Physics

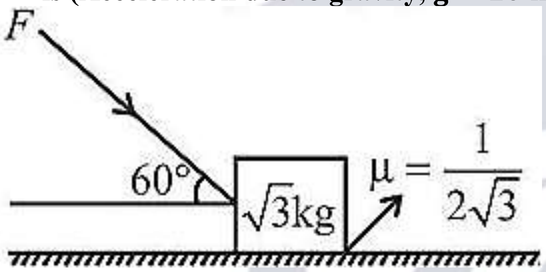
1. **If the charge of electron e, mass of electron m, speed of light in vacuum c and Planck's constant h are taken as fundamental quantities, then the permeability of vacuum μ_0 can be expressed as**
(a) $\frac{h}{mc^2}$ (b) $\frac{hc}{me^2}$
(c) $\frac{h}{ce^2}$ (d) $\frac{mc^2}{he^2}$

2. **The velocity of an object moving in a straight -line path is given as a function of time by $v = 6t - 3t^2$, where v is in ms^{-1}, t is in s. The average velocity of the object between, $t = 0$ and $t = 2$ s is**
(a) 0 (b) $3\ ms^{-1}$
(c) $2\ ms^{-1}$ (d) $4\ ms^{-1}$

3. **A gun and a target are at the same horizontal level separated by a distance of 600 m. The bullet is fired from the gun with a velocity of $500\ ms^{-1}$. In order to hit the target, the gun should be aimed to a height h above the target. The value of h is**
(Acceleration due to gravity, $g = 10\ ms^{-2}$)
(a) 2.4 m (b) 3.6 m
(c) 7.2 m (d) 10.8 m

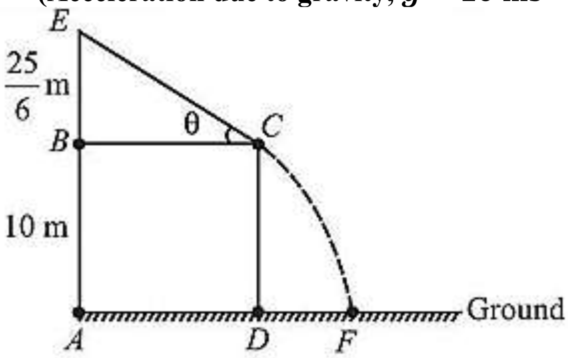
4. **A projectile is thrown in the upward direction making an angle of 60° with the horizontal with a velocity of $140\ ms^{-1}$. Then the time after which its velocity makes an angle 45° with the horizontal is (Acceleration due to gravity, $g = 10\ ms^{-2}$)**
(a) 0.5124 s (b) 51.24 s
(c) 5.124 s (d) 512.4 s

5. **The maximum value of the applied force F such that the block as shown in the arrangement does not move is (Acceleration due to gravity, $g = 10\ ms^{-2}$)**



(a) 20 N (b) 15 N
(c) 25 N (d) 10 N

6. **A rough inclined plane BCE of height $\left(\frac{25}{6}\right)$ m is kept on a rectangular wooden block $ABCD$ of height 10 m, as shown in the figure. A small block is allowed to slide down from the top E of the inclined plane. The coefficient of kinetic friction between the block and the inclined plane is $\frac{1}{8}$ and the angle of inclination of the inclined plane is $\sin^{-1}(0.6)$. If the small block finally reaches the ground at a point F, then DF will be (Acceleration due to gravity, $g = 10\ ms^{-2}$)**



(a) $\frac{5}{3}$ m (b) $\frac{10}{3}$ m
(c) $\frac{13}{3}$ m (d) $\frac{20}{3}$ m

7. **Two particles P and Q each of mass 3 m lie at rest on the X-axis at points $(-a, 0)$ and $(+a, 0)$, respectively. A third particle R of mass 2 m initially at the origin moves towards the particle Q. If all the collisions of the**

system of 3 particles are elastic and head on, the total number of collisions in the system is
(a) 2 (b) 3 (c) 4 (d) 5

