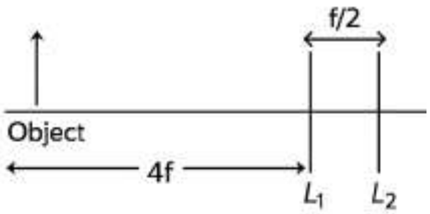
1. **Let $\theta$ be the angle between two vectors A and B. If $\hat{a}_{\perp}$, is the unit vector perpendicular to A, then the direction of $\mathrm{B} - B\sin\theta\hat{a}_{\perp}$ is.**
(a) along **B** (b) perpendicular to **B**
(c) along **A** (d) perpendicular to **A**

2. **The Power $P$ radiated from an accelerated charged particle is given by $P \propto \frac{(qa)^m}{c^n}$, where $q$ is the charge, $a$ is the acceleration of the particle and $c$ is speed of light in vacuum. From dimensional analysis, the value of $m$ and $n$ respectively, are**
(a) $m = 2, n = 2$ (b) $m = 2, n = 3$
(c) $m = 3, n = 2$ (d) $m = 0, n = 1$

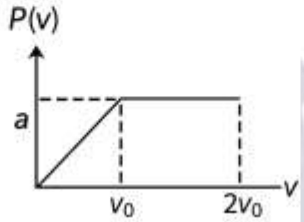
3. **Two convex lenses ( $L_1$ and $L_2$ ) of equal focal length $f$ are placed at a distance $f/2$ apart. An object is placed at a distance $4f$ in the left of $L_1$ as shown in figure. The final image is at.**




(a) $5f/11$ right of $L_2$ (b) $5f/11$ left of $L_2$
(c) $5f$ right of $L_2$ (d) $5f$ left of $L_2$

4. **Which of the following quantity has the dimension of length ( $h$ is Planck's constant, $m$ is the mass of electron and $c$ is the velocity of light).**
(a) $\mathrm{hc/m}$ (b) $\mathrm{h/mc^2}$
(c) $\mathrm{h^2/mc^2}$ (d) $\mathrm{h/mc}$

5. **The speed distribution for a sample of $N$ gas particles is shown below. $P(v) = 0$ for $v > 2v_0$. How many particles have speeds between $1.2v_0$ and $1.8v_0$ ?**



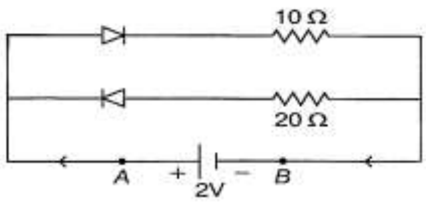

(a) 0.2 N (b) 0.4 N
(c) 0.6 N (d) 0.8 N

6. **The internal energy of a thermodynamic system is given by $U = aS^{4/3}V^{\alpha}$, where $S$ is entropy, $V$ is volume and $a$ and $\alpha$ are constants. The value of $\alpha$ is.**
(a) 1 (b) -1
(c) 1/3 (d) $-1/3$

7. **A particle of mass $m$ moves in one-dimension under the action of a conservative force whose potential energy has the form of $U(x) = \frac{-\alpha x}{x^2+\beta^2}$, where $\alpha$ and $\beta$ are dimensional parameters. The angular frequency of the oscillation is proportional to.**
(a) $\sqrt{\alpha^3/m\beta^4}$ (b) $\sqrt{\alpha/m\beta^4}$
(c) $\sqrt{\alpha/m\beta^3}$ (d) $\sqrt{\alpha/m\beta^6}$

8. **Longitudinal waves cannot**
(a) have a unique wavelength
(b) have a unique wave velocity
(c) transmit energy
(d) be polarised

9. **A 2 V cell is connected across the points $A$ and $B$ as shown in the figure. Assume that the resistance of each diode is zero in forward bias and infinity in reverse bias. The current supplied by the cell is**




(a) 0.5 A (b) 0.2 A
(c) 0.1 A (d) 0.25 A

**10. A charge $Q$ is placed at the centre of a cube of sides $a$. The total flux of electric field through the six surfaces of the cube is.**

(a) $\frac{6Qa^2}{\varepsilon_0}$ (b) $\frac{Qa^2}{6\varepsilon_0}$
(c) $\frac{Q}{\varepsilon_0}$ (d) $\frac{Qa^2}{\varepsilon_0}$

**11. The elastic potential energy of a strained body is.**

(a) stress × strain
(b) stress / strain
(c) stress × strain/volume
(d) $1/2$ × stress × strain × volume

**12. Which of the following statement(s) is/are true in respect of nuclear binding energy?**

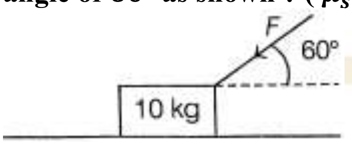
**(i)** The mass energy of a nucleus is larger than the total mass energy of its individual protons and neutrons.
**(ii)** If a nucleus could be separated into its nucleons, an energy equal to the binding energy would have to be transferred to the particles during the separating process.
**(iii)** The binding energy is a measure of how well the nucleons in a nucleus are held together.
**(iv)** The nuclear fission is somehow related to acquiring higher binding energy.

(a) Statements (i), (ii) and (iii) are true.
(b) Statements (ii), (iii) and (iv) are true.
(c) Statements (ii) and (iii) are true.
(d) All the four statements are true.

**13. A satellite of mass $m$ rotates round the earth in a circular orbit of radius $R$. If the angular momentum of the satellite is $J$, then its kinetic energy $K$ and the total energy $E$ of the satellite are**

(a) $K = \frac{J^2}{mR^2}, E = -\frac{J^2}{2mR^2}$
(b) $K = \frac{J^2}{2mR^2}, E = -\frac{J^2}{2mR^2}$
(c) $K = \frac{J^2}{2mR^2}, E = -\frac{J^2}{mR^2}$
(d) $K = \frac{J^2}{2mR^2}, E = \frac{J^2}{mR^2}$

**14. What force $F$ is required to start moving this 10 kg block shown in the figure, if it acts at an angle of 60° as shown ? ( $\mu_s = 0.6$ ).**

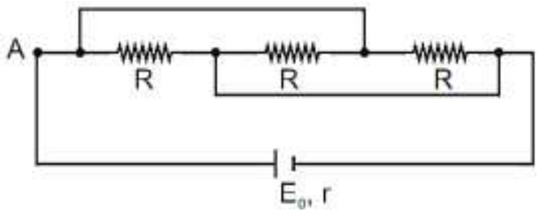



(a) 22.72 N (b) 24.97 N
(c) 25.56 N (d) 57.7 N

**15. Light of wavelength 6000Å is incident on a thin glass plate of RI 1.5 such that the angle of refraction into the plate is 60°. Calculate the smallest thickness of the plate which will make dark fringe by reflected beam interference.**

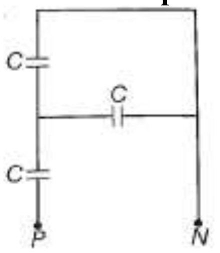
(a) $1.5 \times 10^{-7}$ m (b) $2 \times 10^{-7}$ m
(c) $3.5 \times 10^{-7}$ m (d) $4 \times 10^{-7}$ m

**16. Consider a circuit, where a cell of emf $E_0$ and internal resistance $r$ is connected across the terminal $A$ and $B$ as shown in figure. The value of $R$ for which the power generated in the circuit is maximum, is given by**




(a) $R = r$ (b) $R = 2r$
(c) $R = 3r$ (d) $R = r/3$

**17. The equivalent capacitance of a combination of connected capacitors shown in the figure between the points $P$ and $N$ is.**

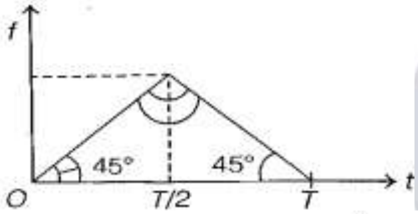


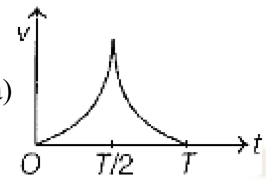

(a) 3 C (b) $\frac{2C}{3}$
(c) $\frac{4C}{5}$ (d) $\frac{3}{2}c$

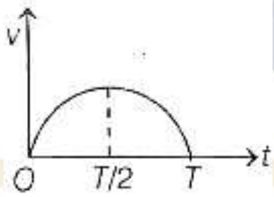
**18. In a single-slit diffraction experiment, the slit is illuminated by light of two wavelengths $\lambda_1$ and $\lambda_2$. It is observed that the 2 nd order diffraction minimum for $\lambda_1$ coincides with the 3rd diffraction minimum for $\lambda_2$. Then,**

