



## SAMPLE PAPER - 11

### Physics

#### Section A

Q. 1.  $P = \frac{\alpha}{\beta} \exp \left( -\frac{\alpha z}{K_B \theta} \right)$

$\theta \rightarrow$  Temperature

$P \rightarrow$  Pressure

$K_B \rightarrow$  Boltzmann constant

$z \rightarrow$  Distance

Dimension of  $\beta$  is

- (1)  $[M^0 L^0 T^0]$                       (2)  $[M^{-1} L^1 T^2]$   
 (3)  $[M^0 L^2 T^0]$                       (4)  $[ML^{-1} T^{-2}]$

Q. 2. If  $\vec{a}_1$  and  $\vec{a}_2$  are two non collinear unit vectors and if  $|\vec{a}_1 + \vec{a}_2| = \sqrt{3}$ , then the value of  $(\vec{a}_1 - \vec{a}_2) \cdot (2\vec{a}_1 + \vec{a}_2)$  is :

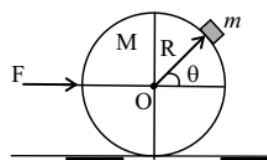
- (1) 2    (2)  $\frac{3}{2}$   
 (3)  $\frac{1}{2}$                                         (4) 1

Q. 3. A body is thrown from a point with speed 50 m/s at an angle  $37^\circ$  with horizontal. When it has moved a horizontal distance of 80 m then its distance from point of projection is :

- (1) 40 m                                      (2)  $40\sqrt{2}$  m  
 (3)  $40\sqrt{5}$  m                              (4) None

Q. 4. A smooth sphere of radius R and mass M is placed on the smooth horizontal floor. Another smooth particle of mass m is placed

on the sphere and a horizontal force F is applied on the sphere as shown. If the particle does not slip on the sphere then the value of force F is :



- (1)  $F = mg \cot \theta$   
 (2)  $F = Mg \cot \theta$   
 (3)  $F = (m + M)g \cot \theta$   
 (4)  $F = (m + M)g \tan \theta$

Q. 5. A block of mass m is pulled by a constant power P placed on a rough horizontal plane. The friction co-efficient between the block and the surface is  $\mu$ . Maximum velocity of the block will be :

- (1)  $\frac{\mu P}{mg}$                                       (2)  $\frac{\mu mg}{P}$   
 (3)  $\mu mg P$                                     (4)  $\frac{P}{\mu mg}$

Q. 6. 80 gm of water at  $30^\circ\text{C}$  is poured on a large block of ice at  $0^\circ\text{C}$ . The mass of ice that melts is :

- (1) 160 gm                                    (2) 80 gm  
 (3) 40 gm                                      (4) 30 gm

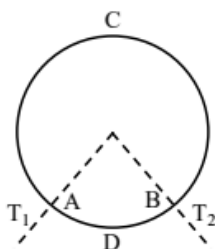
Q. 7. At NTP the density of a gas is  $1.3 \text{ kg/m}^3$  and the velocity of sound propagation in the gas is  $330 \text{ m/s}$ . The degree of freedom of gas molecule is :

- (1) 3 (2) 5  
(3) 6 (4) 7

Q. 8. An expansion process on a diatomic ideal gas ( $C_v = 5/2 R$ ), has a linear path between the initial and final coordinates on a pV diagram. The coordinates of the initial state are : the pressure is  $300 \text{ kPa}$ , the volume is  $0.08 \text{ m}^3$  and the temperature is  $390 \text{ K}$ . The final pressure is  $90 \text{ kPa}$  and the final temperature is  $320 \text{ K}$ . The change in the internal energy of the gas, in SI units, is closest to :

- (1)  $-11,000$  (2)  $-6500$   
(3)  $11,000$  (4) zero

Q. 9. A ring consisting of two parts ADB and ACB of same conductivity K carries an amount of heat H. The ADB part is now replaced with another metal keeping the temperatures  $T_1$  and  $T_2$  constant. The heat carried increases to  $2H$ . What should be the conductivity of the new ADB part ? (Given  $\frac{ACB}{ADB} = 3$ )



- (1)  $\frac{7}{3} K$  (2)  $2 K$   
(3)  $\frac{5}{2} K$  (4)  $3 K$

Q. 10. The height of mercury column measured with brass scale at temperature  $T_0$  is  $H_0$ . What height  $H'$  will the mercury column have at  $T = 0^\circ\text{C}$ . Coefficient of volume expansion of mercury is  $\gamma$ . Coefficient of linear expansion of brass is  $\alpha$  :

- (1)  $H_0(1 + \alpha T_0)$  (2)  $\frac{H_0(1 + 3\alpha T_0)}{1 + \gamma T_0}$   
(3)  $\frac{H_0(1 + 3\alpha T_0)}{(1 + \gamma/3)T_0}$  (4)  $\frac{H_0(1 + \alpha T_0)}{1 + \gamma T_0}$