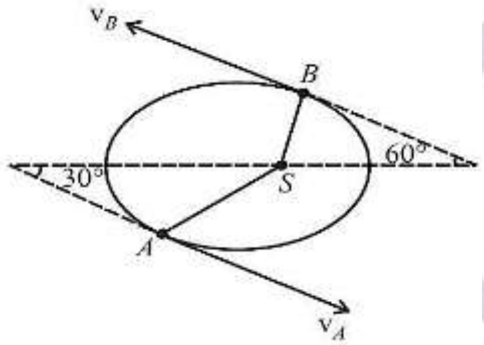
8. **A motor engine pumps 1800 L of water per minute from a well of depth 30 m and allows to pass through a pipe of cross-sectional area $30\ cm^2$. Then the power of the engine is (Acceleration due to gravity, $g = 10\ ms^{-2}$)**
(a) 20.5 kW (b) 15.5 kW
(c) 10.5 kW (d) 9.5 kW

9. **A solid sphere of 100 kg and radius 10 m moving in a space becomes a circular disc of radius 20 m in one hour. Then the rate of change of moment of inertia in the process is**
(a) $\frac{40}{9}\ kg\ m^2\ s^{-1}$ (b) $\frac{10}{9}\ kg\ m^2\ s^{-1}$
(c) $\frac{50}{9}\ kg\ m^2\ s^{-1}$ (d) $\frac{25}{9}\ kg\ m^2\ s^{-1}$

10. **A semicircular plate of mass m has radius r and centre c. The centre of mass of the plate is at a distance x from its centre c. Its moment of inertia about an axis passing through its centre of mass and perpendicular to its plane is**
(a) $\frac{mr^2}{2}$ (b) $\frac{mr^2}{4}$
(c) $\frac{mr^2}{2} + mx^2$ (d) $\frac{mr^2}{2} - mx^2$

11. **Two bodies of masses m_1 and m_2 initially at rest at infinite distance apart move towards each other under gravitational force of attraction. Their relative velocity of approach when they are separated by a distance r is (G = universal gravitational constant.)**
(a) $\left[\frac{2G(m_1-m_2)}{r}\right]^{\frac{1}{2}}$ (b) $\left[\frac{2G(m_1+m_2)}{r}\right]^{\frac{1}{2}}$
(c) $\left[\frac{r}{2G(m_1m_2)}\right]^{\frac{1}{2}}$ (d) $\left[\frac{r}{2G}m_1m_2\right]^{\frac{1}{2}}$

12. **A planet is revolving around the Sun as shown in the figure. The radius vectors joining the Sun and the planet at points A and B are 90×10^6 km and 60×10^6 km, respectively. The ratio of velocities of the planet at the points A and B when its velocities make angle 30° and 60° with major-axis of the orbit is**



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

13. **A solid copper cube of 7 cm edge is subjected to a hydraulic pressure of 8000 kPa. The volume contraction of the copper cube is**
(Bulk modulus of copper = 140GPa)
(a) $196 \times 10^{-3}\ cm^3$ (b) $19.6 \times 10^{-6}\ cm^3$
(c) $19.6 \times 10^{-3}\ cm^3$ (d) $196 \times 10^3\ cm^3$

14. **A long cylindrical glass vessel has a pinhole of diameter 0.2 mm at its bottom. The depth to which the vessel can be lowered vertically in a deep water bath without the water entering into the vessel is (surface tension of water, $T = 0.07 Nm^{-1}$, acceleration due to gravity, $g = 10\ ms^{-2}$)**
(a) 14 cm (b) 7 cm
(c) 21 cm (d) 28 cm

15. **The focal length of a spherical mirror made of steel is 150 cm. If the temperature of the mirror increases by 200 K, its focal length become (coefficient of linear expansion of steel $\alpha = 12 \times 10^{-6}\ °C^{-1}$.)**
(a) 186.3 cm (b) 153.6 cm
(c) 150.036 cm (d) 150.36 cm

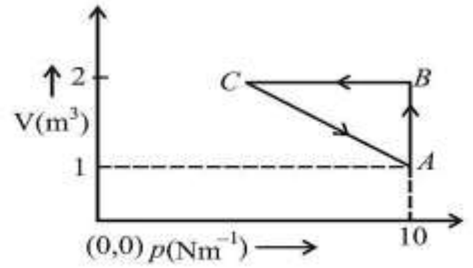
16. A metal rod of length 10 cm and area of cross-section $2.8 \times 10^{-4}\ m^2$ is covered with a non-conducting substance/ One end of it is maintained at $80^{\circ}C$, while the other end is put in ice at $0^{\circ}C$. It is found that 20 gm of ice melts in 5 min. The thermal conductivity of the metal in $Js^{-1}\ m^{-1}\ K^{-1}$ is (Latent heat of ice is $80 calg^{-1}$.)