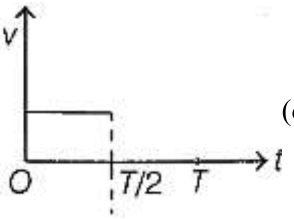
(a) $\frac{\lambda_1}{\lambda_2} = \frac{2}{3}$ (b) $\frac{\lambda_1}{\lambda_2} = \frac{5}{7}$
(c) $\frac{\lambda_1}{\lambda_2} = \frac{3}{2}$ (d) $\frac{\lambda_1}{\lambda_2} = \frac{7}{5}$

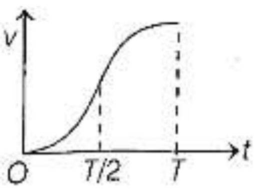
**19. The acceleration-time graph of a particle moving in a straight line is shown in the figure. If the initial velocity of the particle is zero, then the velocity-time graph of the particle will be.**



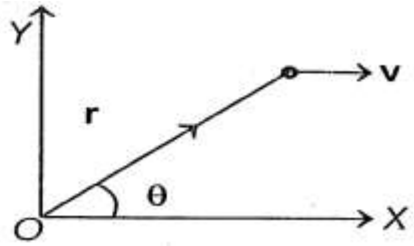

(a)



(b)


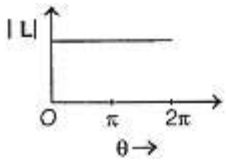

(c)


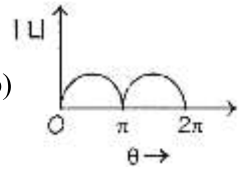

(d)


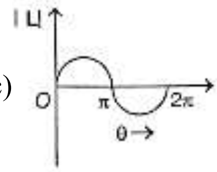

**20. The position vector of a particle of mass $m$ moving with a constant velocity v is given by $\mathbf{r} = x(t)\hat{\imath} + b\hat{\jmath}$, where $b$ is a constant. At an instant, r makes an.**

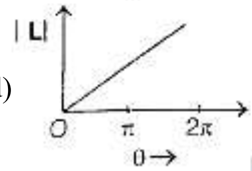



angle $\theta$ with the $X$-axis as shown in the figure. The variation of the angular momentum of the particle about the origin with $\theta$ will be.

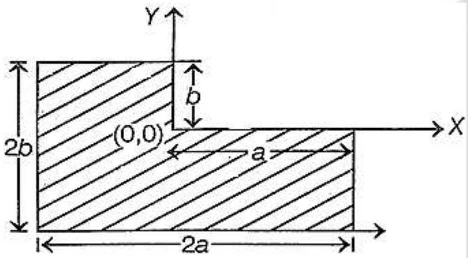
(a) 


(b) 


(c) 


(d) 

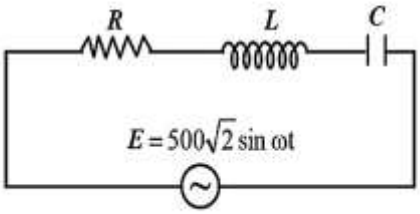

**21. The position of the centre of mass of the uniform plate as shown in the figure is.**




(a) $\left(-\frac{a}{2},-\frac{b}{2}\right)$ (b) $\left(\frac{a}{8},\frac{b}{8}\right)$

(c) $\left(-\frac{b}{6},-\frac{a}{6}\right)$ (d) $\left(-\frac{a}{6},-\frac{b}{6}\right)$

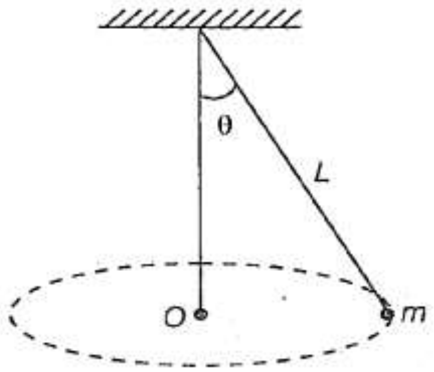
**22. In a series $L-C-R$ circuit, the rms voltage across the resistor and the capacitor are 30 V and 90 V , respectively. If the applied voltage is $50\sqrt{2}\sin\omega t$, then the peak voltage across the inductor is.**




(a) 70 V (b) 50 V

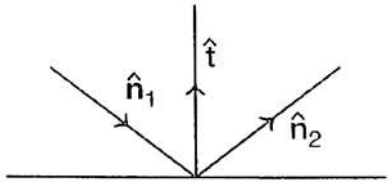
(c) $70\sqrt{2}$ V (d) $50\sqrt{2}$ V

**23. A small ball of mass $m$ is suspended from the ceiling of a floor by a string of length $L$. The ball moves along a horizontal circle with constant angular velocity $\omega$, as shown in the figure. The torque about the centre $O$ of the horizontal circle is.**




(a) $mgL\sin\theta$ (b) $mgL$
(c) 0 (d) $mgL\cos\theta$

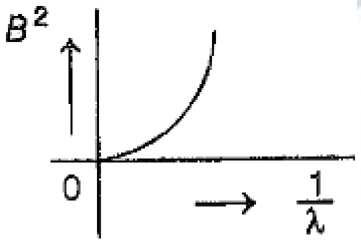
**24. If $\hat{\mathbf{n}}_1, \hat{\mathbf{n}}_2$ and $\hat{\mathbf{t}}$ represent, unit vectors along the incident ray, reflected ray and normal to the surface respectively, then**



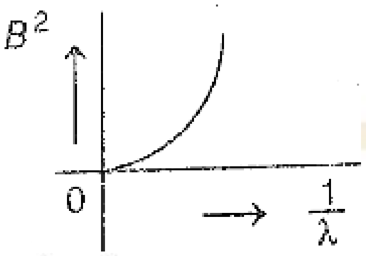
(a) $\hat{\mathbf{n}}_2 = \hat{\mathbf{n}}_1 - 2(\hat{\mathbf{n}}_1 \cdot \hat{\mathbf{t}})\hat{\mathbf{t}}$
(b) $\hat{\mathbf{n}}_2 = \hat{\mathbf{n}}_1 + 2(\hat{\mathbf{n}}_1 \cdot \hat{\mathbf{t}})\hat{\mathbf{t}}$
(c) $\hat{\mathbf{n}}_2 = -\hat{\mathbf{n}}_1$
(d) $\hat{\mathbf{n}}_2 = 2\hat{\mathbf{n}}_1 - (\hat{\mathbf{n}}_1 \times \hat{\mathbf{t}}) \cdot \hat{\mathbf{n}}_1$

**25. A beam of light of wavelength $\lambda$ falls on a metal having work function $\phi$ placed in a magnetic field $B$. The most energetic electrons, perpendicular to the field are bent in circular arcs of radius $R$. If the experiment is performed for different values of $\lambda$, then $B^2$ vs $1/\lambda$ graph will look like (keeping all other quantities constant)**

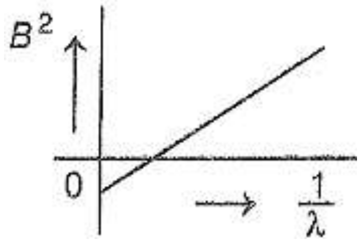
(a)

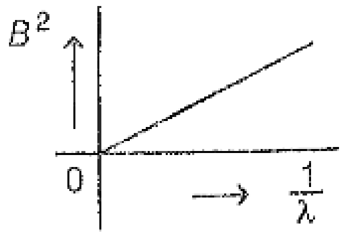


(b)



(c)



(d) 


**26.A charged particle moving with a velocity $v = v_1\hat{i} + v_2\hat{j}$ in a magnetic field B experiences a force $F = F_1\hat{i} + F_2\hat{j}$. Here $v_1, v_2, F_1, F_2$, all are constants. Then B can be.**

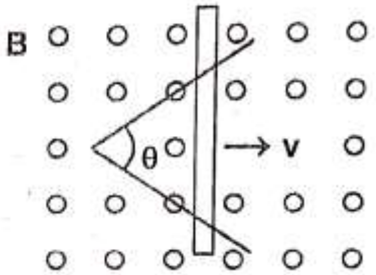
(a) $B = B_1\hat{i} + B_2\hat{j}$ with $\frac{V_1}{V_2} = \frac{B_1}{B_2}$

(b) $B = B_1\hat{i} + B_2\hat{j} + B_3\hat{k}$ with $\frac{V_1}{V_2} = \frac{B_1}{B_2}$

(c) $B = B_3\hat{j}$ with $B_1 = B_2 = 0$

(d) $B = B_1\hat{j} + B_2\hat{k}_2$ with $\frac{B_1}{B_2} = \frac{V_1}{V_2}$

**27. Two straight conducting plates form an angle $\theta$, where their ends are joined. A conducting bar in contact with the plates and forming an.**




