

## IIT-JEE (2006) (Memory Based Question Paper) PHYSICS

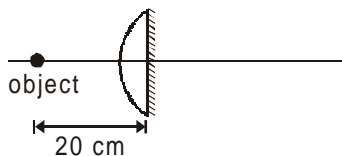
### Section I: Multiple Choice Questions with one correct answer.

**Q.1** A student performs experiment to determine  $g$  using formula  $g = \frac{4\pi^2 \ell}{T^2}$ ; here  $\ell$  (length of the wire) is approximately equal to 1m,  $\Delta \ell$  represents error in measurement of length  $\ell$ ,  $\Delta T$  represents error in measurement of time,  $n$  is total number of oscillation. Then for which of the data of the measurement of  $g$  will be most accurate ?

$\Delta \ell$	$\Delta T$	$n$	Amplitude of oscillation
(a) 5 mm	0.2sec	10	5mm
(b) 5 mm	0.2 sec	20	5mm
(c) 5 mm	0.1 sec	20	1 mm
(d) 1 mm	0.1 sec	50	1mm

**Ans. (d)**

**Q.2** Focal length of the shown plano-convex lens is 15 cm. Plane surface of the lens is silvered. An object is kept on the principal axis of the lens at a distance 20 cm. Image of the object will form.



- (a) 60 cm, left                      (b) 60 cm, right  
(c) 12 cm, left                      (d) 30 cm, right

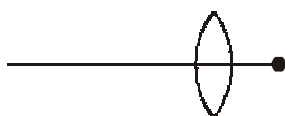
**Ans. (c)**

**Q.3** Half life of a radioactive sample is 4 days. Find the probability that a particular nucleus of the radioactive material decays after 2 half life is

- (a) 1                      (b)  $\frac{1}{2}$                       (c)  $\frac{3}{2}$                       (d)  $\frac{3}{4}$

**Ans. (d)**

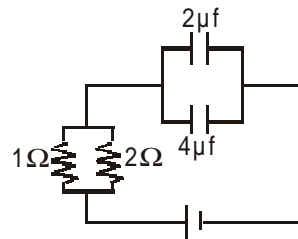
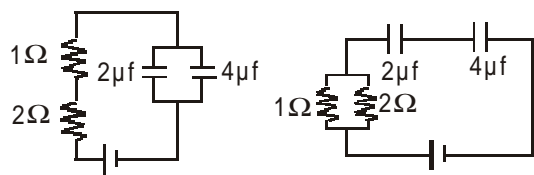
**Q.4** The image of sun is formed on focal plane of lens which is a circular in shape of radius  $r$  and area  $\pi r^2$ .



- (a)  $\pi r^2 \propto f$   
(b)  $\pi r^2 \propto f^2$   
(c) lens is covered half so half image is formed  
(d) on increasing focal length, brightness of the image increases

**Ans. (b)**

**Q.5** Time constant for the given circuits are.

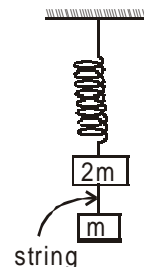


- (a)  $18 \mu s, \frac{8}{9} \mu s, 4 \mu s$                       (b)  $18 \mu s, 4 \mu s, \frac{8}{9} \mu s$

- (c)  $4 \mu s, \frac{8}{9} \mu s, 18 \mu s$                       (d)  $\frac{8}{9} \mu s, 18 \mu s, 4 \mu s$

**Ans. (a)**

**Q.6** In the system shown if the inextensible string connecting  $2m$  and  $m$  is cut, the accelerations of mass  $m$  and  $2m$  are

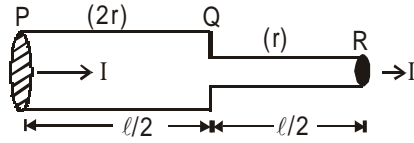


- (a)  $\frac{g}{2}, \frac{g}{2}$                       (b)  $g, \frac{g}{2}$

- (c)  $\frac{g}{2}, g$                       (d)  $g, g$

**Ans. (b)**

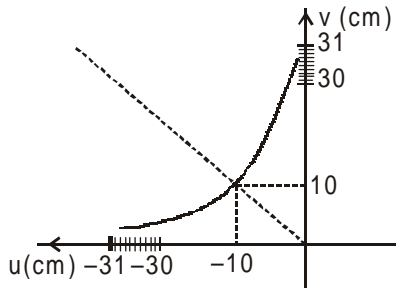
**Q.7** In the figure shown length of each wire is  $\ell/2$  and their radii are  $2r$  and  $r$ . Then



- (a) current density in both wires is same
- (b) power dissipated in QR is 4 times that in the PQ
- (c) ratio of potential drops on PQ & QR is 4
- (d) resistance of PQ is 4 times that of QR

**Ans. (b)**

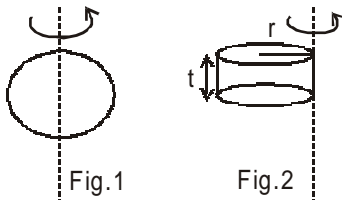
**Q.8** Graph of position of image vs position of a point object from a convex lens is shown in the figure. Then focal length of the lens is



- (a)  $(0.50 \pm 0.05)$  cm
- (b)  $(0.50 \pm 0.10)$  cm
- (c)  $(5.00 \pm 0.05)$  cm
- (d)  $(5.00 \pm 0.10)$  cm

**Ans. (c)**

**Q.9** Moment of inertia of solid sphere of mass  $m$  and radius  $R$  about axis passing through center of mass is  $I$  as shown in figure 1. The sphere is moulded in the form of disc of radius ' $r$ ' and thickness ' $t$ '. The moment of inertia of disc about the axis shown in figure 2 is  $I$ .

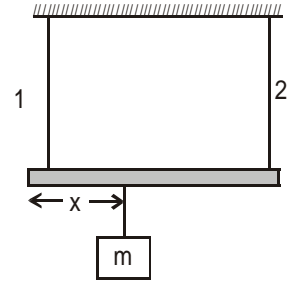


The radius of disc is

- (a)  $\frac{2R}{\sqrt{15}}$
- (b)  $\frac{2R}{\sqrt{5}}$
- (c)  $\frac{R}{\sqrt{15}}$
- (d)  $\frac{R}{\sqrt{5}}$

**Ans. (a)**

**Q.10** Wire 1 is vibrating in first harmonic: Wire 2 is vibrating in second harmonic : What is the position  $x$  of mass  $m$



- (a)  $\frac{4L}{5}$
- (b)  $\frac{L}{5}$
- (c)  $\frac{L}{4}$
- (d)  $\frac{3L}{4}$

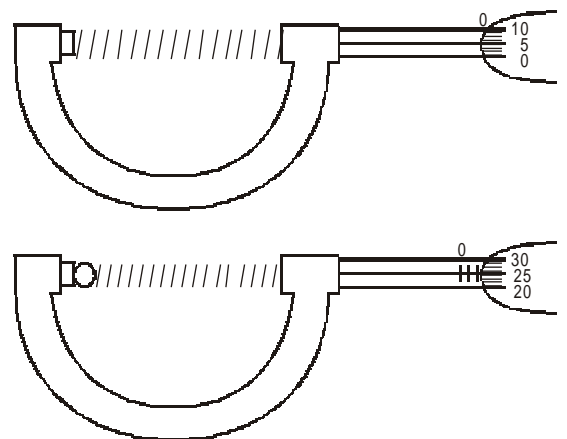
**Ans. (b)**

**Q.11** A double star system having two stars of masses  $m_1$  and  $m_2$ , is rotating about common center of mass in radius  $r_1$  and  $r_2$ , with periods  $T_1$  and  $T_2$ , then

- (a)  $\left(\frac{T_1}{T_2}\right) = \left(\frac{r_1}{r_2}\right)^3$
- (b) if  $T_1 > T_2$  then  $R_1 > R_2$
- (c) if  $T_1 > T_2$  then  $m_1 > m_2$
- (d)  $T_1 = T_2$

**Ans. (d)**

**Q.12** The circular divisions of shown screw gauge are 50 It moves 0.5 mm on main scale in one rotation. The diameter of the ball is -

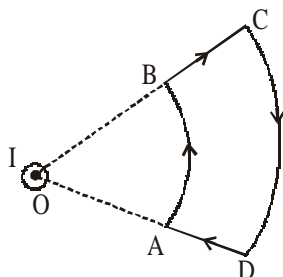


- (a) 2.25 mm
- (b) 2.20 mm
- (c) 1.20 mm
- (d) 1.25 mm

**Ans. (c)**

**Section II: Multiple Choice Questions with one or more correct answer(s).**

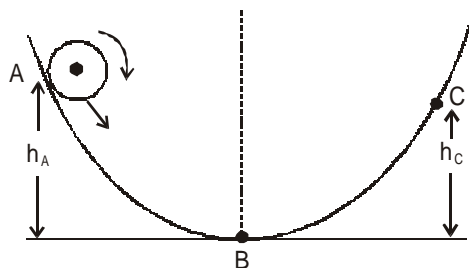
**Q.13** An infinite wire carrying current  $I$  passes through point  $O$  perpendicular to the plane containing a current carrying loop  $ABCD$  as shown in the figure.