(a) 70 (b) 80 (c) 90 (d) 100

17. A gas expands with temperature according to the relation, $V = kT^{2/3}$, where k is a constant. Work done when the temperature changes by 60 K is (R = universal gas constant.)

(a) 10 R (b) 20 R
(c) 50 R (d) 40 R

18. An ideal gas is taken through the cycle
$A \rightarrow B \rightarrow C \rightarrow A$
as shown in the figure. If the net heat supplied to the gas in the cycle is 5 J. The magnitude of work done during the process $C \rightarrow A$ is



(a) 5 J (b) 10 J
(c) 15 J (d) 20 J

19. The average translational kinetic energy of a molecule in a gas becomes equal to 0.69 eV at temperature about, [Boltzmann's constant $= 1.38 \times 10^{-23}\ J\ K^{-1}$]

(a) $3370^{\circ}C$ (b) $3388^{\circ}C$
(c) $5333^{\circ}C$ (d) $5060^{\circ}C$

20. An earthquake generates both transverse S and longitudinal P waves in the earth with speeds $4.5\ km\ s^{-1}$ and $8.0\ km\ s^{-1}$, respectively. A seismograph records that the first P-wave arrives 3.5 minutes earlier than the first S-wave. From the seismograph, the epicentre of the earthquake is located at a distance.

(a) 1080 km(b) 2468 km
(c) 2160 km(d) 4320 km

21. An observer moves towards a stationary source of sound with a speed $\frac{1}{5}^{th}$ of the speed of sound. The wavelength and frequency of the waves emitted by the source are λ and f respectively. The apparent frequency and wavelength heard by the observer are respectively.

(a) $1.2f, \lambda$ (b) $f, 1.2\lambda$
(c) $0.8f, 0.8\lambda$ (d) $1.2f, 1.2\lambda$

22. An object is placed 0.1 m in front of a convex lens of focal length 20 cm made of a material of refractive index 1.5. The surface of the lens away from the object is silvered. If the radius of curvature of the silvered surface is 22 cm, then the distance of the final image from the silvered surface is

(a) 10 cm (b) 11 cm
(c) 12 cm (d) 13 cm

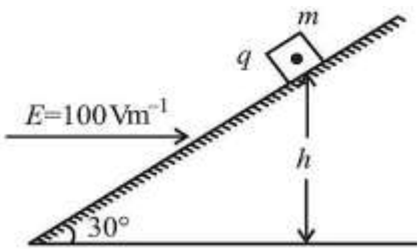
23. In a Young's double slit experiment, if the slit separation is twice the wavelength of light used, then the maximum number of interference maxima is

(a) 0 (b) 3 (c) 5 (d) 7

24. Three charges of each magnitude $100\mu C$ are placed at the corners A, B and C of an equilateral triangle of side 4 m. If the charges at points A and C are positive and the charge at point B is negative, then the magnitude of total force acting on the charge at C and angle made by it with AC are

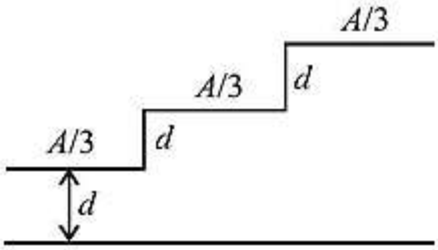
(a) $5.625\ N, 60^{\circ}$ (b) $0.5625\ N, 60^{\circ}$
(c) $5.625\ N, 30^{\circ}$ (d) $0.5625\ N, 30^{\circ}$

25. An inclined plane making an angle 30° with the horizontal is placed in a uniform horizontal electric field of $100 Vm^{-1}$ as shown in the figure. A small block of mass 1 kg and charge, 0.01 C is allowed to slide down from rest from a height, $h = 1$ m. If the coefficient of friction is 0.2, then the acceleration of the block is nearly, (Acceleration due to gravity, $g = 10\ ms^{-2}$)



(a) $1.3\ ms^{-2}$ (b) $2.3\ ms^{-2}$
(c) $3.3\ ms^{-2}$ (d) $4.3\ ms^{-2}$

26. A capacitor is made of a flat plate of area A and a second plate of stair-like structure as shown in the figure. The area of each stair is $\frac{A}{3}$ and the height is d. The capacitance of the arrangement is



(a) $\frac{\varepsilon_0 A}{3d}$ (b) $\frac{6\varepsilon_0 A}{11d}$
(c) $\frac{3\varepsilon_0 A}{d}$ (d) $\frac{11\varepsilon_0 A}{18d}$