**isosceles triangle with them starts at the vertex at time $t = 0$ and moves with constant velocity v to the right as shown in figure. A magnetic field B points out of the page. The magnitude of emf induced at $t = 1$ s will be.**

(a) $Bv\tan\frac{\theta}{2}$ (b) $2Bv^2\tan\frac{\theta}{2}$

(c) $2Bv^2\cot\frac{\theta}{2}$ (d) $2Bv^2\sin\frac{\theta}{2}$

**28. Three point charges $q, -2q$ and $q$ are placed along $X$-axis at $x = -a, 0$ and a respectively. As $a \to 0$ and $q \to 0$ while $qa^2 = Q$ remains finite, the electric field at a point $P$, at a distance $x(x \gg a)$ from $x = 0$ is.**

**$\mathbb{E} = \frac{\alpha Q}{4\pi\epsilon_0 x^\beta}\hat{i}$. Then**

(a) $\alpha = \beta$ (b) $\alpha = 2\beta$

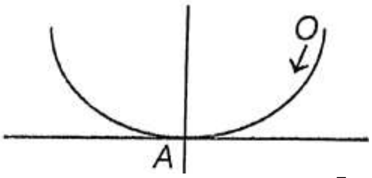
(c) $\alpha = 2/3\beta$ (d) $2\alpha = 3\beta$

**29. A body floats with $1/n$ of its volume keeping outside of water. If the body has been taken to height $h$ inside water and released, it will come to the surface after time $t$. Then.**

(a) $t \propto \sqrt{n}$ (b) $t \propto n$

(c) $t \propto \sqrt{n+1}$ (d) $t \propto \sqrt{n-1}$

**30. A small sphere of mass $m$ and radius $r$ slides down the smooth surface of a large hemispherical bowl of. Radius $R$. If the sphere starts sliding from rest, the total kinetic energy of the sphere at the lowest point $A$ of the bowl will be [Given, moment of inertia of sphere $= \frac{2}{5}mr^2$]**




(a) $mg(R-r)$ (b) $\frac{7}{10}mg(R-r)$

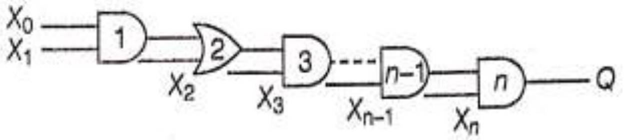
(c) $\frac{2}{7}mg(R-r)$ (d) $\frac{10}{7}mg(R-r)$

**31. When a convex lens is placed above an empty tank, the image of a mark at the bottom of the**

**tank, which is 45 cm from the lens is formed 36 cm above the lens. When a liquid is poured in the tank to a depth of 40 cm , the distance of the image of the mark above the lens is 48 cm . The refractive index of the liquid is 45 cm .**

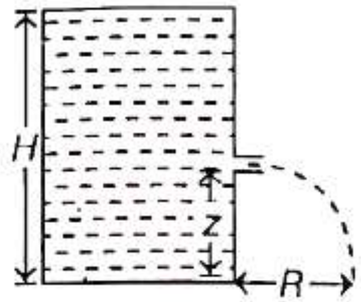
(a) 1.353 (b) 1.544
(c) 1.472 (d) 1,366

**32. In the given network of AND and OR gates, output $Q$ can be written as (assuming $n$ even)**




(a) $X_0X_1 + X_2X_3 + \cdots X_{n-1}X_n$
(b) $X_0X_1 \ldots X_n + X_1X_2 \ldots X_n + X_2X_3 \ldots X_n + X_n$
(c) $x_0x_1 \ldots x_{n-1} + x_{n-2}x_{n-1} + x_n$
(d) $x_0x_1 \ldots x_{n-1} + x_2x_3x_5 \ldots x_{n-1} + x_{n-2}x_{n-1} + x_n$

**33. Water is filled in a cylindrical vessel of height $H$. A hole is made at height $z$ from the bottom, as shown in the figure. The value of $z$ for which the. range $R$ of the emerging water through the hole will be maximum for**

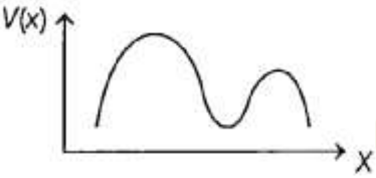



(a) $z = \frac{H}{4}$ (b) $z = \frac{H}{2}$
(c) $z = \frac{H}{8}$ (d) $z = \frac{H}{3}$

**34. A metal plate of area $10^{-2}$ m$^2$ rests on a layer of castor oil, $2 \times 10^{-3}$ m thick, whose coefficient of viscosity is $1.55$Nsm$^{-2}$. The approximate horizontal force required to move the plate with a uniform speed of $3 \times 10^{-2}$ ms$^{-1}$ is**

(a) 0.6718 N (b) 0.2325 N
(c) 0.2022 N (d) 0.6615 N

**35. The following figure shows the variation of potential energy $V(x)$ of a particle with distance $x$. The particle has**




(a) Two equilibrium points, one stable another unstable.
(b) Two equilibrium points, both stable.
(c) Three equilibrium points, one stable two unstable.
(d) Three equilibrium points, two stable one unstable.

**36. Monochromatic light of wavelength $\lambda = 4770$Å is incident separately on the surfaces of four different metals $A, B, C$ and $D$. The work functions of A, B, C and D are $4.2$, eV, $3.7$eV, $3.2$eV and 2.3 eV ,respectively. The metal / metals from which electrons will be emitted is / are.**

(a) A, B, C and D (b) B, C and D
(c) C and D (d) D only

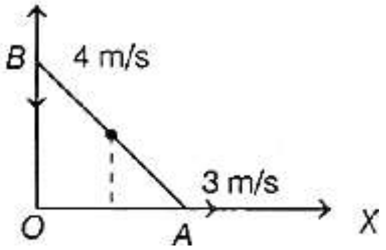
**37. Consider the integral form of the Gauss' law in electrostatics $\oint\!\!\oint \mathbf{E} \cdot d\mathbf{S} = \frac{Q}{\varepsilon_0}$**

**Which of the following statements are correct?**

(a) It contains law of Coulomb.
(b) It contains superposition principle.

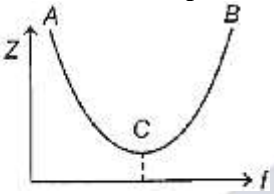
(c) An elementary patch on the enclosing surface is a polar vector.
(d) An elementary patch on the enclosing surface is a pseudo-vector.

**38. A uniform rod $AB$ of length 1 m and mass 4 kg is sliding along two mutually perpendicular frictionless walls $OX$ and $OY$. The velocity of.the two ends of the rod$A$ and $B$ are $\mathrm{m/s}$ and $4\ \mathrm{m/s}$ respectively, as shown in the figure. Then, which of the following statement(s) is/are correct?**




(a) The velocity of the centre of mass of the rod is $2.5\ \mathrm{m/s}$.
(b) Rotational kinetic energy of the rod is 25/6 joule.
(c) The angular velocity of the rod is $5\mathrm{rad/s}$ clockwise.
(d) The angular velocity of the rod is $5\mathrm{rad/s}$ anti-clockwise.

**39. The variation of impedance $Z$ of a series $L-C-R$ circuit with frequency of the source is shown in the figure. Which of the following statement(s) is/are true ?**




(a) The impedance $Z$ is inductive in the portion $AC$
(b) The impedance $Z$ is capacitive in the portion $BC$
(c) The impedance $Z$ is inductive in the portion $BC$
(d) The impedance $Z$ is capacitive in the portion $AC$

**40. The electric field of a plane electromagnetic wave in a medium is given by $\mathrm{E}(x, y, z, t)= E_0\hat{n}_0 e^{ik_0[(x+y+z)-ct]}$ .where $c$ is the speed of light in free space. E field is polarised in the X-Z-plane. The speed of wave is v in the medium. Then,**

(a) $\hat{n}=\hat{\imath}-\hat{k}; V=c$
(b) $\hat{n}=\frac{\hat{\imath}-\hat{k}}{\sqrt{2}}; v=\frac{c}{\sqrt{3}}$
(c) refractive index of the medium is $\sqrt{3}$
(d) $\hat{n}=\frac{\hat{\imath}+\hat{k}}{\sqrt{2}}; v=\frac{c}{\sqrt{2}}$

## Chemistry

**41. In the following sequence of reaction compound ' $M$ ' is**

$\mathrm{M} \xrightarrow{\mathrm{CH_3MgBr}} \mathrm{N}+\mathrm{CH_4}\uparrow \xrightarrow{\mathrm{H^+}} \mathrm{CH_3COCH_2COCH_3}$

(a) $\mathrm{CH_3COCH_2COCH_3}$
(b) $\mathrm{CH_3COCH_2CO_2Et}$
(c) $\mathrm{CH_3-C \equiv CH_3}$
(d) $\mathrm{CH_3-C \equiv OH}$

