which one of the following methods is used to prepare borax crystals ?  
 (1) A hot conc. solution of  $\text{B}_2\text{O}_3$  is made to react with calculated quantity of conc.  $\text{H}_2\text{SO}_4$   
 (2) Tincal is dried up and heated to red heat  
 (3) Tincal is powdered, treated with water and evaporated  
 (4) An alcoholic solution of boric acid is evaporated and cooled.
- Q. 39.**  $\text{PbCl}_4$  exists but  $\text{PbBr}_4$  and  $\text{PbI}_4$  do not because of :  
 (1) Inability of bromine and iodine to oxidise  $\text{Pb}^{2+}$  to  $\text{Pb}^{4+}$   
 (2)  $\text{Br}^-$  and  $\text{I}^-$  are bigger in size  
 (3) More electropositive character of  $\text{Br}_2$  and  $\text{I}_2$   
 (4) Chlorine is a gas
- Q. 40.** The metallic luster exhibited by sodium is explained by :  
 (1) Diffusion of sodium ions  
 (2) Oscillations of loose electrons  
 (3) Excitation of free protons  
 (4) Existence of body centered cubic lattice.
- Q. 41.** The o, p-directing but deactivating group is  
 (1)  $-\text{NH}_2$  (2)  $-\text{OH}$   
 (3) R-(alkyl) (4) X-(Halogen)
- Q. 42.** When 2-alkyne is treated with sodamide product will be :  
 (1) alkene  
 (2) vinyl acetylene  
 (3) 1-alkyne  
 (4) None of these
- Q. 43.** Benzene on ozonolysis followed by hydrolysis gives :  
 (1) 3 Moles of  $\text{CH}_2 = \text{CH}_2$   
 (2) 3 Moles of  $\text{C}_2\text{H}_2$   
 (3) 3 Moles of  $\text{CHO} - \text{CHO}$   
 (4) None of these

- Q. 44. (A)  $\xrightarrow{\text{Cl}_2/h\nu}$  (B)  $\xrightarrow{\text{aq.KOH}}$  (C)  $\xrightarrow{[\text{O}]}$   
 $\text{CH}_3\text{CHO}$ , Identify A, B and C :  
 (1) Ethylalcohol, Ethyl chloride and Ethane  
 (2) Ethane, Ethylchloride and  $\text{CH}_3\text{-CH}_2\text{-OH}$   
 (3) Propane Propylchloride and  
 $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-OH}$   
 (4) All of the above

- Q. 45. Phenol  $\xrightarrow[\text{(ii) CO}_2/140^\circ\text{C}]{\text{(i) NaOH}}$  A  $\xrightarrow{\text{H}^+/\text{H}_2\text{O}}$  B  
 $\xrightarrow[\text{CH}_3\text{COOH}]{\text{Al}_2\text{O}_3}$  C

In this reaction, the end product C is :

- (1) salicylaldehyde (2) salicylic acid  
 (3) phenyl acetate (4) aspirin
- Q. 46. In the given reaction final product(s) will be:



- Q. 47. Formic acid and formaldehyde can be distinguished by treating with :  
 (1) Benedict's solution  
 (2) Tollen's reagent  
 (3) Fehling's solution  
 (4)  $\text{NaHCO}_3$

- Q. 48. A reaction of ethyl amine and acetic anhydride leads to the formation of :  
 (1)  $\text{CH}_3\text{NHCOCH}_3$   
 (2)  $\text{C}_2\text{H}_5\text{CONHCH}_3$   
 (3)  $\text{CH}_3\text{CONHC}_2\text{H}_5$   
 (4)  $\text{CH}_3\text{-CH=N-OC}_2\text{H}_5$

- Q. 49. The Non-proteinous substances which certain enzymes require for their activity are called :  
 (1) Catalysts (2) Inhibitors  
 (3) Co-enzymes (4) Epimers

- Q. 50. Glycinato ligand is :

- (1)
- (2) Bidentate ligand  
 (3) Two donor sites N and O<sup>-</sup>  
 (4) All