27. The radius of a soap bubble is r and the surface tension of the soap solution is S. The electric potential to which the soap bubble be raised by charging it so that the pressure inside the bubble becomes equal to the pressure outside the bubble is
(ε_0 = permittivity of the free space

(a) $\sqrt{\frac{Sr}{8\varepsilon_0}}$ (b) $\sqrt{\frac{Sr}{4\varepsilon_0}}$
(c) $\sqrt{\frac{4Sr}{\varepsilon_0}}$ (d) $\sqrt{\frac{8Sr}{\varepsilon_0}}$

28. The ratio of heats generated through shunt and galvanometer is $7:5$ when they are connected to make an ammeter. If the resistance of the galvanometer is 112Ω then the resistance of the shunt is
(a) 80Ω (b) 8Ω
(c) 15.6Ω (d) 1.56Ω

29. When an inductor of inductance $\frac{6}{\pi}$ H, a capacitor of capacitance $\frac{50}{\pi}\mu$ F and resistor of resistance R are connected in series with an AC supply of rms voltage 220 V and frequency 50 Hz , the rms current through the circuit is 440 mA . Match the inductive reactance, X_L the capacitive reactance, X_C the resistance R and the impedance Z of the circuit given in List-I with the corresponding values given in List-II.

List-I	List-II
(A) X_L	(i) 200Ω
(B) X_C	(ii) 300Ω
(C) R	(iii) 500Ω
(D) Z	(iv) 600Ω

A B C D
(a) (iv) (ii) (i) (iii)
(b) (iv) (iii) (i) (ii)
(c) (iv)(i) (ii) (iii)
(d) (i) (iv) (iii) (ii)

30. Assertion (A) : When proton and a neutron enter into a transverse magnetic field with equal speeds, then they trace a circular paths of equal radii.
Reason (R): In a transverse magnetic field the period of revolution of a charged particle in a circular path

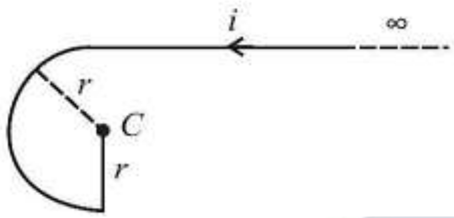
is directly proportional to the mass of the particle.

(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(c) (A) is correct but (R) is not correct.
(d) (A) is not correct but (R) is correct.

31. If only $\frac{1^{th}}{51}$ of the main current is to be passed through a galvanometer then the shunt required is R_1 and if only $\frac{1^{th}}{11}$ of the main voltage is to be developed across the galvanometer, then the resistance required R_2. Then $\frac{R_2}{R_1}$

(a) $\frac{1}{500}$ (b) $\frac{50}{9}$
(c) $\frac{500}{3}$ (d) 500

32. The magnetic field at the centre C of the arrangement shown in figure is



(a) $\frac{\mu_0 i}{2\pi r}(1+\pi)$ (b) $\frac{\mu_0 i}{4\pi r}(1+\pi)$
(c) $\frac{\mu_0 i}{\pi r}(1+\pi)$ (d) $\frac{\mu_0 i}{r}(1+\pi)$

33. To measure a magnetic field between the magnetic poles of a loud speaker, a small coil having 30 turns and $2.5\ cm^2$ area is placed perpendicular to the field and removed immediately. If the total charge flown through the coil is 7.5×10^{-3}C and the total resistance of wire and galvanometer is 0.3Ω, then the magnitude of the magnetic field is

(a) 0.03 T (b) 0.3 T
(c) 3 T (d) 3×10^2 T

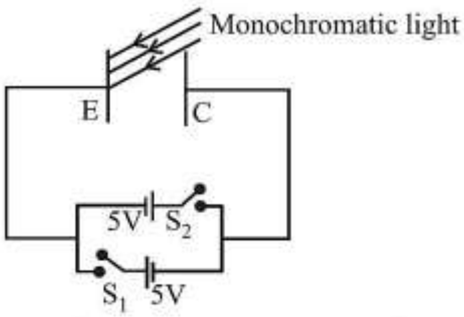
34. In an oscillating LC circuit, the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic fields is

(a) $\frac{Q}{2}$ (b) $\frac{Q}{\sqrt{3}}$
(c) Q (d) $\frac{Q}{\sqrt{2}}$

35. An electromagnetic wave of frequency 1×10^{14} Hz is propagating along z -axis. The amplitude of electric field is $4Vm^{-1}$, then energy density of the electric field will be (Permittivity of free space = $8.8 \times 10^{-12}C^2\ N^{-1}\ m^{-2}$)