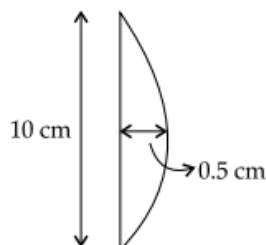
Q. 11. Two closed end pipes when sounded together produce 5 beat per second. If their length are in the ratio  $100 : 101$ , then fundamental notes produced by them are :

- (1) 245, 250 (2) 250, 255  
(3) 495, 500 (4) 500, 505

Q. 12. The period of rotation of the sun at its equator is  $T$  and its radius is  $R$ . Then the Doppler wavelength shift expected for light with wavelength  $\lambda$  emitted from the edge of the sun's disc is : [ $c$  = speed of light]

- (1)  $\pm \frac{\pi R \lambda}{cT}$  (2)  $\pm \frac{T \lambda}{2\pi R c}$   
(3)  $\pm \frac{2\pi R c}{T \lambda}$  (4)  $\pm \frac{2\pi R \lambda}{cT}$

Q. 13. A plano convex lens has diameter of  $10 \text{ cm}$  and its thickness at the centre is  $0.5 \text{ cm}$ . Speed of light in the lens is  $2 \times 10^8 \text{ ms}^{-1}$ . What is the focal length of the lens ?



- (1)  $10 \text{ cm}$  (2)  $17.5 \text{ cm}$   
(3)  $10.5 \text{ cm}$  (4)  $21 \text{ cm}$

Q. 14. Parallel rays striking a spherical mirror far from the optic axis are focussed at a different point than are rays near the axis thereby the focus moves toward the mirror as the parallel rays move toward the outer edge of the mirror. What value of incidence angle  $\theta$  produces a 2% change in the location of the focus, compared to the location for  $\theta$  very close to zero ?

- (1)  $3.5^\circ$  (2)  $5.5^\circ$   
(3)  $8.5^\circ$  (4)  $11.5^\circ$

Q. 15. A horizontal ray of light passes through a prism of index 1.50 and apex angle  $4^\circ$  and then strikes a vertical mirror, as shown in the figure (a). Through what angle must the mirror be rotated if after reflection the ray is to be horizontal ?

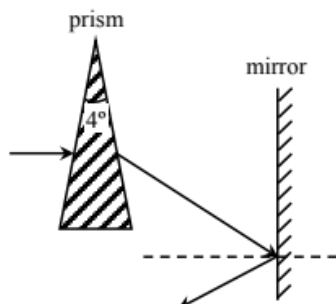
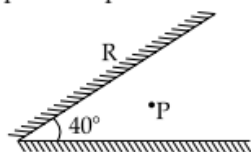


Fig. (a)

- (1)  $1^\circ$  (2)  $2^\circ$   
 (3)  $2.5^\circ$  (4)  $1.5^\circ$
- Q. 16. Two plane mirrors are inclined at an angle of  $40^\circ$ . The possible number of images of an object placed at point P would be ?



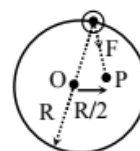
- (1) 4 (2) 6  
 (3) 7 (4) 8
- Q. 17. According to Bohr model, magnetic field at centre (at the nucleus) of a hydrogen atom due to motion of electron in the ninth orbit is proportional to :
- (1)  $\frac{1}{n^3}$  (2)  $\frac{1}{n^5}$   
 (3)  $n^5$  (4)  $n^3$
- Q. 18. If  $\lambda_a$ ,  $\lambda_b$  and  $\lambda_c$  represent the  $K_\alpha$ ,  $K_\beta$  and  $L_\alpha$  transition wavelengths in a hydrogen atom, respectively. Then which of the following is correct ?
- (1)  $\frac{1}{\lambda_A} + \frac{1}{\lambda_B} = \frac{1}{\lambda_C}$  (2)  $\frac{1}{\lambda_C} - \frac{1}{\lambda_B} = \frac{1}{\lambda_A}$   
 (3)  $\frac{1}{\lambda_B} + \frac{1}{\lambda_C} = \frac{1}{\lambda_A}$  (4)  $\frac{1}{\lambda_A} + \frac{1}{\lambda_C} = \frac{1}{\lambda_B}$
- Q. 19. One centimetre on the main scale of vernier callipers is divided into ten equal parts. If 10 divisions of vernier scale coincide with 8 small divisions of the main scale, the least count of the callipers is :
- (1) 0.005 cm (2) 0.05 cm  
 (3) 0.02 cm (4) 0.01 cm
- Q. 20. The photocurrent in an experiment on photoelectric effect increases if :

- (1) the intensity of the source is increased  
 (2) the exposure time is increased  
 (3) the intensity of the source is decreased  
 (4) the exposure time is decreased

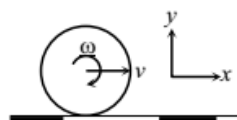
### Section B

- Q. 21. A particle of mass  $10^{-2}$  kg is moving along the positive  $x$ -axis under the influence of a force  $F(x) = -\frac{K}{(2x)^2}$  where  $K = 10^{-2}$  Nm<sup>2</sup>. At time  $t = 0$  it is at  $x = 1.0$  m and its velocity is  $v = 0$ . The velocity of particle will be ..... m/s, when it reaches  $x = 0.50$  m.