### Section B

- Q. 51. A gaseous mixture of He and O<sub>2</sub> is found to have a density of 0.518 gL<sup>-1</sup> at 25° C and 720 torr. The mass percent of helium in this mixture is .....
- Q. 52. The free energy change is - (.....) kJ mol<sup>-1</sup> when 1 mole of NaCl is dissolved in water at 25°C. Lattice energy of NaCl = 777.8 kJ mol<sup>-1</sup> ;  $\Delta S$  for dissolution = 0.043 kJ mol<sup>-1</sup> ; and hydration energy of NaCl = -774.1 kJ mol<sup>-1</sup>.
- Q. 53. A 10 ml of  $(\text{NH}_4)_2\text{SO}_4$  was treated with an excess of NaOH. The evolved NH<sub>3</sub> gas absorbed in 50 ml of 0.1 N HCl. 20 ml of 0.1 N NaOH was required to neutralise the remaining HCl. The strength of  $(\text{NH}_4)_2\text{SO}_4$  in the solution is ..... g/L.
- Q. 54. The volume of dilute nitric acid is ..... mL ( $d = 1.11\text{ g mL}^{-1}$ , 19% w/w HNO<sub>3</sub>) that can be prepared by diluting with water 50 mL of conc. HNO<sub>3</sub> ( $d = 1.42\text{ g mL}^{-1}$ , 69.8% w/w).
- Q. 55. When a certain metal was irradiated with light of frequency  $3.2 \times 10^{16}\text{ Hz}$ , the photoelectrons emitted had twice the kinetic energy as did photoelectrons emitted when the same metal was irradiated with light of frequency  $2.0 \times 10^{16}\text{ Hz}$ . The light of frequency  $\nu_0$  for the metal is .....  $\times 10^{15}\text{ Hz}$ .
- Q. 56. Sea water is found to contain 5.85% NaCl and 9.50% MgCl<sub>2</sub> be weight of solution. The normal boiling point of sea water is .....°C assuming 80% ionisation for NaCl and 50% ionisation of MgCl<sub>2</sub> [ $K_b(\text{H}_2\text{O}) = 0.51\text{ kg mole}^{-1}\text{K}$ ].
- Q. 57. The composition of a sample of wustite is Fe<sub>0.93</sub>O<sub>1.0</sub>. The iron is present in the form of Fe(III) is ..... %.
- Q. 58. The equilibrium constant for the reaction is .....  $\times 10^{26}$ .



Given  $E_{\text{Fe}/\text{Fe}^{2+}}^0 = 0.44\text{ V}$

$E_{\text{Cu}/\text{Cu}^{2+}}^0 = -0.337\text{ V}$

Q. 59. The rate of a first order reaction is  $0.04 \text{ mol litre}^{-1}\text{s}^{-1}$  at 10 minutes and  $0.03 \text{ mol litre}^{-1}\text{sec}^{-1}$  at 20 minutes after initiation. The half life of the reaction is ..... min.

Q. 60. A sample of Ferrous sulphide reacts with dil.  $\text{H}_2\text{SO}_4$  to form  $\text{H}_2\text{S}$  which contains 9% hydrogen by volume. The percentage of Fe in the sample, is .....

## Mathematics

### Section A

Q. 61. If  $\omega (\neq 1)$  is a cube root of unity and  $(1 + \omega)^7 = A + B\omega$ , then A and B are respectively the numbers :

- (1) 0, 1                      (2) 1, 1  
(3) 1, 0                      (4) -1, 1

Q. 62. A speaks truth in 75% of the cases and B in 80% of the cases. The percentage of cases they are likely to contradict each other in making the same statement is.....

- (1) 25%                      (2) 35%  
(3) 50%                      (4) 65%

Q. 63. If  $\begin{vmatrix} 1+x & x & x^2 \\ x & 1+x & x^2 \\ x^2 & x & 1+x \end{vmatrix} = ax^5 + bx^4 + cx^3 + dx^2 + \lambda x + \mu$  be an identity in x, where a, b, c, d,  $\lambda$ ,  $\mu$  are independent of x. Then the value of  $\lambda$  is

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

Q. 64. If  $A_\alpha = \begin{bmatrix} \cos \alpha & \sin \alpha \\ -\sin \alpha & \cos \alpha \end{bmatrix}$ , then which of following statement is TRUE ?