**42.Identify the ion having $4f^6$ electronic configuration**

(a) $\mathrm{Gd^{3+}}$ (b) $\mathrm{Sm^{3+}}$
(c) $\mathrm{Sm^{2+}}$ (d) $\mathrm{Tb^{3+}}$

**43.Metallic conductors and semiconductors are heated separately. What are the changes with respect to conductivity ?**

(a) increase, increase (b) decrease, decrease
(c) increase, decrease (d) decrease, increase

**44. The equivalent weight of $\mathrm{Na_2\ S_2O_3}$ (Gram molecular weight $=\dot{M}$ ) in the given reaction is**
**$\mathrm{I_2+2Na_2\ S_2O_3=2NaI+Na_2\ S_4O_6}$**

(a) $M/2$ (b) $M$
(c) $2M$ (d) $M/4$

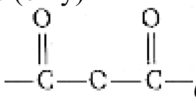
**45. The reactivity order of the following molecules towards $S_N1$ reaction is.**

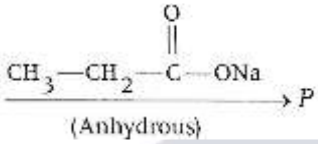
**(I)** Allyl chloride
**(II)** Chlorobenzene
**(III)** Ethyl chloride

(a) I > II > III (b) I > III > II
(c) II > I > III (d) III > I > II

**46. Toluene reacts with mixed acid at 25°C to produce**

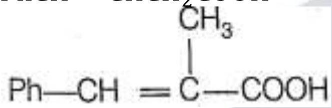
(a) nearly equal amounts of $o$ - and $m$ - nitrotoluene
(b) p-nitrotoluene (only)
(c) predominantlyo-nitrotoluene and $p$-nitrotoluene
(d) 2, 4, 6- trinitrotoluene (only)

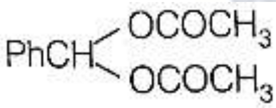
**47. PhCHO + $CH_2CH_2$**  **$CH_2CH_3$**

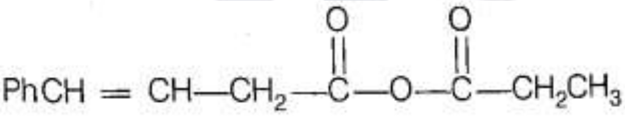


**The product ' $P$ ' in the above reaction is.**

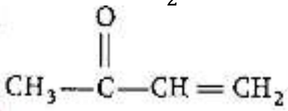
(a) $PhCH = CHCH_2COOH$

(b) 

(c) 

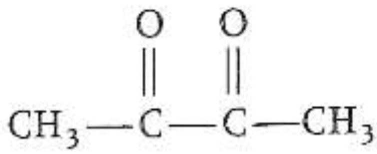
(d) 

**48. The decreasing order of reactivity of the following alkenes towards HBr addition is .**

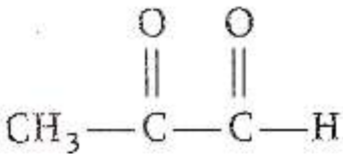
**(I)** $CH_3 - CH = CH_2$
**(II)** $CF_3 - CH = CH_2$
**(III)** $MeOCH = CH_2$
**(IV)** 

(a) I > II > III > IV (b) II > IV > I > III
(c) III > IV > I > II (d) III > I > II > IV

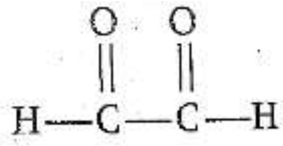
**49. Ozonolysis of $o$-xylene produces.**



**(I)**



**(II)**

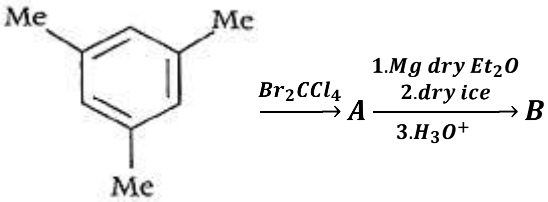


**(III)**

(a) I : III $= 1:2$ (b) II : III $= 2:1$

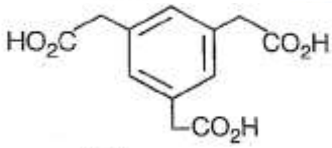
(c) I: II : III $= 1:2:3$ (d) 1 : II: III= $3:2:1$

**50. The compounds *A* and *B* are respectively.**

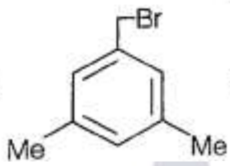


(a) **A=**

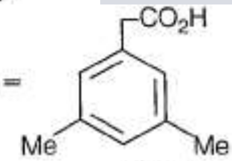
**B=**



(b) $A =$

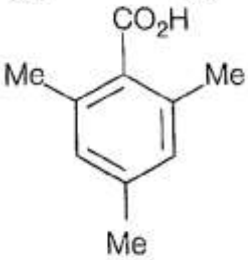


; $B =$

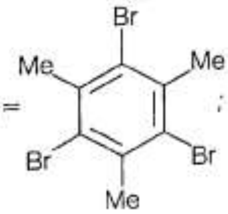


(c) $A=$

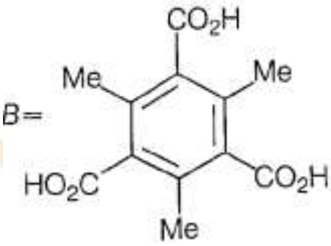
$B=$



(d) $A=$

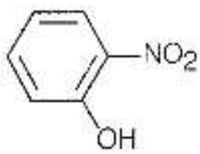


; $B=$

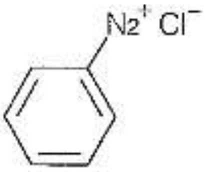


**51. The compound that does not give positive test for nitrogen in Lassaigne's test is.**

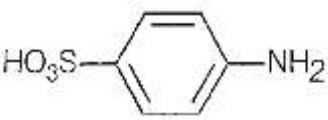
(a)



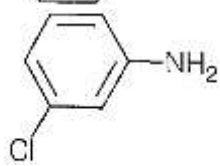
(b)



(c)



(d)

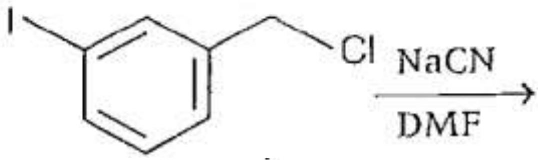


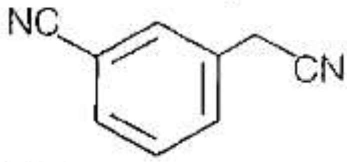
**52. The correct acidity order of phenol (I), 4-hydroxybenzaldehyde (II) and 3-hydroxybenzaldehyde (III) is.**

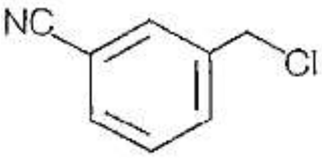
(a) I < II < III (b) I < III < II

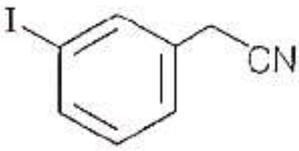
(c) II < III < I (d) III < II < I

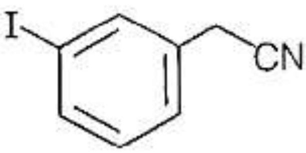
**53. The major product of the following reaction is :**




(a)



(b)



(c)



(d)



**54. Which of the following statements is correct for a spontaneous polymerisation reaction?**

(a) $\Delta G < 0, \Delta H < 0, \Delta S < 0$

(b) $\Delta G < 0, \Delta H > 0, \Delta S > 0$

(c) $\Delta G > 0, \Delta H < 0, \Delta S > 0$

(d) $\Delta G > 0, \Delta H > 0, \Delta S > 0$

**55. At 25°C, the ionic product of water is $10^{-14}$. The free energy change for the self-ionisation ' of water in kcalmol$^{-1}$ is close to.**

(a) 20.5 (b) 14.0

(c) 19.1 (d) 25.3

**56. Consider an electron moving in the first Bohr orbit of a He$^+$ion with a velocity $v_1$. If it is allowed to move in the third Bohr orbit with a velocity $v_3$, then indicate the correct $v_3 : v_1$ ratio.**

(a) 3: 1 (b) 2: 1

(c) 1: 3 (d) 1: 2

**57. The compressibility factor for a van der Waals' gas at high pressure is.**

(a) $1 + \frac{RT}{pb}$ (b) $1 + \frac{pb}{RT}$

(c) $1 - \frac{pb}{RT}$ (d) 1

**58. For a spontaneous process, the incorrect statement is.**

(a) $(\Delta G_{\text{system}})_{T,p} > 0$

(b) $(\Delta S_{\text{system}}) + (\Delta S_{\text{surroundings}}) > 0$

(c) $(\Delta G_{\text{system}})_{T,p} < 0$

(d) $(\Delta U_{\text{system}})_{S,V} < 0$

**59. Identify the incorrect statement among the following.**

(a) viscosity of liquid always decreases with increase in temperature.
(b) surface tension of liquid always decreases with increase in temperature,
(c) viscosity of liquid always increases in presence of impurity.
(d) surface tension of liquid always increases in presence of impurity.