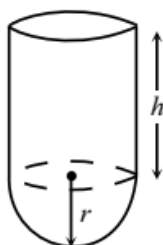
- Q. 22. A small bead of mass  $m$  can move on a smooth circular wire (radius  $R$ ) under the action of a force  $F = \frac{Km}{r^2}$  directed ( $r$  = position of bead from P and  $K$  = constant) towards a point P within the circle at a distance  $R/2$  from the centre. The minimum velocity should be ..... m/s of bead at the point of the wire nearest the centre of force (P) so that bead will complete the circle (Take  $\frac{k}{3R} = 8$  unit)



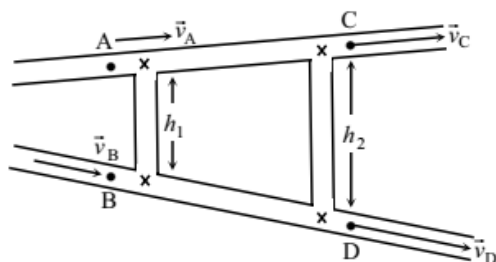
- Q. 23. A disc of radius 5 cm rolls on a horizontal surface with linear velocity  $v = 1 \hat{i}$  m/s and angular velocity  $50$  rad/s. Height of particle from ground on rim of disc which has velocity in vertical direction is ..... cm.



- Q. 24. A container consist of hemispherical shell of radius ' $r$ ' and cylindrical shell of height ' $h$ ' radius of same material and thickness. The maximum value  $h/r$  so that container remain stable equilibrium in the position shown (neglect friction) is .....

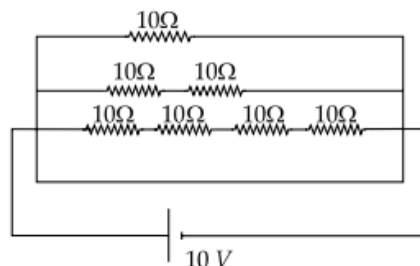


- Q. 25. An ideal fluid is flowing in two pipes of same cross-sectional pipes area. Both the pipes are connected with two vertical tubes, of length  $h_1$  and  $h_2$  as shown in figure. The flow is stream line in both pipes. If velocity of fluid at A, B, and C are 2 m/s, 4 m/s and 4 m/s respectively, the velocity of fluid at D (in m/s) is .....



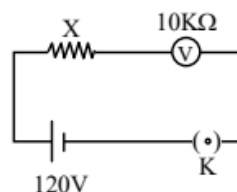
- Q. 26. A beam of charged particles accelerated using a potential difference of 5000 V falls to rest on a metal plate normally constituting a current of 500  $\mu$ A. The force exerted by the beam on the plate is .....  $\times 10^{-6}$  N. (specific charge  $= 4 \times 10^6 \text{ C kg}^{-1}$  for each particle).

- Q. 27.



We have an infinite ladder of parallel resistances. what is the current through the circuit ?

- Q. 28. A DC supply of 120 V is connected to a large resistance X. A voltmeter of resistance 10 k $\Omega$  placed in series in the circuit reads 20 V. This is an unusual use of voltmeter for measuring very high resistance. The value of X is ..... k $\Omega$  (approx).



- Q. 29. A series LCR circuit containing a resistance of 120  $\Omega$  has angular resonance frequency  $4 \times 10^5 \text{ rads}^{-1}$ . At resonance the voltage across resistance and inductance are 60 V and 40 V respectively. The current in the circuit lags the voltage by  $45^\circ$  on the frequency of .....  $\times 10^5 \text{ rad/sec}$ .
- Q. 30.  $^{23}\text{Ne}$  decays to  $^{23}\text{Na}$  by negative beta emission. Mass of  $^{23}\text{Ne}$  is 22.994465 amu mass of  $^{23}\text{Na}$  is 22.989768 amu. The maximum kinetic energy of emitted electrons neglecting the kinetic energy of recoiling product nucleus is ..... MeV.