- (1)  $A_\alpha \cdot A_\beta = A_{\alpha\beta}$  &  $(A_\alpha)^n = \begin{bmatrix} \cos^n \alpha & \sin^n \alpha \\ -\sin^n \alpha & \cos^n \alpha \end{bmatrix}$   
(2)  $A_\alpha \cdot A_\beta = A_{\alpha\beta}$  &  $(A_\alpha)^n = \begin{bmatrix} \cos n\alpha & \sin n\alpha \\ -\sin n\alpha & \cos n\alpha \end{bmatrix}$   
(3)  $A_\alpha \cdot A_\beta = A_{\alpha+\beta}$  &  $(A_\alpha)^n = \begin{bmatrix} \cos^n \alpha & \sin^n \alpha \\ -\sin^n \alpha & \cos^n \alpha \end{bmatrix}$   
(4)  $A_\alpha \cdot A_\beta = A_{\alpha+\beta}$  &  $(A_\alpha)^n = \begin{bmatrix} \cos n\alpha & \sin n\alpha \\ -\sin n\alpha & \cos n\alpha \end{bmatrix}$

Q. 65. The value of  $[\vec{a} + 2\vec{b} - \vec{c}], \vec{a} - \vec{b}, \vec{a} - \vec{b} - \vec{c}]$  is equal to the box product :

- (1)  $[\vec{a} \vec{b} \vec{c}]$                       (2)  $2[\vec{a} \vec{b} \vec{c}]$   
(3)  $3[\vec{a} \vec{b} \vec{c}]$                       (4)  $4[\vec{a} \vec{b} \vec{c}]$

Q. 66. The angle between two lines  $\frac{x+1}{2} = \frac{y+3}{2} = \frac{z-4}{-1}$  and  $\frac{x-4}{1} = \frac{y+4}{2} = \frac{z+1}{2}$  is :

- (1)  $\cos^{-1}\left(\frac{2}{9}\right)$                       (2)  $\cos^{-1}\left(\frac{4}{9}\right)$   
(3)  $\cos^{-1}\left(\frac{5}{9}\right)$                       (4)  $\cos^{-1}\left(\frac{7}{9}\right)$

Q. 67. The normal of the curve given by the equation  $x = a(\sin \theta + \cos \theta)$ ,

$y = a(\sin \theta - \cos \theta)$  at the point  $\theta$  is :

- (1)  $(x + y) \cos \theta + (x - y) \sin \theta = 0$   
(2)  $(x + y) \cos \theta + (x - y) \sin \theta = a$   
(3)  $(x + y) \cos \theta - (x - y) \sin \theta = 0$   
(4)  $(x + y) \cos \theta - (x - y) \sin \theta = a$

Q. 68. Function  $f(x) = x^{100} + \sin x - 1$  is increasing for all  $x \in$  :

- (1)  $[0, 1]$                       (2)  $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$   
(3)  $\left[-\frac{\pi}{2}, 1\right]$                       (4)  $[-\pi, \pi]$

Q. 69. The greatest value of the function  $f(x) = \tan^{-1}x - \frac{1}{2} \log x$  in  $\left[\frac{1}{\sqrt{3}}, \sqrt{3}\right]$  is :

- (1)  $\frac{\pi}{6} + \frac{1}{4} \log 3$                       (2)  $\frac{\pi}{3} - \frac{1}{4} \log 3$   
(3)  $\frac{\pi}{6} - \frac{1}{4} \log 3$                       (4)  $\frac{\pi}{3} + \frac{1}{4} \log 3$

Q. 70. The locus of the mid point of the portion intercept between the axes by the line  $x \cos \alpha + y \sin \alpha = P$  where P is a constant is:

- (1)  $x^2 + y^2 = 4P^2$                       (2)  $\frac{1}{x^2} + \frac{1}{y^2} = \frac{4}{P^2}$   
(3)  $x^2 + y^2 = \frac{4}{P^2}$                       (4)  $\frac{1}{x^2} + \frac{1}{y^2} = \frac{2}{P^2}$

Q. 71. If  $3x + y = 0$  is a tangent to the circle with centre at the point  $(2, -1)$ , then the equation of the other tangent to the circle from the origin is:

- (1)  $x - 3y = 0$       (2)  $x + 3y = 0$   
 (3)  $3x - y = 0$       (4)  $2x + y = 0$

Q. 72. The equation of the line touching both the parabolas  $y^2 = x$  and  $x^2 = y$  is

- (1)  $4x + 4y + 1 = 0$     (2)  $4x + 4y - 1 = 0$   
 (3)  $x + y + 1 = 0$       (4)  $4x - 4y + 1 = 0$

Q. 73.  $(p \Rightarrow q) \cap (q \Rightarrow r) \Rightarrow (p \Rightarrow r)$  is.....

- (1) A Tautology  
 (2) A contradiction  
 (3) A tautology and a contradiction  
 (4) neither tautology nor a contradiction

Q. 74. If  $\sin \theta = \frac{1}{\sqrt{2}}$  and  $\frac{\pi}{2} < \theta < \pi$ . Then the value of  $\frac{\sin \theta + \cos \theta}{\tan \theta}$  is :

- (1) 0      (2) 1  
 (3)  $\frac{1}{\sqrt{2}}$       (4)  $\sqrt{2}$

Q. 75. The general solution of  $x$  satisfying

$$\cot\left(\frac{\pi - x}{4} - \frac{x}{3}\right) = \frac{\sqrt{3}}{3} \text{ is.....}$$

- (1)  $\frac{\pi}{2}(12n - 1); n \in I$   
 (2)  $\frac{\pi}{2}(12n + 1); n \in I$   
 (3)  $\frac{-\pi}{12}(12n + 1); n \in I$   
 (4)  $\frac{\pi}{12}(12n + 1); n \in I$

Q. 76.  $\cos^{-1}(\cos 10)$  is equal to

- (1)  $4\pi + 10$       (2)  $4\pi - 10$   
 (3)  $-4\pi + 10$       (4) 10

Q. 77. Let ABC be a triangle such that  $\angle A = 45^\circ$ ,  $\angle B = 75^\circ$  then  $a + c\sqrt{2}$  is equal to : (in usual notation)

- (1) 0      (2)  $b$   
 (3)  $2b$       (4)  $-b$

Q. 78. If H is the orthocentre of the triangle ABC, then AH is equal to :

- (1)  $a \cot A$       (2)  $a \cot B$   
 (3)  $b \cot A$       (4)  $c \cot A$

Q. 79. If  $\alpha, \beta, \gamma, \delta$  are roots of  $x^4 - 100x^3 + 2x^2 + 4x + 10 = 0$ , then  $\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma} + \frac{1}{\delta}$  is equal to

- (1)  $\frac{2}{5}$       (2)  $\frac{1}{10}$   
 (3) 4      (4)  $-\frac{2}{5}$

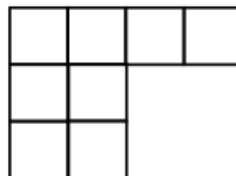
Q. 80. If  $0 < x, y, a, b < 1$ , then the sum of the infinite terms of the series  $\sqrt{x}(\sqrt{a} + \sqrt{x}) + \sqrt{x}(\sqrt{ab} + \sqrt{xy}) + \sqrt{x}(b\sqrt{a} + y\sqrt{x}) + \dots$  is :

- (1)  $\frac{\sqrt{ax}}{1 + \sqrt{b}} + \frac{x}{1 + \sqrt{y}}$     (2)  $\frac{\sqrt{x}}{1 + \sqrt{b}} + \frac{\sqrt{x}}{1 + \sqrt{y}}$   
 (3)  $\frac{\sqrt{x}}{1 - \sqrt{b}} + \frac{\sqrt{x}}{1 - \sqrt{y}}$     (4)  $\frac{\sqrt{ax}}{1 - \sqrt{b}} + \frac{x}{1 - \sqrt{y}}$

### Section B

Q. 81. In the binomial expansion of  $\left(\sqrt[3]{2} + \frac{1}{\sqrt[3]{3}}\right)^n$ , the ratio of the 7<sup>th</sup> term from the beginning to the 7<sup>th</sup> term from the end is 1 : 6 ;  $n$  is .....