(a) $35.2 \times 10^{-13} Jm^{-3}$
(b) $70.4 \times 10^{-13} Jm^{-3}$
(c) $70.4 \times 10^{-12} Jm^{-3}$
(c) $35.2 \times 10^{-12} Jm^{-3}$

36. In a photoelectric experiment, a monochromatic light is incident on the emitter plate E , as shown in the figure. When switch S_1 is closed and switch S_2 is open, the photoelectrons strike the collector plate C with a maximum kinetic energy of 1 eV. If switch S_1 is open and switch S_2 is closed and the frequency of the incident light is doubled the photoelectrons strike the collector plate with a maximum kinetic energy of 20 eV. The threshold wavelength of the emitter plate is



(a) 5233.3Å (b) 4133.3Å
(c) 4166.7Å (d) 5336.7Å

37. In a system, a particle A of mass m and charge -2 q is moving in the nearest orbit around a very heavy particle B having charge +q. Assuming Bohr's model of the atom to be applicable to this system, the orbital angular velocity of the particle A is

(a) $\frac{2\pi m^2 q^2}{\varepsilon_0 h^4}$ (b) $\frac{3\pi m^3 q^2}{\varepsilon_0^3 h^2}$

(c) $\frac{2\pi m q^4}{\varepsilon_0^2 h^3}$ (d) $\frac{5\pi m^2 q^3}{\varepsilon_0^3 h^2}$

38. In a nuclear reactor the activity of a radioactive substance is 2000/s. If the mean life of the product is 50 minutes, then in the steady power generation, the number of radio nuclides is

(a) 12×105 (b) 60×105
(c) 90×105 (d) 15×105

39. In a p-type semiconductor the donor level is at 50 meV above the valence band. To produce one electron, the maximum wavelength of light photon required is (Planck's constant, $h = 6.6 \times 10^{-34}$ Js and speed of light in vacuum, $c = 3 \times 10^8\ ms^{-1}$)

(a) 0.0248 mm (b) 0.248 mm
(c) 2.48 mm (d) 24.8 mm

40. A signal of frequency 10 kHz and peak voltage 10 V is used to amplitude modulate a carrier of frequencies 1 MHz and peak voltage 20 V. The side-band frequenciesin kHz are

(a) 1010,990 (b) 910,1090
(c) 10,11 (d) 1.01,0.99

Chemistry

41. The wavelength of a microscopic particle of mass 9.1×10^{-31} kg is 182 nm , its kinetic energy in J is ($h = 6.625 \times 10^{-34}$ J s)

(a) 7.28×10^{-23} (b) 7.28×10^{-24}
(c) 3.64×10^{-23} (d) 3.64×10^{-24}

42. The energy of an electron in an orbit of hydrogen like ion with an orbit radius of 52.9 pm in J is (ground state energy of electron in hydrogen atom is $= -2.18 \times 10^{-18}$ J)

(a) -4.36×10^{-18} (b) -1.09×10^{-17}
(c) -8.72×10^{-18} (d) -6.54×10^{-18}

43. In which of the following the electron gain enthalpy of elements is correctly arranged?

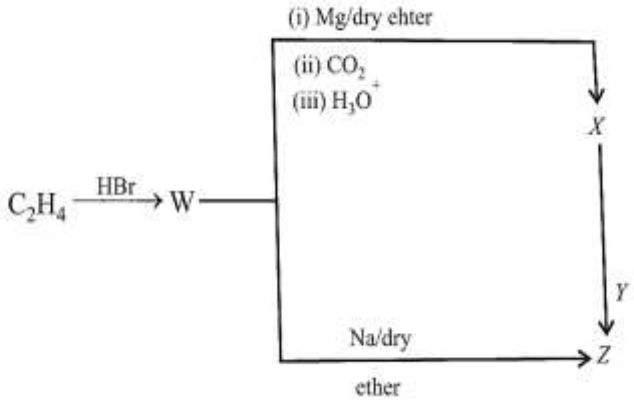
(a) S > Se > Te > O (b) F > Cl > Br > I
(c) Na > Li > K > Rb (d) O > S > Se > Te

44. Which of the following orders are correct against the property given?

(i) Dipole moment	$NF_3 > NH_3 > BF_3$
(ii) Covalent bond length	$C-O > N-O > O-H$
(ii) Bond order	$C_2 > B_2 > He_2$