## Chemistry

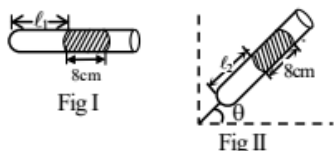
### Section A

- Q. 31.  $\frac{A_0}{2}$  atoms of X(g) are converted into  $X^+(g)$  by absorbing energy  $E_1$ .  $\frac{A_0}{2}$  ions of  $X^+(g)$  are converted into  $X^-(g)$  with release of

energy  $E_2$ . Hence ionization energy and electron affinity of X(g) are is :

- (1)  $\frac{2E_1}{A_0}, \frac{2(E_1 - E_2)}{A_0}$  (2)  $\frac{2E_1}{A_0}, \frac{2(E_2 - E_1)}{A_0}$   
 (3)  $\frac{(E_1 - E_2)}{A_0}, \frac{2E_2}{A_0}$  (4) None of these

Q. 32.



In figure-I an air column of length  $\ell_1$ , is entrapped by a column of Hg of length 8 cm. In figure-II length of same air column at the same temperature is  $\ell_2$ . The  $\frac{\ell_1}{\ell_2}$  is :  
(1 atm = 76 cm of Hg)

- (1)  $1 + \frac{2}{19} \times \cos \theta$  (2)  $1 + \frac{2}{19} \times \sin \theta$   
(3)  $1 + \frac{2}{21} \times \sin \theta$  (4)  $\frac{21}{19}$

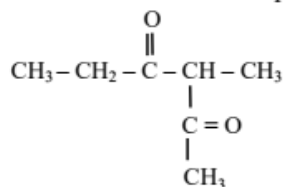
Q. 33. For which of the following  $K_p$  is less than  $K_c$ ?

- (1)  $N_2O_4 \rightleftharpoons 2NO_2$   
(2)  $N_2 + 3H_2 \rightleftharpoons 2NH_3$   
(3)  $H_2 + I_2 \rightleftharpoons 2HI$   
(4)  $CO + H_2O \rightleftharpoons CO_2 + H_2$

Q. 34. Calculate pH of mixture of 400 ml of  $\frac{1}{200}$  M  $Ba(OH)_2$  400 ml of  $\frac{1}{50}$  M HCl and 200 ml of water :

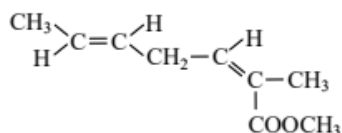
- (1) 8.4 (2) 2.1  
(3) 2.8 (4) None of these

Q. 35. Write the IUPAC name of compound



- (1) 3 - methyl hexane dione - 2, 4 - dione  
(2) 3 - ethyl hexane dione-2, 4 - dione  
(3) 1, 1-di ethyl hexane dione-2, 4 - dione  
(4) None of these

Q. 36. The correct stereochemical name of



- (1) Methyl 2-methylhepta (2E, 5E) dienoate  
(2) Methyl 2-methylhepta (2Z, 5Z) dienoate  
(3) Methyl 2-methylhepta (2E, 5Z) dienoate  
(4) Methyl 2-methylhepta (2Z, 5E) dienoate

Q. 37. 1000 g aqueous solution of  $\text{CaCO}_3$  contains 10 g of calcium carbonate. Hardness of the solution is :

- (1) 10 ppm (2) 100 ppm  
(3) 1000 ppm (4) 10000 ppm

Q. 38. Boron reacts with nitric acid to form :

- (1) Sodium borate,  $\text{H}_2$   
(2) Boric acid  
(3) Diborane  
(4) Borax

Q. 39. What happens when steam is passed over red hot carbon :

- (1)  $\text{C} + 2\text{H}_2 \rightarrow \text{CO}_2 + 2\text{H}_2$   
(2)  $\text{C} + \text{H}_2\text{O} \rightarrow \text{CO} + \text{H}_2$   
(3) Water vapour dissociates into  $\text{H}_2$  and  $\text{O}_2$   
(4) None of these

Q. 40. Halides of alkaline earth metals form hydrates such as  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ ,  $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$ ,  $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$  and  $\text{SrCl}_2 \cdot 2\text{H}_2\text{O}$ . This shows that halides of group 2 elements :

- (1) are hygroscopic in nature  
(2) can act as dehydrating agents  
(3) can absorb moisture from air  
(4) all of the above

Q. 41. Which of the following is most stable carbocations :

- (1)  $\text{CH}_3^+$  (2)  $\text{CH}_3\text{-CH}_2^+$   
(3)  $\text{CH}_3\text{-C}^+=\text{O}$  (4)  $\text{CH}_3\text{-C}^+(\text{CH}_3)\text{-CH}_2$