- (a) Net force on the loop is zero
- (b) Net torque on the loop is zero
- (c) The loop rotates in anticlockwise direction as seen from  $O$
- (d) The loop rotates in clockwise direction as seen from  $O$

**Ans. (a, d)**

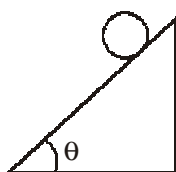
**Q.14** A ball is rolling on the track as shown in the figure.  $AB$  is rough surface and  $BC$  is smooth. Ball reaches to the height  $C$ .  $K_A$ ,  $K_B$  and  $K_C$  are the kinetic energies at  $A$ ,  $B$  and  $C$ .



- (a)  $h_A > h_C$ ;  $K_B > K_C$
- (b)  $h_A < h_C$ ;  $K_B > K_C$
- (c)  $h_A = h_C$ ;  $K_B = K_C$
- (d)  $h_A > h_C$ ;  $K_A < K_C$

**Ans. (a, d)**

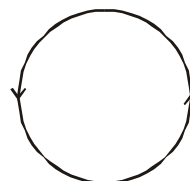
**Q.15** A solid cylinder is rolling over an inclined plane as shown in the figure.



- (a) friction force is dissipative
- (b) on decreasing  $\theta$ , frictional force decreases
- (c) friction force does help in rotation and opposes translation
- (d) friction force is necessarily  $\mu mg \cos \theta$

**Ans. (b, c)**

**Q.16** The given figure shows lines of force of a particular field. Out of the following option, the field line can not represent.



- (a) An electrostatic field
- (b) A magneto static field
- (c) A gravitational field
- (d) An induced electric field

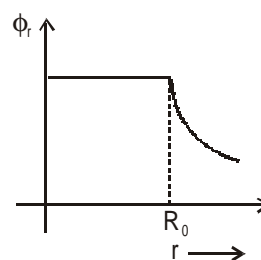
**Ans. (a, c)**

**Q.17** The adjacent figure shows variation of electric potential with distance for a spherical symmetric charge distribution system and given as

$$\phi_r = \frac{q}{4\pi\epsilon_0 r} \quad (r \geq R_0)$$

$$\phi_r = \frac{q}{4\pi\epsilon_0 R_0} \quad (r \leq R_0)$$

Which of the following option is/are correct ?



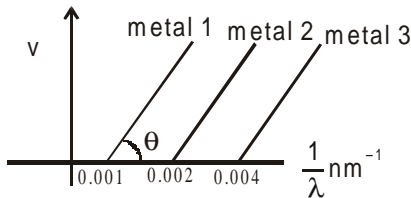
- (a) For spherical region  $r \leq R_0$  total electrostatic energy stored is zero
- (b) Within  $r = 2R_0$ , total charge is  $q$ .
- (c) There will be no charge anywhere except at  $r = R_0$
- (d) Electric field is discontinuous at  $r = R_0$

**Ans. (a, b, c, d)**

- Q.18**  $f(t) = A\sin^2\omega t + B\cos^2\omega t + C\sin\omega t\cos\omega t$   
 The above function represents SHM  
 (a) for all values of A and B, with  $C \neq 0$   
 (b)  $A = -B$ ,  $C = 2B$ ; with amplitude  $\sqrt{2} B$   
 (c)  $A = B$ ,  $C = 2B$ ; amplitude  $|B|$   
 (d)  $A = B$ ,  $C = 0$

**Ans. (b, c)**

- Q.19** The graph between  $\frac{1}{\lambda}$  and stopping potential (V) of three metal having work functions  $\phi_1$ ,  $\phi_2$  and  $\phi_3$  in an experiment of photo electric effect is plotted as shown in the figure which of the following statement(s) is/are correct ? ( $\lambda$  represents wavelength of the incident ray.)



- (a) Ratio of work functions  $\phi_1 : \phi_2 : \phi_3 = 1 : 2 : 4$   
 (b) Ratio of work functions  $\phi_1 : \phi_2 : \phi_3 = 4 : 2 : 1$   
 (c)  $\tan \theta$  is directly proportional to  $hc/e$ , where  $h$  is plank's constant and  $c$  is the speed of light  
 (d) the violet color can eject photoelectrons from metal 2 & 3.

**Ans. (a, c)**

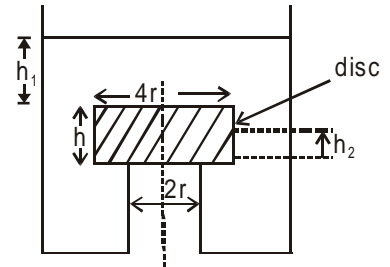
- Q.20** A black body at temperature  $T$  is kept in a dark room with surrounding temperature  $T_0$ . Sun rays are allowed to fall on the black body through a hole in the roof of the room while  $T$  and  $T_0$  are maintained. Assuming that there is no change in the surrounding temperature of the room, select the correct statement(s).  
 (a) The quantity of radiation absorbed by the black body per unit time will increase  
 (b) The quantity of radiation emitted by black body per unit time will increase  
 (c) Black body radiates more energy per unit time in the visible spectrum  
 (d) The reflected energy per unit time by the black body remains same

**Ans. (d)**

**Section III: Questions based on comprehensions with one correct answer.**

**PASSAGE - 1**

A tank has a cylindrical opening as shown of diameter  $2r$ . A cylinder of diameter  $4r$  and density  $\rho/3$  is placed on the top of the opening as shown in figure. Liquid of density  $\rho$  is to be filled in the tank.



- Q.21** What is the height  $h_1$  of the liquid level for the mass to be lifted.

- (a)  $h_1 = \frac{5h}{4}$  (b)  $h_1 = \frac{5h}{3}$   
 (c)  $h_1 = \frac{2h}{3}$  (d)  $h_1 = \frac{5h}{2}$

**Ans. (b)**

- Q.22** The disc is kept pressed and water is lowered in the tank upto the height ' $h_2$ ' as shown, what is the height  $h_2$  for the disc to be again lifted.

- (a)  $\frac{h}{3}$  (b)  $\frac{4h}{9}$   
 (c)  $\frac{2h}{3}$  (d)  $h$

**Ans. (b)**

- Q.23** Water is still lowered in the tank, what is the another height  $h'_2$ , for the disc to be lifted ?

- (a)  $\frac{h}{3}$  (b)  $\frac{h}{4}$   
 (c)  $\frac{h}{5}$   
 (d) no height  $h'_2$  at which disc will be lifted

**Ans. (d)**

**PASSAGE-2**

Equations of two waves are given as

$$y_1 = A \cos[0.5\pi x - 100\pi t]$$

$$y_2 = A \cos[0.46\pi x - 92\pi t]$$

- Q.24** How many maximum will a stationary observer hear ?

- (a) 4 (b) 5  
 (c) 6 (d) 7

**Ans. (a)**

**Q.25** Resultant wave is given as  $y_R = y_1 + y_2$  at  $x = 0$ . How many times is the resultant  $y_R$  zero in 1 sec.

- (a) 100 (b) 192  
(c) 46 (d) 96

**Ans. (d)**

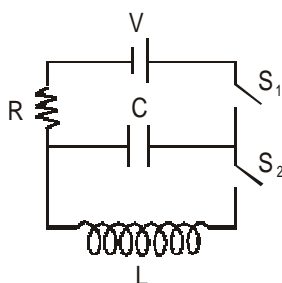
**Q.26** Maximum velocity of the wave having maximum intensity.

- (a) 200 m/s (b) 180 m/s  
(c) 192 m/s (d) 100 m/s

**Ans. (a)**

**PASSAGE-3**

The capacitor of capacitance  $C$  can be charged (with the help of resistance  $R$ ) by a battery of e.m.f.  $V$  while keeping switch  $S_2$  open. The capacitor can be connected to an inductor of inductance  $L$  by closing switch  $S_2$  and opening  $S_1$ .