**60. Which of the following statements is true about equilibrium constant and rate constant of a single step chemical reaction ?**
(a) Equilibrium constant may increase or decrease but rate constant always increases with temperature.
(b) Both equilibrium constant and rate constant increase with temperature.
(c) Rate constant may increase or decrease but equilibrium constant always increases with temperature.
(d) Both equilibrium constant and rate constant decrease with temperature.

**61. After the emission of a $\beta$-particle followed by an $\alpha$-particle from $^{214}_{83}Bi$, the number of neutrons in the atom is.**
(a) 210 (b) 128
(c) 129 (d) 82

**62. Which hydrogen like species will have the same radius as that of 1st Bohr orbit of hydrogen atom?**
(a) $n=2, Li^{2+}$ (b) $n=2, Be^{3+}$
(c) $n=2, He^{+}$ (d) $n=3, Li^{2+}$

**63. For a first order reaction with rate constant $k$, the slope of the plot of log (reactant concentration) against time is.**
(a) $\frac{k}{2.303}$ (b) $k$
(c) $\frac{-k}{2.303}$ (d) $-k$

**64. Equal volumes of aqueous solution of $0.1(M)HCl$ and $0.2(M)H_2SO_4$ are mixed. The concentration of $H^+$ ions in the resulting solution is.**
(a) $0.15(M)$ (b) $0.30(M)$
(c) $0.10(M)$ (d) $0.25(M)$

**65. The correct order of boiling point of the given aqueous solutions is**
(a) $1NKNO_3 > 1\ NNaCl > 1NCH_3COOH > 1$ N sucrose
(b) $1NKNO_3 = 1\ NNaCl > 1NCH_3COOH > 1$ N sucrose
(c) Same for all
(d) $1NKNO_3 = 1\ NNaCl = 1NCH_3COOH > 1$ N sucrose

**66. Correct solubility order of AgF, AgCl, AgBr, AgI is water is.**
(a) $AgF < AgCl < AgBr < AgI$
(b) $AgI < AgBr < AgCl < AgF$
(c) $AgF < AgI < AgBr < AgCl$
(d) $AgCl > AgBr > AgF > AgI$

**67. What will be the change in acidity if**
**(i)** $CuSO_4$ is added in saturated $(NH_4)_2SO_4$ solution
**(ii)** $SbF_5$ is added in anhydrous HF
(a) increase, increase (b) decrease, decrease
(c) increase, decrease (d) decrease, increase

**68. Which of the following contains maximum number of lone pairs on the central atom ?**
(a) $ClO_3^-$ (b) $XeF_4$
(c) $SF_4$ (d) $1_3^-$

**69. Number of moles of ions produced by complete dissociation of one mole of Mohr's salt in water is.**
(a) 3 (b) 4
(c) 5 (d) 6

**70. Which of the following species exhibits both LMCT and paramagnetism?**
(a) $MnO_4^{2-}$ (b) $MnO_4^-$
(c) $Cr_2O_7^{2-}$ (d) $CrO_4^{2-}$

**71. How many $P-O-P$ linkages are there in $P_4O_{10}$.**

(a) Six (b) Four
(c) Five (d) One

**72.** $\mathbf{Me_3CCH_2CH_2OH \xleftrightarrow{Q} Me_3CCH=CH_2}$

$$\xrightarrow{R} Me_3C{-}\underset{}{\overset{\displaystyle OH}{\overset{|}{C}H}}{-}CH_3$$

***Q* and *R* in the above reaction sequences are respectively**

(a) $Hg(OAc)_2, NaBH_4/OH^-; B_2H_6, H_2O_2/OH^-$
(b) $B_2H_6, H_2O_2/OH^-; H^+/H_2O$
(c) $Hg(OAc)_2, NaBH_4/OH^-; H^+/H_2O$
(d) $B_2H_6, H_2O_2/OH^-; Hg(OAc)_2, NaBH_4/OH^-$

**73. pH of $10^{-8}$(M)HCl solution is.**

(a) 8
(b) greater than 7 , less than 8
(c) greater than 8
(d) greater than 6 , less than 7

**74. The specific conductance ( $\kappa$ ) of 0.02 (M) aqueous acetic acid solution at 298 K is $1.65 \times 10^{-5}$ S cm$^{-1}$, The degree of dissociation of acetic acid is**
$\left[\lambda^\circ_{H^+} = 349.1 \text{ S cm}^2 \text{ mol}^{-1}\right.$
**and** $\left.\lambda^\circ_{CH_3COO^-} = 40.9 \text{ S cm}^2 \text{ mol}^{-1}\right]$

(a) 0.021 (b) 0.21
(c) 0.012 (d) 0.12

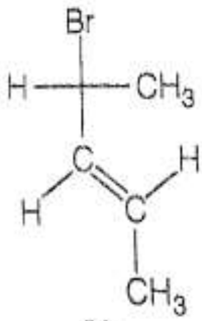
**75. The number(s) of -OH group(s) present in $H_3PO_3$ and $H_3PO_4$ is/are**

(a) 3 and 3 respectively
(b) 3 and 4 respectively ‘
(c) 2 and 3 respectively
(d) 1 and 3 respectively.

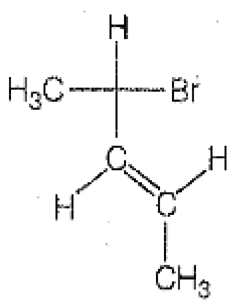
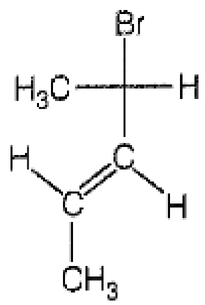
**76. Which of the following statements about the $S_N2$ reaction mechanism is/are true ?**

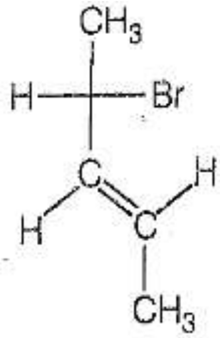
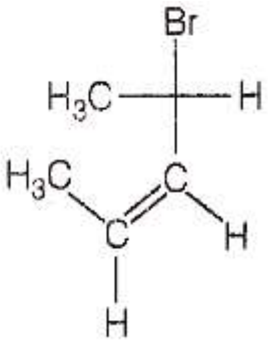
(a) The rate of reaction increases with increasing nucleophilicity.
(b) The number 2 denotes a second order reaction.
(c) Tertiary butyl substrates do not follow this mechanism.
(d) The optical rotation of substrates always changes from (+) to (-) or from (-) to (+) in the products.

**77. Which of the following represent(s) the enantiomer of *Y* ?**



(Y)

(a)  (b) 

(c)  (d) 

**78. Identify the correct statement(s).**

(a) The oxidation number of $Cr^{-}$in $CrO_5$ is +6 .

(b) $\Delta H > \Delta U$ for the reaction $N_2O_4(g) \rightarrow 2NO_2(g)$, provided both gases behavior ideally.

(c) pH of 0.1( N)$H_2SO_4$ is less than that of 0.1( N) HCl at 25°C.

(d) $(RT/F) = 0.0591$ volt at 25°C.

**79. Which of the following ion/ions is/are diamagnetic?**

(a) $[CoF_6]^{3-}$ (b) $[Co(NH_3)_6]^{3+}$

(c) $[Fe(OH_2)_6]^{2+}$ (d) $[Fe(CN)_6]^{4-}$ –

**80. Which of the following statement/statements is/are correct ?**

(a) Solid $I_2$ is freely soluble in water.

(b) Solid $I_2$ is freely soluble in water but only in presence of excess KI .

(c) Solid $I_2$ is freely soluble in $CCl_4$.

(d) Solid $I_2$ is freely soluble in hot water.