Q. 42. Which sodium salt will be heated with sodalime to obtain propane :

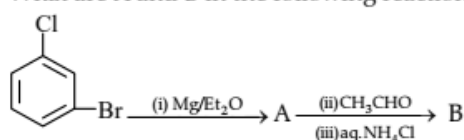
- (1)  $\text{CH}_3\text{-CH}_2\text{-C}(=\text{O})\text{-O}^-\text{Na}^+$   
(2)  $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-C}(=\text{O})\text{-O}^-\text{Na}^+$   
(3)  $(\text{CH}_3)_2\text{-CH-C}(=\text{O})\text{-O}^-\text{Na}^+$   
(4) 2 and 3 both


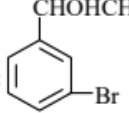
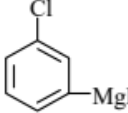
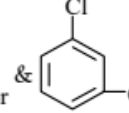
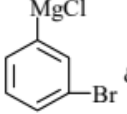
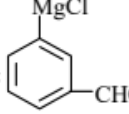
Q. 43. The reaction of benzene with CO and HCl in the presence of anhydrous  $\text{AlCl}_3$  gives :

- (1) Chlorobenzene  
(2) Toluene  
(3) Benzyl chloride  
(4) Benzaldehyde



Q. 44. What are A and B in the following reaction



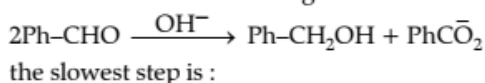
- (1)  &   
 (2)  &   
 (3)  & 

(4) None of these

Q. 45. A compound 'X' with molecular formula  $\text{C}_3\text{H}_8\text{O}$  can be oxidised to a compound 'Y' with the molecular formula  $\text{C}_3\text{H}_6\text{O}_2$ , 'X' is most likely to be :

- (1) Primary alcohol (2) Secondary alcohol  
 (3) Aldehyde (4) Ketone

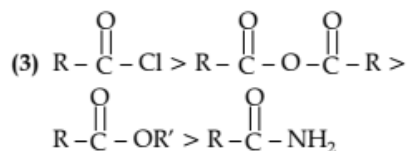
Q. 46. In the Cannizzaro reaction given below :



- (1) The attack of  $\text{OH}^-$  at the carbonyl group  
 (2) The transfer of hydride to the carbonyl group  
 (3) The abstraction of proton from the carboxylic group  
 (4) The deprotonation of  $\text{Ph-CH}_2\text{OH}$

Q. 47. The relative order of reactivity of acyl derivatives is :

- (1)  $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl} > \text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{R} > \text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}_2 > \text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OR}'$   
 (2)  $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl} > \text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OR}' > \text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{R} > \text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}_2$



(4) None of the above

Q. 48. Of the following statements :

- (P)  $\text{C}_6\text{H}_5\text{N}=\text{CH}-\text{C}_6\text{H}_5$  is a Schiff's base  
 (Q) A dye is obtained by the reaction of aniline and  $\text{C}_6\text{H}_5\text{N}=\text{NCl}$   
 (R)  $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$  on treatment with  $[\text{NaNO}_2 + \text{HCl}]$  gives diazonium salt  
 (S) p-Toluidine on treatment with  $[\text{HNO}_2 + \text{HCl}]$  gives diazonium salt  
 (1) Only (P) and (Q) are correct  
 (2) Only (P) and (R) are correct  
 (3) Only (R) and (S) are correct  
 (4) (P), (Q) and (S) are correct

Q. 49. When sucrose is heated with conc.  $\text{HNO}_3$  the product is :

- (1) Sucrose nitrate  
 (2) Oxalic acid  
 (3) Formic acid  
 (4) Citric acid

Q. 50. Kjeldahl's method is used in the estimation of :

- (1) Nitrogen (2) Halogens  
 (3) Sulphur (4) Oxygen

### Section B

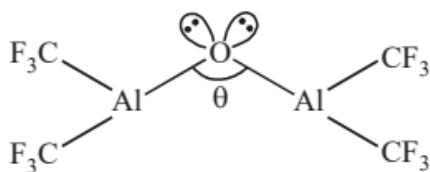
Q. 51. An alloy of Iron (54.7%), nickel (45.0%) and manganese (0.3%) has a density of  $8.17 \text{ g cm}^{-3}$ .  $\dots \times 10^{26}$  iron atoms are there in a block of alloy measuring  $10.0 \text{ cm} \times 20.0 \text{ cm} \times 15.0 \text{ cm}$ .