**Q.27** Initially the capacitor was uncharged, Now switch  $S_1$  is closed and  $S_2$  is kept open. If time constant of the given circuit is  $\tau$  then

- (a) After 1 time constant, charge on the capacitor is  $CV/2$   
(b) After time interval  $2\tau$ , charge on the capacitor is  $CV(1 - e^{-2})$   
(c) The work done by the voltage source will be half of the heat dissipated, when the capacitor is fully charged  
(d) After 2 time constant, charge on the capacitor is  $CV(1 - e^{-1})$

**Ans. (b)**

**Q.28** After the capacitor gets fully charged,  $S_1$  is opened, and  $S_2$  is closed so that the inductor is connected in series with the capacitor, then

- (a) at  $t = 0$ , energy stored in the circuit is purely in the form of magnetic energy  
(b) direction of current is same for any time  $t$   
(c) at  $t > 0$ , there is no exchange of energy takes place between the inductor and capacitor

(d) maximum current in the circuit is  $v \sqrt{\frac{C}{L}}$

**Ans. (d)**

**Q.29** If maximum charge stored on the capacitor in LC circuit is  $Q_0$  then for  $t \geq 0$ .

(a) the charge on the capacitor

$$Q = Q_0 \cos\left(\frac{\pi}{2} - \frac{1}{\sqrt{LC}} t\right)$$

(b) the charge on the capacitor is  $Q = -LC \frac{d^2Q}{dt^2}$

(c) the charge on the capacitor is

$$Q = Q_0 \cos\left(\frac{\pi}{2} + \frac{1}{\sqrt{LC}} t\right)$$

(d) the charge on the capacitor is

$$Q = -\frac{1}{\sqrt{LC}} \frac{d^2Q}{dt^2}$$

**Ans. (b)**

**PASSAGE - 4**

A number of designs have been developed for magnetic levitation. In one of the designs electrodynamic system (EDS) is used. This model is conceptually simple because it depends only on the attractive force between magnets and ferromagnetic materials. In Japan the magnetic levitated trains run based on the EDS model which uses Lenz's Law in the simplest form. The train carries a magnet. As the magnet passes over a metal plate or coils of wire currents are induced in the plates or coils that tend to oppose the original change this results in repulsive force which lifts the train. This model has a stabilizing feature that if the train drops the repulsion becomes stronger and pushes the train back up. If the train rises the force decreases and the train drops down. In Maglev Train the dissipative forces against friction are absent. The disadvantage of this model is that induced current results in drag force as well as lift force. This requires more power for propulsion The drag force is larger than the lift force for small speed, but the drag force maximizes at some speed and then begins to decrease. The lift force continues to increase as the speed increases. Thus it is advantageous to travel at high speed, but the significant drag force at low speed must be overcome as the train starts up.

**Q.30** What causes the train to lift up -

- (a) Electrostatic force  
(b) Time varying electric field  
(c) Magnetic force  
(d) Induced electric field

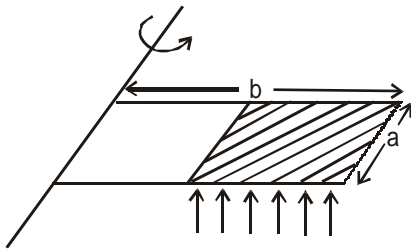
**Ans. (c)**

- Q.31** The limitation of E.D.S model is that  
 (a) The train experiences upward force due to Lenz's law.  
 (b) Friction force creates a drag on the train  
 (c) Retardation is caused  
 (d) By Lenz's law train experiences a drag force  
**Ans. (d)**

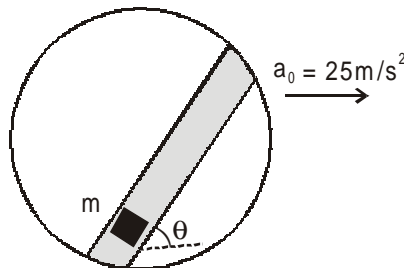
- Q.32** The advantage of the train is that -  
 (a) Electromagnetic force draws the train  
 (b) Gravitational force is zero  
 (c) Electrostatic force draws the train  
 (d) Resistive forces due to friction are absent  
**Ans. (d)**

**Section IV: This section consists of 4 questions. Answers are to be given in between 0000 to 9999 in the form of nearest integer.**

- Q.33** 'n' balls per second per unit area of mass  $m$  collide elastically with plate of mass  $m$  on the half shaded region as shown. If the plate remains in equilibrium. Find the velocity of balls. ( $n = 100$ ,  $m = 0.01$  kg,  $M = 3$ kg,  $b = 2m$ ,  $a = 2m$   $g = 10$  m/s<sup>2</sup>.)  
**Ans. 0010**



- Q.34** A disc having a groove as shown in kept on smooth horizontal plane. A block of mass  $m$  can slide in the groove. The disc move with acceleration  $a_0 = 25$  m/s<sup>2</sup> as shown in figure. The coefficient of friction between block and groove is  $2/5$  and  $\sin\theta = 3/5$ . Find the acceleration of block relative to the disc.



**Ans. 0010**

- Q.35** A thermally insulated container has 0.43 kg of ice at  $-20^\circ\text{C}$ . Steam at 373 K is passed through the ice. Find the final temperature of mixture.  
**Ans. 0273**

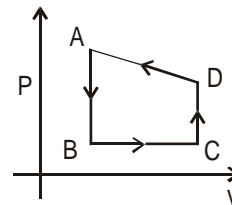
- Q.36** In a hydrogen like atom ( $z = 11$ ),  $n^{\text{th}}$  line of Lyman series has wavelength  $\lambda$  equal to the deBroglie's wavelength of electron in the level from which it originated, what is the initial energy level of electron.  
**Ans. 0025**

**Section V: This section consists of 4 questions. Each having two columns with 4 entries in each column. Entries of column I are to be matched with column II. One entry of column I may have more than one matching in column II.**

- |             |                         |   |
|-------------|-------------------------|---|
| <b>Q.37</b> | <b>Column-I</b>         | <b>Column-II</b>  |
|             | (A) Nuclear Fusion      | (P) Some matter converted into energy                       |
|             | (B) Nuclear Fission     | (Q) Generally occurs in nuclei having low atomic number.    |
|             | (C) $\beta$ -decay      | (R) Generally occurs in nuclei having higher atomic number. |
|             | (D) Exothermic reaction | (S) Essentially occurs due to weak nuclear force.           |

**Ans.** A  $\rightarrow$  P, Q  
 B  $\rightarrow$  P, R  
 C  $\rightarrow$  P, S  
 D  $\rightarrow$  P, Q, R

- Q.38**  $\Delta W$ -represents work done by the system and  $\Delta Q$  represents heat absorbed by the system



- |                 |                    |
|-----------------|--------------------|
| <b>Column I</b> | <b>Column II</b>   |
| (A) AB          | (P) $\Delta W > 0$ |
| (B) BC          | (Q) $\Delta W < 0$ |
| (C) CD          | (R) $\Delta Q > 0$ |
| (D) DA          | (S) $\Delta Q < 0$ |

- Ans.** A → S  
 B → P, R  
 C → R  
 D → Q, S

**Q.39 Column-I**

- (A) A stationary uniformly charged dielectric ring  
 (B) Dielectric ring uniformly charged rotating with angular velocity  $\omega$ .  
 (C) Constant current in ring  $i_0$   
 (D)  $i = i_0 \cos \omega t$

**Column II**

- (P) Time independent electrostatic field out of system  
 (Q) Magnetic field  
 (R) Induced electric field  
 (S) Magnetic moment

- Ans.** A → P  
 B → P, Q, S  
 C → Q, S  
 D → Q, R, S

**Q.40** Focal length of objective & eyepiece of a telescope are  $f_o$  &  $f_e$  respectively.

**Column - I**

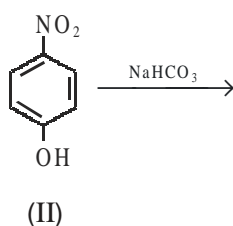
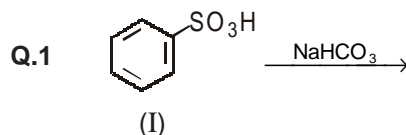
- (A) Intensity of the image  
 (B) Angular magnification  
 (C) Length of telescope  
 (D) Sharpness of image

**Column - II**

- (P) Radius of curvature (R)  
 (Q) Dispersion of lens  
 (R) Focal length  $f_o$  &  $f_e$   
 (S) Spherical aberration

- Ans.** A → P  
 B → R  
 C → R  
 D → P, Q, S

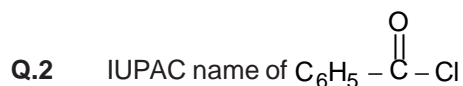
**Section I : Multiple Choice Questions with one correct answer.**



Gases released in reaction (I) and (II) are :

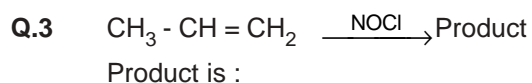
- (a) CO<sub>2</sub>, CO<sub>2</sub>                      (b) SO<sub>2</sub>, NO<sub>2</sub>  
(c) SO<sub>2</sub>, CO<sub>2</sub>                      (d) SO<sub>2</sub>, NO