## Mathematics

**81. All values of a for which the inequality $\frac{1}{\sqrt{a}}\int_1^a \left(\frac{3}{2}\sqrt{x}+1-\frac{1}{\sqrt{x}}\right)dx < 4$ is satisfied, lie in the interval**

(a) (1,2) (b) (0,3)

(c) (0,4) (d) (1,4)

**82. For any integer $n$ $\int_0^\pi e^{\cos^2 x}\cdot\cos^3(2n+1)xdx$ has the value.**

(a) $\pi$ (b) 1

(c) 0 (d) $3\pi/2$

**83. Let $f$ be a differential function with $\lim\limits_{x\to\infty} f(x) = 0$. If $y' + yf'(x) - f(x)f'(x) = 0$, $\infty$ $\lim\limits_{x\to\infty} y(x) = 0$, then.**

(a) $y + 1 = e^{f(x)} + f(x)$

(b) $y + 1 = e^{-f(x)} + f(x)$

(c) $y + 2 = e^{-f(x)} + f(x)$

(d) $y - 1 = e^{-f(x)} + f(x)$

**84. If $xy' + y - e^x = 0, y(a) = b$, then $\lim\limits_{x\to 1} y(x)$ is.**

(a) $e + 2ab - e^a$

(b) $e^2 + ab - e^{-a}$

(c) $e - ab + e^a$

(d) $e + ab - e^a, \left(y' = \frac{dy}{dx}\right)$

**85. The area bounded by the curves $x = 4 - y^2$ and the $Y$-axis is.**

(a) 16 sq. units (b) $\frac{32}{3}$ sq. units

(c) $\frac{16}{3}$ sq. units (d) 32 sq. units

**86. $f(x) = \cos x - 1 + \frac{x^2}{2!}, x \in R$**

**Then, $f(x)$ is**

(a) decreasing function

(b) increasing function

(c) neither increasing nor decreasing
(d) constant, $\forall x > 0$

**87.** **Let $y = f(x)$ be any curve on the $XY$-plane and $P$ be a point on the curve. Let $C$ be a fixed point not on the curve. The length $PC$ is either a maximum or a minimum, then.**
(a) $PC$ is perpendicular to the tangent at $P$
(b) $PC$ is parallel to the tangent at $P$
(c) $PC$ meets the tangent at an angle of 45°
(d) PC meets the tangent at an angle of 60°

**88.** **If a particle moves in a straight line according to the law $x = a\sin(\sqrt{\lambda}t + b)$, then the particle will come to rest at two points whose distance is [symbols have their usual meaning]**
(a) a (b) $a/2$
(c) $2a$ (d) $4a$

**89.** **A unit vector in $XY$-plane making an angle $45^\circ$ with $\hat{\mathbf{i}} + \hat{\mathbf{j}}$ and an angle $60^\circ$ with $3\hat{\mathbf{i}} - 4\hat{\mathbf{j}}$ is**
(a) $\frac{13}{14}\hat{\mathbf{i}} + \frac{1}{14}\hat{\mathbf{j}}$ (b) $\frac{1}{14}\hat{\mathbf{i}} + \frac{13}{14}\hat{\mathbf{j}}$
(c) $\frac{13}{14}\hat{\mathbf{i}} - \frac{1}{14}\hat{\mathbf{j}}$ (d) $\frac{1}{14}\hat{\mathbf{i}} - \frac{13}{14}\hat{\mathbf{j}}$

**90.** **Let $f: R \to R$ be given by $f(x) = |x^2 - 1|$, then.**
(a) $f$ has a local minima at $x = \pm 1$ but no local maxima
(b) $f$ has a local maxima at $x = 0$, but no local minima
(c) $f$ has a local minima at $x = \pm 1$ and a local maxima at $x = 0$
(d) $f$ has neither any local maxima nor any local minima

**91.** **Given an AP and a GP with positive terms with the first and second terms of the progressions being equal. If $a_n$ and $b_n$, are the $n$th term of AP and GP respectively, then.**
(a) $a_n > b_n$ for all $n > 2$
(b) $a_n < b_n$ for all $n > 2$
(c) $a_n = b_n$ for some $n > 2$
(d) $a_n = b_n$, for some odd $n$

**92.** **If for the series $a_1, a_2, a_3, \ldots$ etc, $a_r - a_{r+1}$ bears a constant ratio with $a_r \cdot a_{r+1}$, then $a_1, a_2, a_3$ are in.**
(a) AP (b) GP
(c) HP (d) Any other series

**93.** **If $z_1$ and $z_2$ are two roots of the equation $z^2 + az + b = 0, a^2 < 4b$, then the origin, $z_1$ and $z_2$ form an equilateral triangle, if**
(a) $a^2 = 3b^2$ (b) $a^2 = 3b$
(c) $b^2 = 3a$ (d) $b^2 = 3a^2$

**94.** **If $\cos\theta + i\sin\theta, \theta \in R$ is a root of the equation $a_0x^n + a_1x^{n-1} + \cdots + a_{n-1}x + a_n = 0, a_0, a_1, \ldots a_n \in R, a_0 \neq 0$, then the value of $a_1\sin\theta + a_2\sin 2\theta + \cdots + a_n\sin n\theta$ is.**
(a) $2n$ (b) $n$
(c) 0 (d) $n + 1$

**95.** **If $(x^2\log_x 27) \cdot \log_9 x = x + 4$, then the value of $x$ is.**
(a) 2 (b) $-\frac{4}{3}$
(c) -2 (d) $\frac{4}{3}$

**96.** **If $P(x) = ax^2 + bx + c$ and $Q(x) = -ax^2 + dx + c$, where $ac \neq 0$, then $P(x) \cdot Q(x) = 0$ has ($a, b, c, d$ are real)**
(a) 2 real roots (b) at least two real roots
(c) 4 real roots (d) no real root

**97.** **Let $N$ be the number of quadratic equations with coefficients from $\{0, 1, 2, \ldots., 9\}$ such that 0 is a solution of each equation. Then, the value of $N$ is.**
(a) $2^9$ (b) $3^9$
(c) 90 (d) 81

**98.** **If $a, b, c$ are distinct odd natural numbers, then the number of rational roots of the equation**

$\boldsymbol{ax^2+bx+c=0}$

(a) must be 0

(b) must be 1

(c) must be 2

(d) Cannot be determined from the given data

**99.The numbers $1,2,3,\dots,m$ are arranged in random order. The number of ways this can be done, so that the numbers $1,2,r(r<m)$ appears as neighbours is.**

(a) $(m-r)!$ (b) $(m-r+1)!$

(c) $(m-r)!\,r!$ (d) $(m-r+1)!\,r!$

**100. If $A=\begin{bmatrix}\cos\theta & -\sin\theta\\ \sin\theta & \cos\theta\end{bmatrix}$ and $\theta=\frac{2\pi}{7}$, then $A^{100}=A\times A\times\dots$ ( 100 times) is equal to**

(a) $\begin{bmatrix}\cos 2\theta & -\sin 2\theta\\ \sin 2\theta & \cos 2\theta\end{bmatrix}$ (b) $\begin{bmatrix}\cos\theta & -\sin\theta\\ \sin\theta & \cos\theta\end{bmatrix}$

(c) $\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$ (d) $\begin{bmatrix}0 & -1\\ 1 & 0\end{bmatrix}$

**101. If $(1+x+x^2+x^3)^5=\sum_{k=0}^{15}a_kx^k$, then $\sum_{k=0}^{7}(-1)^k\cdot a_{2k}$ is equal to.**

(a) $2^5$ (b) $4^5$

(c) 0 (d) $4^4$

**102. The coefficient of $a^{10}b^7c^3$ in the expansion of $(bc+ca+ab)^{10}$ is.**

(a) 140 (b) 150

(c) 120 (d) 160

**103. If $\begin{vmatrix}x^k & x^{k+2} & x^{k+3}\\ y^k & y^{k+2} & y^{k+3}\\ z^k & z^{k+2} & z^{k+3}\end{vmatrix}=(x-y)(y-z)(z-x)\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)$, then.**

(a) $k=-3$ (b) $k=3$

(c) $k=1$ (d) $k=-1$

**104. If $\begin{bmatrix}2 & 1\\ 3 & 2\end{bmatrix}\cdot A\cdot\begin{bmatrix}-3 & 2\\ 5 & -3\end{bmatrix}=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$, then $A=$**

(a) $\begin{bmatrix}1 & 1\\ 1 & 0\end{bmatrix}$ (b) $\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}$

(c) $\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}$ (d) $\begin{bmatrix}0 & 1\\ 1 & 1\end{bmatrix}$

**105. Let $f(x)=\begin{vmatrix}\cos x & x & 1\\ 2\sin x & x^3 & 2x\\ \tan x & x & 1\end{vmatrix}$, then $\lim_{x\to0}\frac{f(x)}{x^2}=$.**

(a) 2 (b) -2

(c) 1 (d) -1

**106. In $R$, $a$ relation $p$ is defined as follows: $\forall a,b\in R$, apb holds iff $a^2-4ab+3b^2=0$. Then,**

(a) $p$ is equivalence relation

(b) $p$ is only symmetric

(c) $p$ is only reflexive

(d) $p$ is only transitive

**107. Let $f:R\to R$ be a function defined by $f(x)$, then $\frac{e^{|x|}-e^{-x}}{e^x+e^{-x}}$, then**

(a) $f$ is both one-one and onto

(b) $f$ is one-one but not onto

(c) $f$ is onto but not one-one

(d) $f$ is neither one-one nor onto

**108. Let $A$ be the set of even natural numbers that are $<8$ and $B$ be the set of prime integers that are $<7$. The number of relations from $A$ to $B$ are.**

(a) $3^2$ (b) $2^{9-1}$

(c) $9^2$ (d) $2^9$

**109. Two smallest squares are chosen one by one on a chess board. The probability that they**

**have a side in common is.**

(a) $\frac{1}{9}$ (b) $\frac{2}{7}$.