Q. 52. The wavelength associated with an electron equal to wavelength of proton would be  $\dots \times 10^3$ .

$$(\text{mass of } e = 9 \times 10^{-28} \text{ g ;})$$

$$\text{mass of proton} = 1.6725 \times 10^{-24} \text{ g})$$

Q. 53. In following structure the percentage of 's' character in lone pair occupy by oxygen atom is  $\dots$ .



Given :  $\cos \theta = -0.99$

- Q. 54.** 4 ml of pure A ( $d = 2.45$  gm/ml) was added to 46 ml of B ( $d = \frac{25.1}{23}$  gm/ml), the molarity of solution of A in B will be ....., if density of final solution is 1.8 gm/ml.  
Given: Molar mass of A = 98.  
Molar mass of B = 46.
- Q. 55.** 20% surface sites have adsorbed  $N_2$ . On heating  $N_2$  gas evolved from sites and were collected at 0.001 atm and 298 K in a container of volume is  $2.46 \text{ cm}^3$ . Density of surface sites is  $6.023 \times 10^{14}/\text{cm}^2$  and surface area is  $1000 \text{ cm}^2$ , the no. of surface sites occupied per molecule of  $N_2$  is .....
- Q. 56.** The density of a pure substance 'X' whose atoms pack in cubic close pack arrangement is 1g/cc. If all tetrahedral voids are occupied by 'Y' atoms. The value of '3a' is ..... g/cc, if the density of resulting solid is 'a' g/cc. [Given : Atomic mass (X) = 30 g/mol, (Y) = 20 g/mol]
- Q. 57.** The vapour pressure of solution obtained by mixing 0.2 mol of NaCl in 72g of water at  $25^\circ\text{C}$  will be ..... torr.  
[Given : vapour pressure of water at  $25^\circ\text{C}$  is 24.2 torr]
- Q. 58.** On passing electricity through nitrobenzene solution, it is converted into azobenzene. The mass of azobenzene is ..... mg, if same quantity of electricity produces oxygen just sufficient to burn 96 mg of fullerene ( $C_{60}$ ).
- Q. 59.** 0.1 mole of a gaseous compound B is mixed with 0.5 mole of solid A in a constant volume adiabatic bomb calorimeter in which A and B react according to reaction  
 $3A(s) + 2B(g) \rightarrow 3C(g) + 4D(l)$  :  $\Delta H = ?$   
The temperature inside the calorimeter raise to 310 K from 300 K as a result of complete reaction.  
The mixture of products now cooled back to original temperature at 300 K. Now a current of strength 100 mA flowing across a potential gradient of 10 Volt is passed for 1974 seconds through the calorimeter system which restores the temperature of product mixture to 310 K. The given reaction (calories) is [(-).....)]. [Use  $R = 2$  calories/degree mole, 1 calorie = 4.2 Joule]
- Q. 60.** Enthalpy for the reaction  $Ag^+(aq) + Br^-(aq) \rightarrow AgBr(s)$  is  $-84.54 \text{ kJ}$ . Magnitude of enthalpy of formation of  $Ag^+(aq)$  and  $Br^-(aq)$  are in the ratio 8 : 9. Formation of  $Ag^+(aq)$  is an endothermic process whereas formation of  $Br^-$  is an exothermic process. Enthalpy of formation of  $AgBr$  is  $-99.54 \text{ kJ/mol}$ . The enthalpy of formation of  $Ag^+(aq)$  is ..... kJ/mol.

## Mathematics

### Section A

- Q. 61.** A circle touches two of the smaller sides of a  $\Delta ABC$  ( $a < b < c$ ) and has its centre on the greatest side. Then the radius of the circle is :  
 (1)  $\frac{a-b-c}{2}$  (2)  $\frac{abc}{2}$   
 (3)  $\frac{2\Delta}{a+b}$  (4)  $\frac{a+b+c}{2}$
- Q. 62.** The number of solutions of the equation  $\sin 2x - 2 \cos x + 4 \sin x = 4$  in the interval  $[0, 5\pi]$  is :  
 (1) 3 (2) 5  
 (3) 4 (4) 6
- Q. 63.** If  $|x-1| + |x-2| + |x-3| \geq 6$  then.  
 (1)  $0 \leq x \leq 4$  (2)  $x \leq -2$  or  $x \geq 4$   
 (3)  $x \leq 0$  or  $x \geq 4$  (4)  $x \leq -1$  or  $x \geq 3$