**Ans. (a)**



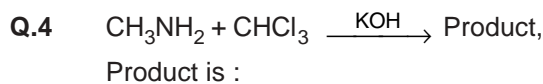
- (a) Benzoylchloride  
(b) Benzenecarbonylchloride  
(c) Chlorophenyl ketone  
(d) phenylchloroketone

**Ans. (b)**



- (a)  $CH_3 - \underset{\substack{| \\ Cl}}{CH} - CH_2 - NO$   
(b)  $CH_3 - \underset{\substack{| \\ NO}}{CH} - CH_2 - Cl$   
(c)  $CH_3 - CH_2 - CH_2 - Cl$   
(d)  $NO - CH_2 - CH_2 - CH_2 - Cl$

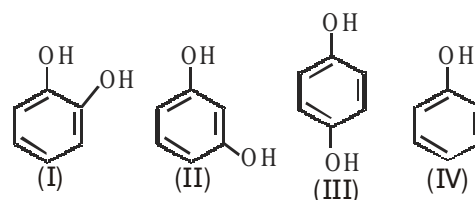
**Ans. (a)**



- (a)  $CH_3 - \overset{\oplus}{N} \equiv \overset{\ominus}{C}:$                       (b)  $CH_3 - \overset{\oplus}{N} \equiv \overset{\ominus}{C}:$   
(c)  $CH_3 - NH - CH_3$                       (d)  $CH_3 - C \equiv N$

**Ans. (a)**

**Q.5** Order of boiling point for the following compounds is :



- (a) (I) < (II) < (III) < (IV)  
(b) (I) < (II) < (IV) < (III)  
(c) (IV) < (I) < (II) < (III)  
(d) (II) < (I) < (III) < (IV)

**Ans. (c)**

**Q.6** On dilution with H<sub>2</sub>O and after boiling results in the formation of white ppt. The formation of white gelatinous ppt. take place OH treating it with excess mixture of NH<sub>4</sub>OH & NH<sub>4</sub>Cl. Identify the ppt. which dissolves in NH<sub>4</sub>OH/NH<sub>4</sub>Cl :

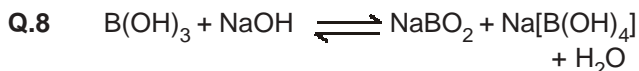
- (a) Zn(OH)<sub>2</sub>                      (b) Al(OH)<sub>3</sub>  
(c) Ca(OH)<sub>2</sub>                      (d) Mg(OH)<sub>2</sub>

**Ans. (a)**

**Q.7** Express molar specific heat in terms of R, given that P/V at any instant is constant and is equal to 1.

- (a)  $\frac{3}{2} RT$                       (b)  $\frac{5}{2} RT$   
(c)  $\frac{4}{2} RT$                       (d) 0

**Ans. (c)**

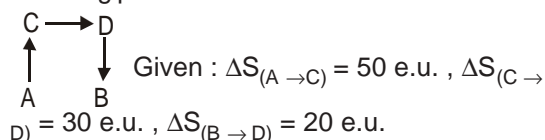


The reaction can be made to proceed in the forward direction by adding :

- (a) cis 1,2 diol (b) borax  
(c) trans 1, 2 diol (d)  $Na_2HPO_4$

**Ans. (a)**

**Q.9** The conversion A to B is carried out by the following path :



Where e.u. is entropy unit then  $\Delta S_{(A \rightarrow B)}$  is :

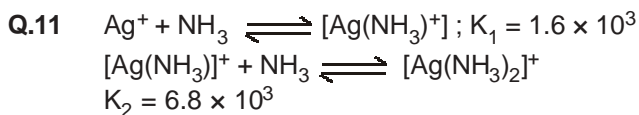
- (a) +100 e.u. (b) +60 e.u.  
(c) -100 e.u. (d) -60 e.u.

**Ans. (b)**

**Q.10**  $CuSO_4$  decolorizes on addition of KCN the product is :

- (a)  $[Cu(CN)_4]^{2-}$   
(b)  $Cu^{2+}$  get reduced to form  $[Cu(CN)_4]^{3-}$   
(c) CuCN  
(d)  $Cu(CN)_2$

**Ans. (b)**



The formation constant of  $[Ag(NH_3)_2]^+$  is

- (a)  $6.08 \times 10^6$  (b)  $1.08 \times 10^7$   
(c)  $1.08 \times 10^3$  (d)  $3.8 \times 10^5$

**Ans. (b)**

**Q.12** In the Haber process which of the following is correct if the reaction is carried out in a vessel of constant volume



(a) If  $N_2$  is added the equilibrium will shift to right. Because according to II law of thermodynamics entropy must increase in the direction of spontaneous reaction.

(b) The condition for equilibrium is  $G_{N_2} + 3G_{H_2} = 2G_{NH_3}$  where G is Gibbs free energy per mole of the gaseous species measured at that partial pressure. The condition of equilibrium is unaffected by the use of catalyst which increases the rate of both the forward reaction by  $\alpha$  and that of backward reaction by  $\beta$ .

(c) The catalyst will increase the rate of forward reaction by  $\alpha$  and that of backward reaction  $\beta$ .

(d) If the reaction is carried out at 400 K then forward rate constant remains unaffected while the backward rate constant is decreased.

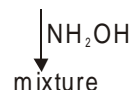
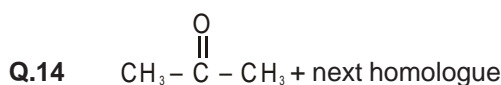
**Ans. (a)**

**Section II : Multiple Choice Questions with one or more correct answer(s).**

**Q.13** The bond length of CO is 1.128Å. The bond length of CO in  $Fe(CO)_5$  is (in Angstroms)

- (a) 1.76 (b) 1.128  
(c) 1.15 (d) 1.118

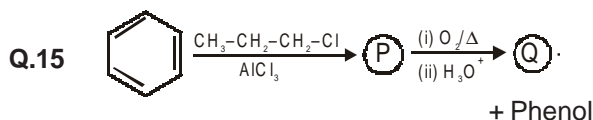
**Ans. (d)**



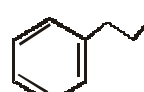
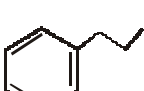
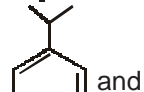
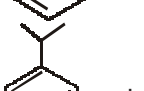
Following statements is/are correct about mixture :

- (a) mixture is 3-types of oximes  
(b) mixture is 2-types of oximes  
(c) all are optically active  
(d) one is optically active.

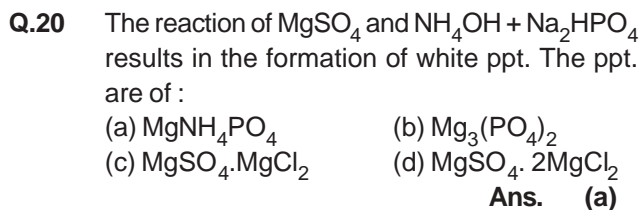
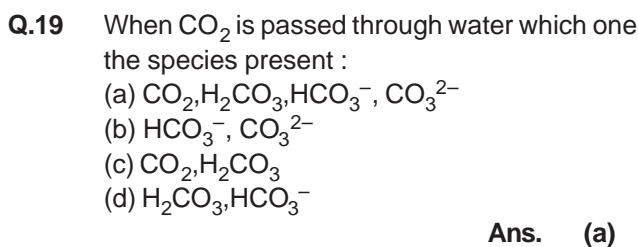
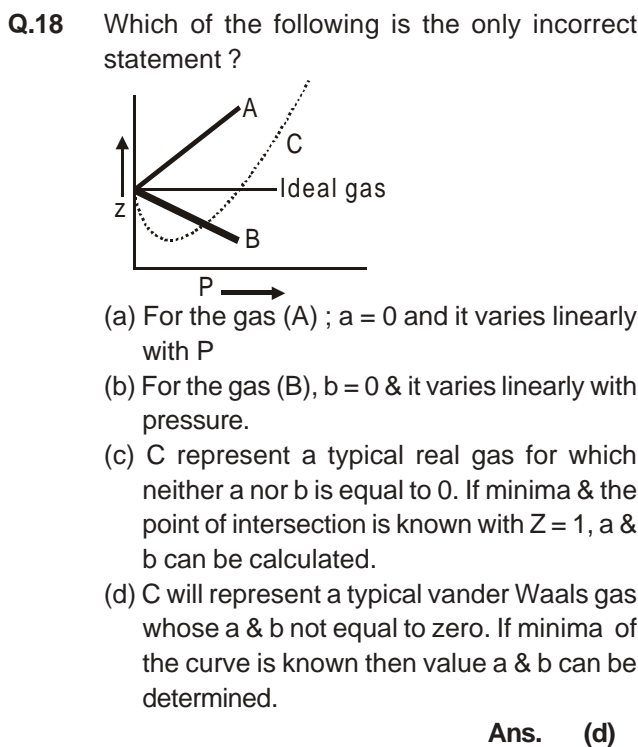
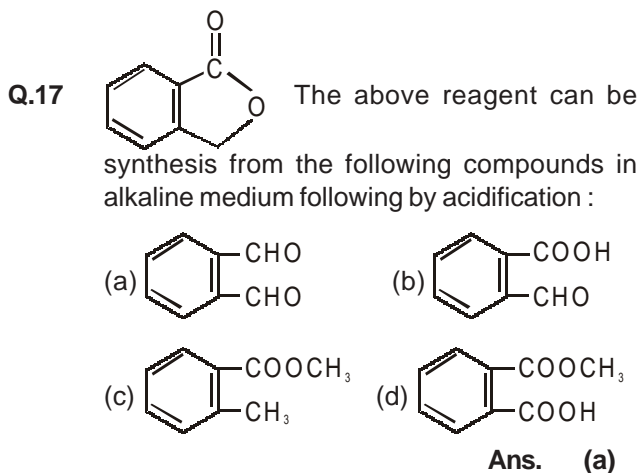
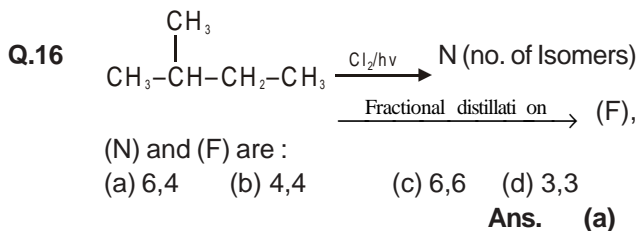
**Ans. (a)**