(c) $\frac{1}{18}$ (d) $\frac{5}{18}$

**110. Two integers $r$ and $s$ are drawn one at a time without replacement from the set $\{1, 2, \ldots, n\}$. Then, $P(r \leq k/s \leq k) =$**

(a) $\frac{k}{2}$ (b) $\frac{k}{n-1}$

(c) $\frac{k-1}{n}$ (d) $\frac{k-1}{n-1}$

( $k$ is an integer $< n$ )

**111. A biased coin with probability $p(0 < p < 1)$ of getting head is tossed until head appears for the first time. If the probability that the number of tosses required is even is $2/5$, then $p =$**

(a) $\frac{1}{4}$ (b) $\frac{1}{3}$

(c) $\frac{2}{3}$ (d) $\frac{3}{4}$

**112. The expression $\cos^2 \phi + \cos^2(\theta + \phi) - 2\cos\theta\cos\phi\cos(\theta + \phi)$ is**

(a) independent of $\theta$

(b) independent of $\phi$

(c) independent of $\theta$ and $\phi$

(d) dependent on $\theta$ and $\phi$

**113. If $0 < \theta < \frac{\pi}{2}$ and $\tan 3\theta \neq 0$, then $\tan\theta + \tan 2\theta + \tan 3\theta = 0$ if $\tan\theta \cdot \tan 2\theta = k$ where $k =$**

(a) 1 (b) 2

(c) 3 (d) 4

**114. The equation $r\cos\theta = 2a\sin^2\theta$ represents the curve**

(a) $x^3 = y^2(2a + x)$ (b) $x^2 = y^2(2a + x)$

(c) $x^3 = y^2(2a - x)$ (d) $x^3 = y^2(a + x)$

**115. If $(1, 5)$ is the mid-point of the segment of a line between the line $5x - y - 4 = 0$ and $3x + 4y - 4 = 0$, then the equation of the line will be.**

(a) $83x + 35y - 92 = 0$

(c) $83x - 35y - 92 = 0$

(b) $83x - 35y + 92 = 0$

(d) $83x + 35y + 92 = 0$

**116. In $\triangle ABC$, coordinates of $A$ are $(1, 2)$ and the equation of the medians through $B$ and $C$ are $x + y = 5$ and $x = 4$ respectively. Then, the mid-point of $BC$ is.**

(a) $\left(5, \frac{1}{2}\right)$ (b) $\left(\frac{11}{2}, 1\right)$

(c) $\left(11, \frac{1}{2}\right)$ (d) $\left(\frac{11}{2}, \frac{1}{2}\right)$

**117. A line of fixed length $a + b, a \neq b$ moves so that its ends are always on two fixed perpendicular straight lines. The locus of a point which divides the line into two parts of length $a$ and $b$ is.**

(a) a parabola (b) a circle

(c) an ellipse (d) a hyperbola

**118. With origin as a focus and $x = 4$ as corresponding directrix, a family of ellipse are drawn. Then, the locus of an end of minor axis is.**

(a) a circle (b) a parabola

(c) a straight line (d) a hyperbola

**119. Chords $AB$ and $CD$ of a circle intersect at right angle at the point $P$. If the length of $AP, PB, CP, PD$ are 2, 6, 3, 4 units respectively, then the radius of the circle.**

(a) 4 units (b) $\frac{\sqrt{65}}{2}$ units

(c) $\frac{\sqrt{67}}{2}$ units (d) $\frac{\sqrt{66}}{2}$ units

**120. The plane $2x - y + 3z + 5 = 0$ is rotated through $90^\circ$ about its line of intersection with the**

**plane $x+y+z=1$. The equation of the plane in new position is.**

(a) $3x+9y+z+17=0$
(b) $3x+9y+z=17$
(c) $3x-9y-z=17$
(d) $3x+9y-z=17$

**121. If the relation between the direction ratios of two lines in $R^3$ are given by $l+m+n=0$, $2lm+2mn-\ln=0$, then the angle between the lines is ( $l, m, n$ have their usual meaning).**

(a) $\pi/6$ (b) $2\pi/3$
(c) $\pi/2$ (d) $\pi/4$

**122. $\triangle OAB$ is an equilateral triangle inscribed in the parabola $y^2=4ax, a>0$ with $O$ as the vertex, then the length of the side of $\triangle OAB$ is.**

(a) $8a\sqrt{3}$ units (b) $8a$ units
(c) $4a\sqrt{3}$ units (d) $4a$ units

**123. For every real number $x \neq -1$, let $f(x)=\frac{x}{x+1}$. Write $f_1(x)=f(x)$ and for $n \geq 2$, $f_n(x)=f(f_{n-1}(x))$. Then, $f_1(-2)\cdot f_2(-2)\ldots f_n(-2)$ must be.**

(a) $\frac{2^n}{1\cdot 3\cdot 5\ldots(2n-1)}$ (b) 1
(c) $\frac{1}{2}\begin{bmatrix}2n\\ n\end{bmatrix}$ (d) $\begin{bmatrix}2n\\ n\end{bmatrix}$

**124. If $U_n(n=1,2)$ denotes the $n$th derivative $(n=1,2)$ of $U(x)=\frac{Lx+M}{x^2-2Bx+C}$ ($L, M, B, C$ are constants), then $PU_2+QU_1+RU=0$, holds for.**

(a) $P=x^2-2B, Q=2x, R=3x$
(b) $P=x^2-2Bx+C, Q=4(x-B), R=2$
(c) $P=2x, Q=2B, R=2$.
(d) $P=x^2, Q=x, R=3$

**125. The equation $2^x+5^x=3^x+4^x$ has.**

(a) no real solution
(b) only one non-zero real solution
(c) infinitely many solutions
(d) only three non-negative real solutions

**126. Consider the function $f(x)=(x-2)\log_e x$. Then, the equation $x\log_e x=2-x$**

(a) has at least one root in (1,2)
(b) has no root in (1,2)
(c) is not at all solvable
(d) has infinitely many roots in $(-2,1)$

**127. If $\alpha$ and $\beta$ are the roots of the equation $ax^2+bx+c=0$, then $\lim_{x\to\beta}\frac{1-\cos(ax^2+bx+c)}{(x-\beta)^2}$ is.**

(a) $(\alpha-\beta)^2$ (b) $\frac{1}{2}(\alpha-\beta)^2$
(c) $\frac{a^2}{4}(\alpha-\beta)^2$ (d) $\frac{a^2}{2}(\alpha-\beta)^2$

**128. If $f(x)=\frac{e^x}{1+e^x}$, $I_1=\int_{f(-a)}^{f(a)} xg(x(1-x))dx$ and $I_2=\int_{f(-a)}^{f(a)} g(x(1-x))dx$, then the value of $\frac{I_2}{I_1}$ is.**

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

**129. Let $f: R\to R$ be a differentiable function and $f(1)=4$. Then, the value of $\lim_{x\to 1}\int_4^{f(x)}\frac{2t}{x-1}dt$, if $f'(1)=2$ is.**

(a) 16 (b) 8
(c) 4 (d) 2

**130. If $\int\frac{\log_e\left(x+\sqrt{1+x^2}\right)}{\sqrt{1+x^2}}dx=f(g(x))+c$, then**

(a) $f(x)=\frac{x^2}{2}, g(x)=\log_e\left(x+\sqrt{1+x^2}\right)$

(b) $f(x)=\log_e\left(x+\sqrt{1+x^2}\right), g(x)=\frac{x^2}{2}$

(c) $f(x)=x^2, g(x)=\log_e\left(x+\sqrt{1+x^2}\right)$

(d) $f(x)=\log_e\left(x-\sqrt{1+x^2}\right), g(x)=x^2$

**131. Let $I(R)=\int_0^R e^{-R\sin x}dx, R>0$. Then,**

(a) $I(R)>\frac{\pi}{2R}(1-e^{-R})$

(b) $I(R)<\frac{\pi}{2R}(1-e^{-R})$

(c) $I(R)=\frac{\pi}{2R}(1-e^{-R})$

(d) $I(R)$ and $\frac{\pi}{2R}(1-e^{-R})$ are not comparable

**132. Consider the function $f(x)=x(x-1)(x-2)\ldots(x-100)$. Which one of the following is correct?**

(a) This function has 100 local maxima

(b) This function has 50 local maxima

(c) This function has 51 local maxima

(d) Local minima do not exist for this function

**133. In a plane a and b are the position vectors of two points $A$ and $B$ respectively. A point $P$ with position vector r moves on that plane in such a way that $|\mathbf{r}-\mathbf{a}| \sim |\mathbf{r}-\mathbf{b}|=c$ (real constant). The locus of $P$ is a conic section whose eccentricity is.**