- Q. 64. The value of 'a' for which the sum of the squares of the roots of  $2x^2 - 2(a-2)x - a - 1 = 0$  is least is  
 (1) 1 (2)  $\frac{3}{2}$   
 (3) 2 (4) -1
- Q. 65. The sum of infinite number of terms of a decreasing G.P. is 4 and the sum of the squares of its terms to infinity is  $\frac{16}{3}$ , then the G.P. is :  
 (1)  $2, 1, \frac{1}{2}, \frac{1}{4}, \dots$  (2)  $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \dots$   
 (3)  $2, 4, 8, \dots$  (4)  $\frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \dots$
- Q. 66. The 4<sup>th</sup> term from the end in the expansion of  $\left(\frac{x^3}{2} - \frac{2}{x^2}\right)^7$  is :  
 (1)  $70x$  (2)  $70x^2$   
 (3)  $-35x^6$  (4)  $-70x$
- Q. 67. If  ${}^{m+n}P_2 = 90$  and  ${}^{m-n}P_2 = 30$ , then (m, n) is given by :  
 (1) (7, 3) (2) (16, 8)  
 (3) (9, 2) (4) (8, 2)
- Q. 68. The orthocentre of the triangle formed by the lines  $4x - 7y + 10 = 0$ ,  $x + y = 5$  and  $7x + 4y = 15$ , is :  
 (1) (1, 2) (2) (1, -2)  
 (3) (-1, -2) (4) (-1, 2)
- Q. 69. Length of intercept made by line  $x + y = 2$  on the circle  $x^2 + y^2 - 4x - 6y - 3 = 0$  is :  
 (1)  $2\sqrt{23}$  (2)  $\sqrt{23}$   
 (3)  $\sqrt{46}$  (4)  $4\sqrt{23}$
- Q. 70. If the vertex = (2, 0) and the extremities of the latus rectum are (3, 2) and (3, -2) then the equation of the parabola is :  
 (1)  $y^2 = 2x - 4$  (2)  $x^2 = 4y - 8$   
 (3)  $y^2 = 4x - 8$  (4)  $x^2 = 2y - 4$
- Q. 71. If the chord through the points whose eccentric angles are  $\alpha$  and  $\beta$  on the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  passes through the focus (ae, 0), then the value of  $\tan \frac{\alpha}{2} \tan \frac{\beta}{2}$  will be  
 (1)  $\frac{e+1}{e-1}$  (2)  $\frac{e-1}{e+1}$   
 (3)  $\frac{e+1}{e-2}$  (4)  $\frac{e-2}{e+1}$
- Q. 72. The hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  passes through the point of intersection of the lines  $x - 3\sqrt{5}y = 0$  and  $\sqrt{5}x - 2y = 13$  and the length of its latus rectum is  $\frac{4}{3}$  units. The coordinates of its focus are :  
 (1)  $(\pm 2\sqrt{10}, 1)$  (2)  $(\pm 3\sqrt{10}, 0)$   
 (3)  $(\pm 2\sqrt{10}, 0)$  (4)  $(\pm 3\sqrt{10}, 1)$
- Q. 73. Two vertical poles of heights, 20 m and 80 m stand apart on a horizontal plane. The height (in meters) of the point of intersection of the lines joining the top of each pole to the foot of the other, From this horizontal plane is :  
 (1) 15 (2) 18  
 (3) 12 (4) 16
- Q. 74. If  $f(x) = x^5 - 20x^3 + 240x$ , then  $f(x)$  satisfies :  
 (1) It is monotonically decreasing everywhere  
 (2) It is monotonically decreasing on  $(0, \infty)$   
 (3) It is monotonically increasing on  $(-\infty, 0)$   
 (4) It is monotonically increasing everywhere
- Q. 75. Let  $f(x) = (x-a)^n g(x)$ , where  $g^{(n)}(a) \neq 0$ ;  $n = 0, 1, 2, 3, \dots$  then  
 (1)  $f(x)$  has local extremum at  $x = a$ , when  $n = 3$   
 (2)  $f(x)$  has local extremum at  $x = a$ , when  $n = 4$   
 (3)  $f(x)$  has neither local maximum nor local minimum at  $x = a$ , when  $n = 2$   
 (4)  $f(x)$  has neither local maximum nor local minimum at  $x = a$ , when  $n = 4$
- Q. 76. If  $(x + iy)^{1/5} = a + ib$ , and  $u = \frac{x}{a} - \frac{y}{b}$ , then  
 (1)  $a - b$  is a factor of  $u$   
 (2)  $a + b$  is a factor of  $x$   
 (3)  $a + ib$  is a factor of  $y$   
 (4)  $a - ib$  is a factor of  $a$
- Q. 77. A line passes through the points (6, -7, -1) and (2, -3, 1). The direction cosines of the line so directed that the angle made by it with positive direction of x-axis is acute, are :  
 (1)  $\frac{2}{3}, \frac{-2}{3}, \frac{-1}{3}$  (2)  $\frac{2}{3}, \frac{-2}{3}, \frac{1}{3}$   
 (3)  $\frac{2}{3}, \frac{2}{3}, \frac{1}{3}$  (4)  $-\frac{2}{3}, \frac{2}{3}, \frac{1}{3}$



Q. 78. For three vectors  $\vec{u}$ ,  $\vec{v}$ ,  $\vec{w}$  which of the following expressions is not equal to any of the remaining three ?