**P** & **Q** are :

- (a)  and  $CH_3 - CH_2 - \overset{O}{\parallel} C - H$   
 (b)  and  $CH_3 - \overset{O}{\parallel} C - CH_3$   
 (c)  and  $CH_3 - \overset{O}{\parallel} C - CH_3$   
 (d)  and  $CH_3 - CH_2 - \overset{O}{\parallel} C - H$

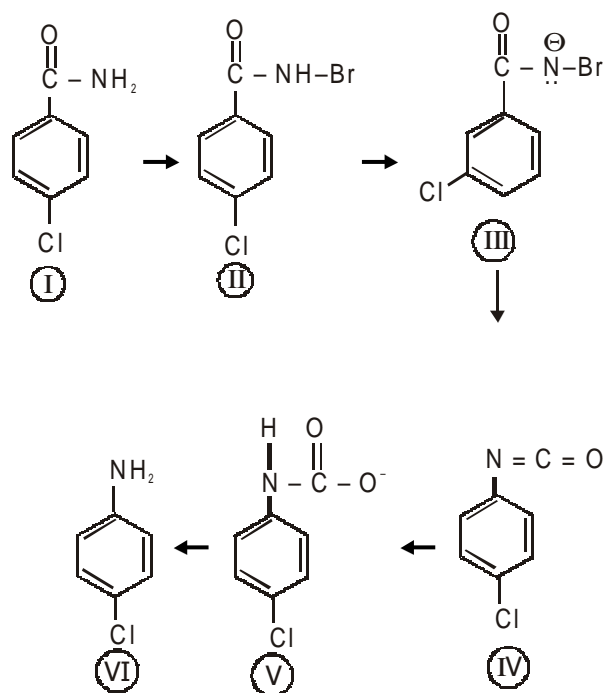
**Ans. (c)**



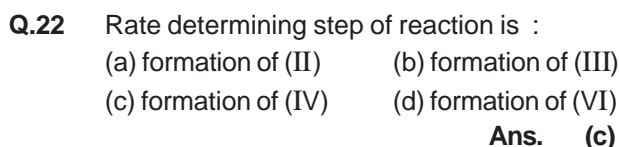
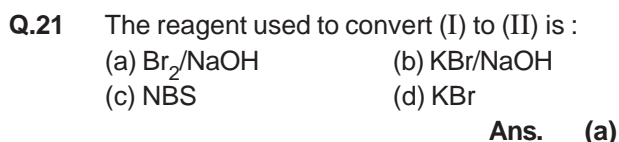
**Section III : Questions based on comprehensions with one correct answer.**

**Passage : 1**

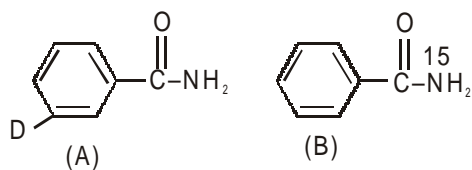
The reaction sequence given below represents Hoffmann bromamide reaction in which  $\text{RCONH}_2$  is converted into  $\text{R} - \text{NH}_2$  :



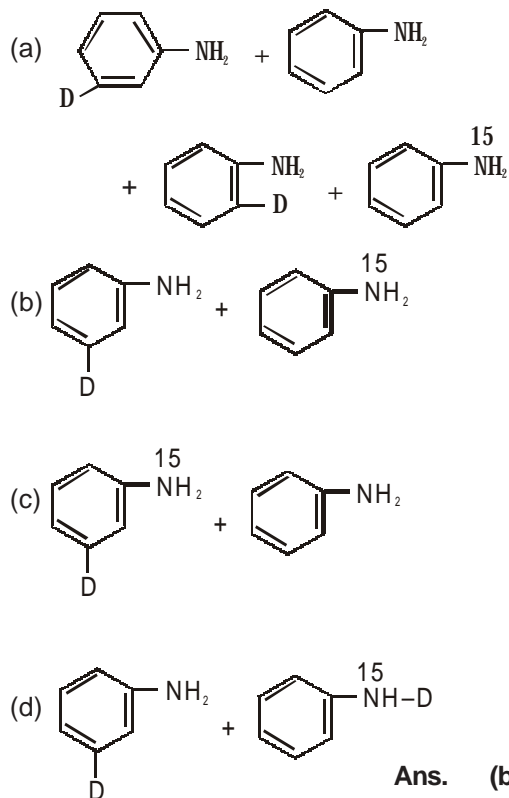
Electron donating groups attached to phenyl activates the reaction. The above reaction sequence is intermolecular reaction.



Q.23



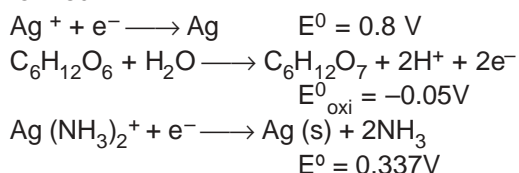
Products formed when mixture (a) and (b) undergo Hoffmann bromamide degradation ?



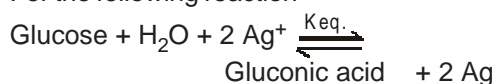
Ans. (b)

Passage : 2

Tollen's reagent is used for the detection of aldehyde when a solution of  $\text{AgNO}_3$  is added to glucose with  $\text{NH}_4\text{OH}$  then gluconic acid is formed



Q.24 For the following reaction



Determine the value of  $\ln K_{\text{eq}}$  :

- (a) 58.8 (b) 46.2  
(c) 28.3 (d) 66.13

Ans. (a)

Q.25 With the increase in concentration of  $\text{NH}_3$  pH increases to 11. Consider there is no change in concentration of  $\text{C}_6\text{H}_{12}\text{O}_6$  &  $\text{C}_6\text{H}_{12}\text{O}_7$  on addition of  $\text{NH}_3$ .

Which of the following is correct ?

- (a)  $E_{\text{ox}}$  increases by 0.65V from  $E^0_{\text{ox}}$   
(b)  $E_{\text{ox}}$  decreases by 0.65V from  $E^0_{\text{ox}}$   
(c)  $E_{\text{red}}$  increases by 0.65V from  $E^0_{\text{red}}$   
(d)  $E_{\text{red}}$  decreases by 0.65V from  $E^0_{\text{red}}$

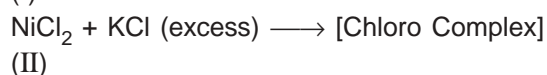
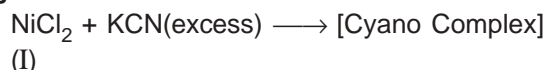
Ans. (c)

Q.26 Ammonia is always added in this reaction. Which of the following must be incorrect ?

- (a)  $\text{NH}_3$  easily forms complex with  $\text{Ag}^+$   
(b)  $\text{Ag}(\text{NH}_3)_2^+$  is a strong oxidising reagent than  $\text{Ag}^+$ .  
(c) In absence of  $\text{NH}_3$  silver salt of gluconic acid is formed  
(d)  $\text{NH}_3$  has affected the standard reduction potential of glucose/gluconic acid electrode.