Q. 82. The no. of different ways, the letters of the word KUMARI can be placed in the 8 boxes of the given figure so that no row remains empty will be .....



Q. 83. The point on the ellipse  $x^2 + 2y^2 = 6$  closest to the line  $x + y = 7$  is  $(a, b)$ . The value of  $(a + b)$  will be .....

Q. 84. The hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  passes through the point of intersection of the lines,  $7x + 13y - 87 = 0$  and  $5x - 8y + 7 = 0$ , the latus rectum is  $32\frac{\sqrt{2}}{5}$ . The value of  $(a\sqrt{2} + b)$  will be .....

Q. 85. Let  $f(x)$  be a function which satisfies  $f(x^3)f'(x) = f'(x)f'(x^3) + f''(x^2)$ . Given that  $f(1) = 1$  and  $f''(1) = 1/4$ , then value of  $4(f'(1) + f''(1))$  is .....



Q. 86.  $\lim_{n \rightarrow \infty} \frac{(1^2 + 2^2 + \dots + n^2)(1^4 + 2^4 + \dots + n^4)}{(1^7 + 2^7 + \dots + n^7)} = \frac{k+1}{15}$ ,

then  $k$  is equal to .....

Q. 87. Let  $f: \mathbb{R} \rightarrow \mathbb{R}$  and  $f$  be a differentiable function such that  $f(x + 2y) = f(x) + 4f(y) + 2y(2x - 1)$   $\forall x, y \in \mathbb{R}$  and  $f'(0) = 1$ , then  $f(3) + f'(3)$  is equal to .....

Q. 88. If  $x + y = t + \frac{1}{t}$  and  $x^2 + y^2 = t^2 + \frac{1}{t^2}$  then  $150 \left| x^2 \frac{dy}{dx} \right|$  is .....

Q. 89. If  $f(x) = \int (3x - 1)x(x + 1)(18x^{11} + 15x^{10} - 10x^9)^{1/6} dx$ , where  $f(0) = 0$ , is in the form of

$$\frac{(18x^\alpha + 15x^\beta - 10x^\gamma)^\delta}{\theta}$$

, then  $(3\alpha + 4\beta + 5\gamma + 6\delta + 7\theta)$  is ..... (Where  $\delta$  is a rational number in its simplest form)

Q. 90. If  $\lim_{n \rightarrow \infty} \frac{\int_{\frac{1}{n+1}}^{\frac{1}{n}} \tan^{-1}(nx) dx}{\int_{\frac{1}{n+1}}^{\frac{1}{n}} \sin^{-1}(nx) dx} = \frac{p}{q}$ , (where  $p$  and  $q$

are coprime), then  $(p + q)$  is .....

## Answers

### Physics

Q. No.	Answer
1	(2)
2	(4)
3	(3)
4	(3)
5	(1)
6	(2)
7	(1)
8	(1)
9	(2)
10	(3)
11	(2)
12	(1)
13	(1)
14	(3)
15	(4)

Q. No.	Answer
16	(2)
17	(1)
18	(4)
19	(1)
20	(3)
21	47.70
22	68.00
23	154
24	30.00
25	93.70
26	1.50
27	2.00
28	40.00
29	4.00
30	2.00

### Chemistry

Q. No.	Answer
31	(2)
32	(3)
33	(2)
34	(1)
35	(1)
36	(2)
37	(2)
38	(3)
39	(1)
40	(2)
41	(4)
42	(3)
43	(3)
44	(2)
45	(4)

Q. No.	Answer
46	(1)
47	(4)
48	(3)
49	(3)
50	(4)
51	19.90
52	9.114
53	19.80
54	234.98
55	8.00
56	101.99
57	15.05
58	1.71
59	24.00
60	5.92

### Mathematics

Q. No.	Answer
61	(2)
62	(2)
63	(1)
64	(4)
65	(3)
66	(2)
67	(3)
68	(1)
69	(1)
70	(2)
71	(1)
72	(1)
73	(1)
74	(1)
75	(3)

Q. No.	Answer
76	(2)
77	(3)
78	(1)
79	(4)
80	(4)
81	9.00
82	18720
83	3.00
84	9.00
85	3.00
86	7.00
87	19.00
88	150.00
89	298
90	3.00