(a) $\frac{|\mathbf{a}-\mathbf{b}|}{c}$ (b) $\frac{|a+b|}{c}$

(c) $\frac{|\mathbf{a}-\mathbf{b}|}{2c}$ (d) $\frac{|\mathbf{a}+\mathbf{b}|}{2c}$

**134. Five balls of different colours are to be placed in three boxes of different sizes. The number of ways in which we can place the balls in the boxes so that no box remains empty is.**

(a) 160 (b) 140

(c) 180 (d) 150

**135. Let $A=\begin{bmatrix}1&-1&0\\0&1&-1\\1&1&1\end{bmatrix}, B=\begin{bmatrix}2\\1\\7\end{bmatrix}$**

**Then, for the validity of the result $AX=B, X$ is**

(a) $\begin{bmatrix}-1\\1\\7\end{bmatrix}$ (b) $\begin{bmatrix}1\\2\\4\end{bmatrix}$

(c) $\begin{bmatrix}3\\1\\-1\end{bmatrix}$ (d) $\begin{bmatrix}4\\2\\1\end{bmatrix}$

**136. If $\alpha_1, \alpha_2, \ldots, \alpha_n$ are in AP with common difference $\theta$, then the sum of the series $\sec\alpha_1\sec\alpha_2+\sec\alpha_2\sec\alpha_3+\cdots+\sec\alpha_{n-1}\sec\alpha_n=k(\tan\alpha_n-\tan\alpha_1)$, where $k=$**

(a) $\sin\theta$ (b) $\cos\theta$

(c) $\sec\theta$ (d) $\operatorname{cosec}\theta$

**137. For the real numbers $x$ and $y$, we write $xpy$ iff $x-y+\sqrt{2}$ is an irrational number. Then, relation $p$ is.**

(a) reflexive (b) symmetric

(c) transitive (d) equivalence relation

**138. Let $A=\begin{bmatrix}0&0&-1\\0&-1&0\\-1&0&0\end{bmatrix}$, then**

(a) $A$ is a null matrix

(b) $A$ is skew-symmetric matrix

(c) $A^{-1}$ does not exist

(d) $A^2=I$

**139. If $1000!=3^n\times m$, where $m$ is an integer not divisible by 3 , then $n=$**

(a) 498 (b) 298
(c) 398 (d) 98

**140.** **If $A$ and $B$ are acute angles such that $\sin A = \sin^2 B$ and $2\cos^2 A = 3\cos^2 B$, then $(A, B) =$**

(a) $\left(\frac{\pi}{6}, \frac{\pi}{4}\right)$ (b) $\left(\frac{\pi}{6}, \frac{\pi}{6}\right)$
(c) $\left(\frac{\pi}{4}, \frac{\pi}{6}\right)$ (d) $\left(\frac{\pi}{4}, \frac{\pi}{4}\right)$

**141.** **If two circles which pass through the points $(0, a)$ and $(0, -a)$ and touch the line $y = mx + c$, cut orthogonally, then.**

(a) $c^2 = a^2(1 + m^2)$
(b) $c^2 = a^2(2 + m^2)$
(c) $c^2 = a^2(1 + 2m)^2$
(d) $2c^2 = a^2(1 + m^2)$

**142.** **The locus of the mid-point of the system of parallel chords parallel to the line $y = 2x$ to the hyperbola $9x^2 - 4y^2 = 36$ is.**

(a) $8x - 9y = 0$ (b) $9x - 8y = 0$
(c) $8x + 9y = 0$ (d) $9x - 4y = 0$

**143.** **Angle between two diagonals of a cube will Be.**

(a) $\cos^{-1}(1/3)$ (b) $\sin^{-1}(1/3)$
(c) $\frac{\pi}{2} - \cos^{-1}(1/3)$ (d) $\frac{\pi}{2} - \sin^{-1}(1/3)$

**144.** **If $y = \tan^{-1}\left[\frac{\log_e\left(\frac{e}{x^2}\right)}{\log_e(ex^2)}\right] + \tan^{-1}\left[\frac{3+2\log_e x}{1-6\cdot\log_e x}\right]$, then $\frac{d^2y}{dx^2} =$**

(a) 2 (b) 1
(c) 0 (d) -1

**145.** **$\lim_{n\to\infty} \frac{1}{n^{k+1}}\left[2^k + 4^k + 6^k + \cdots + (2n)^k\right] =$**

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

**146.** **The acceleration $\frac{fft}{\sec^2}$ of a particle after a time $t$ second starting from rest is given by $f = 6 - \sqrt{12t}$. Then, the maximum velocity $v$ and Time $T$ to attend this velocity are.**

(a) $T = 20$ s (b) $v = 60$ft/s
(c) $T = 30$ s (d) $v = 40$ft/s

**147.** **Let $\Gamma$ be the curve $y = be^{-x/a}$ and $L$ be the straight line $\frac{x}{a} + \frac{y}{b} = 1$ where $a, b \in R$. Then,**

(a) $L$ touches the curve $\Gamma$ at the point where the curve crosses the axis of $Y$.
(b) $L$ does not touch the curve at the point where the curve crosses the axis of $Y$.
(c) $\Gamma$ touches the axis of $X$ at a point.
(d) $\Gamma$ never touches the axis of $X$.

**148.** **If $n$ is a positive integer, then the value of $(2n + 1)^nC_0 + (2n - 1)^nC_1 + (2n - 3)^nC_2 + \cdots + 1 \cdot {}^nC_n$ is.**

(a) $(n + 1)2^n$
(b) $3^n$
(c) $f'(2)$ where $f(x) = x^{n+1}$
(d) $(n + 1)2^{n+1}$

**149.** **If the quadratic equation $ax^2 + bx + c = 0$ $(a > 0)$ has two roots $\alpha$ and $\beta$ such that $\alpha < -2$ and $\beta > 2$, then.**

(a) $c < 0$ (b) $a + b + c > 0$
(c) $a - b + c < 0$ (d) $a - b + c > 0$

**150.** **If $a_i, b_i, c_i \in R (i = 1, 2, 3)$ and $x \in R$ and $\begin{vmatrix} a_1 + b_1x & a_1x + b_1 & c_1 \\ a_2 + b_2x & a_2x + b_2 & c_2 \\ a_3 + b_3x & a_3x + b_3 & c_3 \end{vmatrix} = 0$, then**

(a) $x=1$ (b) $x=-1$

(c) $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}=0$ (d) $x=2$

**151. The function $f: R \rightarrow R$ defined by $f(x)=e^x+e^{-x}$ is.**

(a) one-one (b) onto

(c) bijective (d) not bijective

**152. A square with each side equal to ' $a$ ' above the $X$-axis and has one vertex at the origin. One of the sides passing through the origin makes an angle $\alpha\left(0<\alpha<\frac{\pi}{4}\right)$ with the positive direction of the axis. Equation of the diagonals of the square**

(a) $y(\cos\alpha-\sin\alpha)=x(\sin\alpha+\cos\alpha)$

(b) $y(\cos\alpha+\sin\alpha)=x(\cos\alpha-\sin\alpha)$

(c) $y(\sin\alpha+\cos\alpha)+x(\cos\alpha-\sin\alpha)=a$

(d) $y(\cos\alpha-\sin\alpha)+x(\cos\alpha+\sin\alpha)=a$

**153. If $ABC$ is an isosceles triangle and the coordinates of the base points are $B(1,3)$ and $C(-2,7)$. The coordinates of $A$ can be.**

(a) $(1,6)$ (b) $\left(-\frac{1}{8},5\right)$

(c) $\left(\frac{5}{6},6\right)$ (d) $\left(-7,\frac{1}{8}\right)$

**154. The points of extremum of $\int_0^{x^2}\frac{t^2-5t+4}{2+e^t}dt$ are**

(a) $\pm 1$ (b) $\pm 2$

(c) $\pm 3$ (d) $\pm\sqrt{2}$

**155. Choose the correct statement:**

(a) $x+\sin 2x$ is a periodic function

(b) $x+\sin 2x$ is not a periodic function

(c) $\cos(\sqrt{x}+1)$ is a periodic function

(d) $\cos(\sqrt{x}+1)$ is not a periodic function