Ans. (d)

Passage : 3



In the product Ni has the coordination number as 4.

Q.27 The IUPAC name of the products formed are :

- (a) Potassium tetracyano nickelate (II) & Potassium tetrachloro nickelate (II)  
(b) Tetracyano potassium nickelate & Tetrachloro potassium nickelate  
(c) Potassium tetracyano nickel (II) & Potassium chloro nickel (II)  
(d) Tetracyano nickel (II) & Tetrachloro nickel (II)

Ans. (a)

Q.28 Hybridisation in I and II is :

- (a)  $\text{dsp}^2, \text{sp}^3$  (b)  $\text{sp}^3, \text{sp}^3$   
(c)  $\text{dsp}^2, \text{dsp}^2$  (d)  $\text{sp}^3\text{d}^2, \text{d}^2\text{sp}^3$

Ans. (a)

Q.29 Which of the following is correct about I and II

- (a) Both are diamagnetic  
(b) Both are paramagnetic  
(c) I<sup>st</sup> is diamagnetic & II is paramagnetic with two unpaired electrons  
(d) I<sup>st</sup> is diamagnetic & II is paramagnetic with one unpaired electrons

Ans. (c)

**Passage : 4**

Carbon-14 is used to determine the age of organic material. The procedure is based on the formation of  $^{14}\text{C}$  by neutron capture in the upper

atmosphere  ${}^7_{14}\text{N} + {}^1_0\text{n} \longrightarrow {}^6_{14}\text{C} + {}^1_1\text{p}$ ,  $^{14}\text{C}$  is

absorbed by living organisms during photosynthesis. The  $^{14}\text{C}$  content is constant in living organism once the plant or animal dies, the uptake of carbon dioxide by it ceases and the level of  $^{14}\text{C}$  in the dead being, falls due to the decay which  $^{14}\text{C}$  undergoes

${}^6_{14}\text{C} \longrightarrow \text{N} + \beta^-$ . The half life period of  $^{14}\text{C}$  is 5770 years. The decay constant ( $\lambda$ ) can be calculated by using the following formula

$\lambda = \frac{0.693}{t_{1/2}}$ . The comparison of the  $\beta^-$  activity

of the dead matter with that of the carbon still in circulation enables measurement of the period of the isolation of the material from the living cycle. The method however, ceases to be accurate over periods longer than 30,000 years. The proportion of  $^{14}\text{C}$  to  $^{12}\text{C}$  in living matter is 1 :  $10^{12}$ .

**Q.30** Which of the following is correct ?

- (a) In living organism, circulation of  $^{14}\text{C}$  from atmosphere is high so the carbon content is constant in organism
- (b) Carbon dating can be used to find out the age of earth crust and rocks
- (c) Radioactive absorption due to cosmic radiation is equal to the rate of radioactive decay, hence the carbon content remains constant in living organism.
- (d) Carbon dating can not be used to determine concentration of  $^{14}\text{C}$  in dead beings.

**Ans. (c)**

**Q.31** What should be the age of fossil for meaningful determination of its age ?

- (a) 6 years
- (b) 6000 years
- (c) 60,000 years
- (d) It can be used to calculate any age

**Ans. (b)**

**Q.32** A nuclear explosion has taken place leading to increase in concentration of  $^{14}\text{C}$  in nearby areas.  $^{14}\text{C}$  concentration is  $C_1$  in nearby areas and  $C_2$  in areas far away. If the age of the fossil is determined to be  $T_1$  and  $T_2$  at the places respectively then :

(a) The age of the fossil will increase at the place where explosion has taken place and

$$T_1 - T_2 = \frac{1}{\lambda} \ln \frac{C_1}{C_2}$$

(b) The age of the fossil will decrease at the place where explosion has taken place and

$$T_1 - T_2 = \frac{1}{\lambda} \ln \frac{C_1}{C_2}$$

(c) The age of fossil will be determined to be same.

(d)  $\frac{T_1}{T_2} = \frac{C_1}{C_2}$

**Ans. (b)**

**Section IV : This section consists of 4 questions.**

**Answers are to be given in between 0000 to 9999 in the form of nearest integer.**

**Q.33** For a cubical system the following information are available.

Edge length =  $5\text{\AA}$  ; density =  $2\text{ gm/cm}^3$ , Atomic wt. = 75

Determine the radius of the atom in pm ?

**Ans. 0217**

**Q.34** 75.2 g phenol is added in (1kg) of the solvent . The depression in freezing point is 7. Calculate the percentage association if phenol undergoes dimerisation ( $k_f = 14$ ).

**Ans. 0075**

**Q.35** 2 moles of CO are mixed with 1 mole of  $\text{O}_2$  in a container of 1ℓ. They completely to form 2 moles of  $\text{CO}_2$ . If the pressure in the vessel changes from 70 atm to 40 atm, what will be the value of  $\Delta U$  in kJ at 500 K (The gases deviate appreciably from ideal behaviour.)

$2\text{ CO} + \text{O}_2 \longrightarrow 2\text{CO}_2$  ;  $\Delta H = -560\text{ kJ/mol}$ ,  
1 L atm = 0.1 kJ

**Ans.  $\Delta U = 0557$**

- Q.36**  $K_{sp}$  of AgBr =  $12 \times 10^{-14}$ . To the saturated solution of AgBr, AgNO<sub>3</sub> is added at the conc. of  $10^{-7}$ (M)  $\lambda_{\infty}$  of Ag<sup>+</sup> =  $6 \times 10^{-3}$  ohm<sup>-1</sup> m<sup>2</sup> mol<sup>-1</sup>,  $\lambda_{\infty}$  of NO<sub>3</sub><sup>-</sup> =  $7 \times 10^{-3}$  ohm<sup>-1</sup> m<sup>2</sup> mol<sup>-1</sup>,  $\lambda_{\infty}$  of Br<sup>-</sup> =  $8 \times 10^{-3}$  ohm<sup>-1</sup> m<sup>2</sup> mol<sup>-1</sup>
- Ans. 55 × 10<sup>7</sup>**
- ohm<sup>-1</sup> m<sup>-1</sup>.

**Section V : This section consists of 4 questions. Each having two columns with 4 entries in each column. Entries of column I are to be matched with column II. One entry of column I may have more than one matching in column II.**

- Q.37** (a) SiO<sub>4</sub><sup>4-</sup> → Si<sub>2</sub>O<sub>7</sub><sup>4-</sup> (P) Heat  
 (b) B<sub>4</sub>O<sub>7</sub><sup>2-</sup> → B(OH)<sub>3</sub> (Q) Hydrolysis  
 (c) Bi<sub>3</sub><sup>+</sup> → [BiO]<sup>+</sup> (R) Acidification  
 (d) AlO<sub>2</sub><sup>-</sup> → Al(OH)<sub>3</sub> (S) Dilution by water
- Ans. (a) → P ; (b) → Q & R ; (c) → Q ; (d) → R**

- Q.38** Match the extraction process listed in Column I with metals listed in Column II :
- | Column I  | Column II  |
|---|------------|
| (a) Self reduction                              | (P) lead   |
| (b) Carbon reduction                            | (Q) Silver |
| (c) Complex formation and displacement by metal | (R) Copper |
| (d) Decomposition of iodide                     | (S) Boron  |
- Ans. a - P , R ; b - P, R ; c - Q ; d - S**

- Q.39** According to Bohr's theory ,  
 $E_n$  = Total energy ;  $K_n$  = Kinetic energy  
 $V_n$  = Potential energy  $r_n$  = Radius of n<sup>th</sup> orbit  
 Match the following :
- | Column I   | Column II |
|--|-----------|
| (a) $V_n/K_n = ?$                                    | (P) 0     |
| (b) If radius of nth orbital $\propto E_n^x$ , x = ? | (Q) -1    |
| (c) Angular momentum in lowest orbital               | (R) -2    |
| (d) $\frac{1}{r^n} \propto Z^y$ , y = ?              | (S) 1     |
- Ans. a → R ; b → Q ; c → P ; d → S**

- Q.40** Match the following

(A) Ph-CH <sub>2</sub> -CH <sub>2</sub> -Br & Ph-CD <sub>2</sub> -CH <sub>2</sub> -Br Reacts with the same rate	(P) E <sup>1</sup> reaction
(B) Ph-CH-CH <sub>3</sub> reacts   Br faster than Ph-CH-CD <sub>3</sub>   Br	(Q) E <sup>2</sup> reaction
(C) Ph-CH <sub>2</sub> -CH <sub>2</sub> -Br ↓ C <sub>2</sub> H <sub>5</sub> OD/C <sub>2</sub> H <sub>5</sub> O <sup>-</sup> Ph-CD = CH <sub>2</sub>	(R) E <sup>1</sup> <sub>CB</sub> Reaction
(D) CH <sub>3</sub> -CH-CD <sub>3</sub>   Br ↓ alc. KOH CH <sub>2</sub> =CH-CD <sub>3</sub> (Major Product)	(S) 1 <sup>st</sup> order reaction