- (1)  $\vec{u} \cdot (\vec{v} \times \vec{w})$  (2)  $(\vec{v} \times \vec{w}) \cdot \vec{u}$   
 (3)  $\vec{v} \cdot (\vec{u} \times \vec{w})$  (4)  $(\vec{u} \times \vec{v}) \cdot \vec{w}$

Q. 79. If  $A = \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$  and  $A^2 - kA - I_2 = 0$ , then value of  $k$  is :

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

Q. 80. The value of the determinant

$$\begin{vmatrix} 1 & \cos(\beta - \alpha) & \cos(\gamma - \alpha) \\ \cos(\alpha - \beta) & 1 & \cos(\gamma - \beta) \\ \cos(\alpha - \gamma) & \cos(\beta - \gamma) & 1 \end{vmatrix}$$

is equal to

- (1)  $\cos \alpha + \cos \beta + \cos \gamma$   
 (2)  $\cos \alpha \cos \beta + \cos \beta \cos \gamma + \cos \gamma \cos \alpha$   
 (3) -1  
 (4) 0

### Section B

Q. 81. A complex number  $z$  is moving on  $\arg\left(\frac{z-1}{z+1}\right) = \frac{\pi}{2}$ . If the probability that  $\arg\left(\frac{z^3-1}{z^3+1}\right) = \frac{\pi}{2}$  is  $\frac{m}{n}$ , where  $m, n \in \text{prime}$ , then  $(m+n)$  is equal to .....

Q. 82. Let  $\tan 9^\circ = \left(1 - \sqrt{\frac{\sqrt{5}k}{m}}\right)k$  where  $k = \sqrt{5} + 1$  then  $m$  is equal to .....

Q. 83. Number of values of  $x$  which satisfy then relation  $12 \tan^2 x + \frac{24}{\sqrt{3}} \tan x + 12 \sin^2 x - 12 \sin x + 7 \in (-2\pi, 4\pi)$  .....

Q. 84. Let  $x_1, x_2, x_3$  be the solutions of  $\tan^{-1}\left(\frac{2x+1}{x+1}\right) + \tan^{-1}\left(\frac{2x-1}{x-1}\right) = 2 \tan^{-1}(x+1)$  where  $x_1 < x_2 < x_3$  then  $2x_1 + x_2 + x_3^2$  is equal to .....

Q. 85. Difference between the greatest and least value of  $f(x) = \left(1 + \frac{\cos^{-1} x}{\pi}\right)^2 - \left(1 + \frac{\sin^{-1} x}{\pi}\right)^2$  is .....

Q. 86. Let  $x$  is a real number such that are functions involved are well defined then the value of  $\lim_{t \rightarrow 0} \left[ \max \left\{ \left( \sin^{-1} \frac{x}{3} + \cos^{-1} \frac{x}{3} \right)^2, \min(x^2 + 4x + 7) \right\} \right] \left( \frac{\sin^{-1} t}{t} \right)$  where  $[.]$  is greatest integer function and all other brackets are usual brackets.

Q. 87. Area bounded by the curves  $y = e^{x^2}$ , the  $x$ -axis and the lines  $x = 1$ ,  $x = 2$  is given to be  $\alpha$  square units. If the area bounded by the curve  $y = \sqrt{\ln x}$ , the  $x$ -axis and the lines  $x = e$  and  $x = e^4$  is expressed as  $(pe^4 - qe - \alpha)$ , (where  $p$  and  $q$  are positive integers), then  $(p+q)$  is .....

Q. 88. Let  $\int \frac{(x^6-4)dx}{(x^6+2)^{1/4} \cdot x^4} = \frac{\ell(x^6+2)^m}{x^n} + C$ , then  $\frac{n}{\ell m}$  is equal to .....

Q. 89. The value of the integral  $\int_0^{\sqrt{2}} ([\sqrt{2-x^2}] + 2x) dx$  (where  $[.]$  denotes greatest integer function) is .....

Q. 90. Let  $\int_0^\infty \frac{t^4 dt}{(1+t^2)^6} = \frac{3\pi}{64k}$  then  $k$  is equal to .....

## Answers

### Physics

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

Q. No.	Answer
16	(4)
17	(2)
18	(4)
19	(3)
20	(1)
21	1.00
22	8.00
23	3.00
24	1.00
25	2.00
26	25.00
27	2.00
28	50.00
29	8.00
30	4.00

### Chemistry

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

Q. No.	Answer
46	(2)
47	(3)
48	(4)
49	(2)
50	(1)
51	1.44
52	1.85
53	0.26
54	3.00
55	2.00
56	7.00
57	2.00
58	728
59	8800
60	120

### Mathematics

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

Q. No.	Answer
76	(1)
77	(1)
78	(3)
79	(1)
80	(4)
81	5.00
82	8.00
83	3.00
84	1.00
85	5.00
86	3.00
87	3.00
88	6.00
89	3.00
90	8.00