- Ans. (a) → (P) & (S) ; (b) → (Q) ; (c) → (R) ; (d) → (Q)**



**Q.8** If  $\omega = \alpha + i\beta$  where  $\beta \neq 0$  and  $z \neq 1$  satisfies the condition that  $\left(\frac{\omega - \bar{\omega}z}{1-z}\right)$  is purely real, then set of  $z$  is –

- (a)  $\{z : z = \bar{z}\}$  (b)  $\{z : |z| = 1, z \neq 1\}$   
 (c)  $\{z : z \neq 1\}$  (d)  $\{z : |z| = 1\}$

**Ans. [b]**

**Q.9** A plane passes through  $(1, -2, 1)$  and is perpendicular to two planes  $2x - 2y + z = 0$  and  $x - y + 2z = 4$ . The distance of the plane from point  $(1, 2, 2)$  is –

- (a)  $2\sqrt{2}$  (b) 0  
 (c) 1 (d)  $\sqrt{2}$

**Ans. [a]**

**Q.10** If  $f''(x) = -f(x)$  and  $g(x) = f'(x)$  and

$$F(x) = \left(f\left(\frac{x}{2}\right)\right)^2 + \left(g\left(\frac{x}{2}\right)\right)^2 \text{ and given that}$$

$F(5) = 5$ , then  $F(10)$  is

- (a) 15 (b) 0  
 (c) 5 (d) 10

**Ans. [c]**

**Q.11** Let  $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$ ,  $\vec{b} = \hat{i} - \hat{j} + \hat{k}$  and  $\vec{c} = \hat{i} + \hat{j} - \hat{k}$ . A vector in the plane of  $\vec{a}$  and  $\vec{b}$  whose projection on  $\vec{c}$  is of length  $\frac{1}{\sqrt{3}}$  unit is –

- (a)  $4\hat{i} + \hat{j} - 4\hat{k}$  (b)  $4\hat{i} - \hat{j} + 4\hat{k}$   
 (c)  $2\hat{i} + \hat{j} - 2\hat{k}$  (d)  $3\hat{i} + \hat{j} - 3\hat{k}$

**Ans. [b]**

**Q.12** If  $r, s, t$  are prime numbers and  $p, q$  are the positive integers such that the LCM of  $p, q$  is  $r^2t^4s^2$ , then the number of ordered pair  $(p, q)$  is –

- (a) 224 (b) 225  
 (c) 252 (d) 256

**Ans.[b]**

**Section II: Multiple Choice Questions with one or more correct answer(s).**

**Q.13** If  $f(x) = \min\{1, x^2, x^3\}$ , then

- (a)  $f'(x) > 0 \forall x \in \mathbb{R}$   
 (b)  $f(x)$  is continuous  $\forall x \in \mathbb{R}$   
 (c)  $f(x)$  is not differentiable for two values of  $x$   
 (d)  $f(x)$  is not differentiable but continuous  $\forall x \in \mathbb{R}$

**Ans. [b, d]**

**Q.14** If a hyperbola passes through the focus of

the  $\frac{x^2}{25} + \frac{y^2}{16} = 1$  and its transverse and

conjugate axes coincide with the major and minor axis of ellipse, and product of eccentricities is 1, then

- (a) Focus of hyperbola is  $(5, 0)$   
 (b) Focus of hyperbola is  $(5\sqrt{3}, 0)$

(c) The equation of hyperbola is  $\frac{x^2}{9} - \frac{y^2}{25} = 1$

(d) The equation of hyperbola is  $\frac{x^2}{9} - \frac{y^2}{16} = 1$

**Ans. [a, d]**

**Q.15** The equation(s) of common tangent(s) to the parabola  $y = x^2$  and  $y = -(x-2)^2$

- (a)  $y = -4(x-1)$  (b)  $y = 0$   
 (c)  $y = 4(x-1)$  (d)  $y = -30x - 50$

**Ans. [b, c]**

**Q.16** Internal angle bisector of  $\angle A$  of triangle ABC, meets side BC at D. A line drawn through D perpendicular to AD intersects the side AC at P and the side AB at Q. If  $a, b, c$  represent the sides of  $\triangle ABC$  then.

(a)  $AD = \frac{2bc}{b+c} \cos \frac{A}{2}$

(b)  $PQ = \frac{4bc}{b+c} \sin \frac{A}{2}$

- (c) The triangle APQ is isosceles  
 (d) AP is HM of  $b$  and  $c$

**Ans.[a, b, c, d]**

- Q.17** A tangent at P(x,y) point on the curve  $y = f(x)$  intersects to the axes at A and B points respectively such that  $AP : BP \equiv 1 : 3$ , given that  $f(1) = 1$ , then—  
 (a) normal at (1, 1) is  $x + 3y = 4$   
 (b) equation of curve is  $3y + xy' = 0$   
 (c) curve passes through (2, 1/8)  
 (d) equation of curve is  $xy' - 3y = 0$

**Ans. [b,c]**

- Q. 18**  $f(x)$  is a cubic polynomial such that  $f(3) = 18$ ,  $f(-1) = 2$  and  $f(x)$  has local maximum at  $x = -1$ . If  $f'(x)$  has local maximum at  $x = 0$ , then  
 (a)  $f(x)$  is increasing for  $x \in [1, 2, \sqrt{5}]$   
 (b) the distance between  $(-1, 2)$  and  $(a, f(a))$  where  $x = a$  is the point of local minimum is  $2\sqrt{5}$   
 (c)  $f(x)$  has local minima at  $x = 1$   
 (d) the value of  $f(0) = 5$

**Ans. [b c]**

- Q.19** Let  $\vec{A}$  is a vector parallel to line of intersection of planes  $P_1$  and  $P_2$  through origin.  $P_1$  is parallel to the vectors  $2\hat{j} + 3\hat{k}$  and  $4\hat{j} - 3\hat{k}$  and  $P_2$  is parallel to  $\hat{j} - \hat{k}$  and  $3\hat{j} + 3\hat{k}$  then angle between vectors  $\vec{A}$  and  $2\hat{i} + \hat{j} - 2\hat{k}$  is—

- (a)  $\frac{\pi}{2}$  (b)  $\frac{\pi}{4}$   
 (c)  $\frac{\pi}{6}$  (d)  $\frac{3\pi}{4}$

**Ans [b, d]**

- Q.20** Let  $f(x) = \begin{cases} e^x & 0 \leq x < 1 \\ 2 - e^{x-1} & 1 < x \leq 2 \\ x - e & 2 < x \leq 3 \end{cases}$  and

$g(x) = \int_0^x f(t) dt$ ,  $x \in [1, 3]$  then  $g(x)$  has

- (a) local maximum at  $x = 1$  and local minimum at  $x = 2$   
 (b) No local maximum  
 (c) No point of local minimum  
 (d) Local maximum point is  $x = 1 + \log 2$  and local minimum at  $x = e$  **Ans [a, d]**

**Section III : Questions based on comprehensions with one correct answer.**

**Passage – I**

Now we define the definite integral using the

formula  $\int_a^b f(x) dx = \frac{b-a}{2} (f(a) + f(b))$ , for more accurate result for  $c \in (a,b)$ ,

$$F(c) = \left[ \frac{b-a}{2} (f(a) + f(c)) \right] + \left[ \frac{b-c}{2} (f(b) + f(c)) \right]$$

when  $c = \frac{a+b}{2}$ ,

$$\int_a^b f(x) dx = \left( \frac{b-a}{4} \right) (f(a) + f(b) + 2f(c))$$

- Q.21** Evaluate  $\int_0^{\frac{\pi}{2}} \sin x dx$

- (a)  $\frac{\pi}{8\sqrt{2}}(1 + \sqrt{2})$  (b)  $\frac{\pi}{8}(1 + \sqrt{2})$   
 (c)  $\frac{\pi}{4}(1 + \sqrt{2})$  (d)  $\frac{\pi}{4}(1 + 2\sqrt{2})$

**Ans [b]**

- Q.22** If  $f'(x) < 0$ ,  $\forall x \in (a,b)$  and  $c$  is a point such that  $a < c < b$ , and  $(c, f(c))$  is the point lying on the curve for which  $F(c)$  is maximum, then  $f'(c)$  is equal to

- (a)  $\frac{f(b) - f(a)}{b - a}$  (b)  $\frac{2(f(b) - f(a))}{b - a}$   
 (c)  $\frac{2f(b) - f(a)}{2b - c}$  (d) 0

**Ans [a]**

- Q.23**  $\lim_{t \rightarrow a} \frac{\int_a^t f(x) dx - \left( \frac{t-a}{2} \right) (f(t) + f(a))}{(t-a)^3}$  exists,

then which of the following is the utmost degree of function  $f(x)$  is

- (a) 1 (b) 2  
 (c) 3 (d) 4

**Ans [d]**

**Passage – II**

Total  $n$  urns each containing  $(n+1)$  balls such that the  $i^{\text{th}}$  urn contains  $i$  white balls and  $(n + 1 - i)$  red balls.

Now  $u_i$  be the event of selecting  $i^{\text{th}}$  urn,  $i = 1, 2, 3 \dots n$  and  $w$  denotes the event of getting a white ball.

**Q.24** If  $P(u_i) \propto i$ , where  $i = 1, 2, 3, \dots, n$ , then  $\lim_{n \rightarrow \infty} P(w)$  is equal to

- (a)  $\frac{2}{3}$  (b) 1  
(c)  $\frac{3}{4}$  (d)  $\frac{1}{4}$

**Ans [a]**

**Q.25** If  $P(u_i) = c$ , where  $c$  is a constant then  $P(u_n/w)$  is equal to

- (a)  $\frac{2}{n+1}$  (b)  $\frac{n}{n+1}$   
(c)  $\frac{1}{n+1}$  (d)  $\frac{1}{2(n+1)}$

**Ans [a]**

**Q.26** If  $n$  is even and  $E$  denotes the event of choosing even numbered urn and also  $P(u_i) = \frac{1}{n}$ , then find the value of  $P(w/E)$

- (a)  $\frac{n+2}{2(n+1)}$  (b)  $\frac{n+2}{2n+1}$   
(c)  $\frac{n}{n+1}$  (d)  $\frac{1}{n+1}$

**Ans [a]**

**Passage – III**

Let  $C_1$  is a circle touching to all the sides of square ABCD of side length 2 units internally and  $C_2$  circle is passing through the vertices of square. A line  $L$  is drawn through A.

**Q.27** Let  $P$  is a point on  $C_1$  and  $Q$  is on  $C_2$ , then

$$\frac{PA^2 + PB^2 + PC^2 + PD^2}{QA^2 + QB^2 + QC^2 + QD^2} =$$

- (a) 0.75 (b) 0.5  
(c) 1.25 (d) 1

**Ans. [a]**

**Q.28** A variable circle touches to the line  $L$  and circle  $C_1$  externally such that both circles are on the same side of the line, then the locus of center of variable circle is –

- (a) ellipse (b) circle  
(c) Hyperbola (d) parabola

**Ans. [d]**

**Q.29** A line  $M$  through  $A$  is drawn parallel to  $BD$ . Locus of point  $R$ , which moves such that its distances from the line  $BD$  and the vertex  $A$  are equal, cuts to line  $M$  at  $T_2$  and  $T_3$  and  $AC$  at  $T_1$ , then area of triangle  $T_1T_2T_3$  is

- (a)  $\frac{1}{2}$  (sq.units) (b) 2(sq.units)  
(c) 1 (sq.units) (d)  $\frac{4}{3}$  (sq.units)

**Ans. [c]**

**Passage – IV**

If  $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & -1 \\ 1 & 1 & 0 \end{bmatrix}$ , if  $U_1, U_2$  and  $U_3$  are column matrices satisfying

$$A U_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, A U_2 = \begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix}, A U_3 = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}, \text{ and}$$

$U$  is  $3 \times 3$  matrix whose columns are  $U_1, U_2, U_3$  then answer the following questions.

**Q.30** The value of  $|U|$  is –

- (a) 2 (b) 3  
(c) 6 (d) 12

**Ans. [b]**

**Q.31** Sum of the elements of  $U^{-1}$  is –

- (a) 1/12 (b) 1/6  
(c) 1/3 (d) 1/4

**Ans. [c]**

**Q.32** Find the value of –

$$[3 \ 2 \ 0] U \begin{bmatrix} 3 \\ 2 \\ 0 \end{bmatrix} \text{ is -}$$

- (a) 13 (b) 26  
(c) 12 (d) 24

**Ans. [a]**

**Section IV :This section consists of 4 questions.**  
**Answers are to be given in between 0000 to 9999 in the form of nearest integer.**

**Q.33** If roots of  $x^2-10cx-11d=0$  are a, b and the roots of  $x^2-10ax-11b=0$  are c, d, then the value of a+b+c+d is equal to (a,b,c,d are different numbers) .....

**Ans. [1210]**

**Q.34** The value  $5050 \frac{\int_0^1 (1-x^{50})^{100} dx}{\int_0^1 (1-x^{50})^{101} dx}$  is equal to .....

**Ans [5051]**

**Q.35** Let  $a_n = \frac{3}{4} - \left(\frac{3}{4}\right)^2 + \left(\frac{3}{4}\right)^3 - \dots$

$(-1)^{n-1} \left(\frac{3}{4}\right)^n$  and  $b_n = 1-a_n$  then find the

natural number  $n_0$  such that  $b_n > a_n, n > n_0$ . is.....

**Ans [0005]**

**Q.36** If  $f(x)$  is twice differentiable and  $f(a) = 0, f(b) = 2, f(c) = -1, f(d) = 2, f(e) = 0,$  where  $a < b < c < d < e$  then the minimum number of zeroes of  $g(x) = \{f'(x)\}^2 + \{f''(x)f(x)\}$  in  $[a,e]$  is ?

**Ans.[0006]**

**Section V: This section consists of 4 questions.**  
**Each having two columns with 4 entries in each column. Entries of column I are to be matched with column II. One entry of column I may have more than one matching in column II.**

**Q.37** Three normals drawn at P,Q and R on the parabola  $y^2 = 4x$  intersect at (3, 0). Then

- | Column I                                   | Column II    |
|--|--------------|
| (a) Radius of circumcircle of $\Delta PQR$ | (p) 5/2      |
| (b) Area of $\Delta PQR$                   | (q) (5/2, 0) |
| (c) Centroid of $\Delta PQR$               | (r) (2/3, 0) |
| (d) circumcentre of $\Delta PQR$           | (s) 2        |

**Ans.-**

- (a)  $\rightarrow$  (p)  
 (b)  $\rightarrow$  (s)  
 (c)  $\rightarrow$  (r)  
 (d)  $\rightarrow$  (q)

**Q.38 Column I**

- (a) Area bounded by  $-4y^2 = x$  and  $x-1 = -5y^2$  (p) 0  
 (b) cosine of the angle of intersection of curves  $y = x^x-1$  and  $y = 3^{x-1} \log x$  (q)  $6 \ln 2$   
 (c)  $\int_0^{\pi/2} (\sin x)^{\cos x} (\cos x \cdot \cot x - \log(\sin x)^{\sin x}) dx$  (r)  $4/3,$   
 (d) Not available (s) 1,

**Ans.-**

- (a)  $\rightarrow$  (r)  
 (b)  $\rightarrow$  (s)  
 (c)  $\rightarrow$  (s)

**Q.39** (a)  $\sum_{i=1}^{\infty} \tan^{-1}\left(\frac{1}{2i^2}\right) = t,$  (p) 0

then  $\tan t =$

- (b) A line perpendicular to  $x + 2y + 2z = 0$  and passes through (0, 1, 0) then the perpendicular distance of the line from origin is (q)  $\frac{\sqrt{5}}{3}$   
 (c) Not available (r) 1  
 (d) Not available (s)  $2/3$

**Ans.-**

- (a)  $\rightarrow$  (r)  
 (b)  $\rightarrow$  (s)

**Column I**

**Q.40(a)** Two rays in the 1st quadrant  $ax - y = 1$  and  $x + y = |a|$  cut each other in the interval  $a \in (a_0, \infty)$  the value of  $a_0$  is

(b)  $\sin A \sin B \sin C + \cos A \cos B = 1$   
then  $\sin C =$

(c)  $\left| \int_0^1 (1 - y^2) dy \right| + \left| \int_1^0 (y^2 - 1) dy \right|$

(d) Let  $\vec{a} = \alpha \hat{i} + \beta \hat{j} + \gamma \hat{k}$ ,  $\hat{k} \times (\hat{k} \times \vec{a}) = \vec{0}$   
and a point  $(\alpha, \beta, \gamma)$  lies on plane  $x + y + z = 2$ , then  $\gamma =$

**Column II**

(p)  $4/3$

(q)  $\left| \int_0^1 \sqrt{1-x} dx \right| + \left| \int_{-1}^0 \sqrt{1+x} dx \right|$

(r) 1

(s) 2

**Ans.-**

(a)  $\rightarrow$  (r)

(b)  $\rightarrow$  (r)

(c)  $\rightarrow$  (p) & (q)

(d)  $\rightarrow$  (s)