(a) i, ii only (b) ii, iii only
(c) i, iii only (d) i, ii, iii

45. **The molecule on having diamagnetic nature and a bond order of 1.0 is**
(a) He_2^+ (b) Li_2^+
(c) B_2 (d) O_2
46. **If the kinetic energy of O_2 gas is 4.0 kJ mol^{-1}, its RMS speed in cms^{-1} is**
(a) 5.0×10^2 (b) 5.0×10^3
(c) 5.0×10^4 (d) 5.0×10^{-4}
47. **The volume of 0.02 M acidified permanganate solution required for complete reaction of 60 mL, of $0.01 MI^-$ ion solution to from I_2 in mL is**
(a) 60 (b) 20 (c) 40 (d) 6
48. **6 g of graphite is burnt in a bomb calorimeter at $25^\circ C$ and 1 atm pressure. The temperature of water increased from $25^\circ C$ to $31^\circ C$. If ΔH of this reaction is -248 kJ mol^{-1}, find out C_V(in kJK^{-1}) of bomb calorimeter.**
(a) 20.667 (b) 41.33
(c) 1488 (d) 0.145
49. **In which of the following, the solubility of AgCl will be minimum?**
(a) 0.1 M KNO 3 (b) 0.1 M KCl
(c) 0.2 M KNO 3 (d) Water
50. **The number of species of the following that can act both as Bronsted acids and bases is**
$HCl, ClO_4^-, {}^-OH, H^+, H_2O, HSO_4^-, SO_4^{2-}, H_2SO_4, Cl^-$
(a) 4 (b) 3 (c) 1 (d) 2
51. **Which one of the following properties has same value for H_2 and D_2 ?**
(a) Density
(b) Enthalpy of bond dissociation
(c) Bond length
(d) Melting point
52. **Identify the correct statements from the following:**
(I) Tendency to form halide hydrates gradually increases from Be to Ba down the group.
(II) Tendency to form stable super oxides increases from Li to Cs down the group.
(III) Low solubility of LiF is due to its high lattice energy.
(IV) Solubility of carbonates of group-2 elements increases down the group.
(a) I, II (b) III, IV
(c) II, III (d) I, III
53. **Which of the following metals exist in liquid state during summer season?**
(a) Ga (b) Al (c) Pb (d) Sn
54. **Formic acid is heated with conc. H_2SO_4 at $100^\circ C$ to form A and B. When Fe_2O_3 is heated strongly with B, the products formed are C and D. C can also be obtained by reacting $CaCO_3$ with dil. HCl. What is D ?**
(a) Fe (b) CO
(c) CO_2 (d) Fe_3O_4
55. **The non-biodegradable waste formed in fertilizer industries is**
(a) fly ash (b) carbon monoxide
(c) gypsum (d) lead
56. **Which one of the following has maximum number of hybrid orbitals?**
(a) C_6H_6 (b) $(CH_3)_4C$
(c) $(CH_3)_2C = O$ (d) $CH_3 - CH = CH - CN$
57. **In Dumas method one gram of carbon compound gives 50 mL of N_2 at 300 K and 740 mm Hg pressure. If the aqueous tension at 300 K is 15 mm Hg, what is the percentage of nitrogen in it?**
(a) 5.42 (b) 10.84
(c) 21.68 (d) 2.71
58. **Sodium acetate was electrolysed by Kolbe's method to form two gases A and B at anode. C and D are formed, when B is heated with regulated supply of O_2 or air in the presence of $(CH_3COO)_2Mn$. C reacts with NaOH to form a salt. A and D are respectively,**
(a) CO_2, CH_3COOH (b) CO_2, H_2O
(c) C_2H_6, H_2O (d) CO_2, H_2O_2
59. **What are Y and Z in the following reaction sequence?**



Y	Z
(a) NaOH/CaO	$CH_3(CH_2)_2CH_3$
(b) NaOH/ electrolysis	H_3C-CH_3
(c) NaOH/CaO	H_3C-CH_3
(d) NaOH/ electrolysis	$CH_3(CH_2)_2CH_3$

60. At T(K), copper (atomic mass = 63.5u) has fcc unit cell structure with edge length of xÅ. What is the approximate density of Cu in gcm^{-3} at that temperature? $\left(N_A = 6.0 \times 10^{23}\ mol^{-1}\right)$

(a) $\frac{42.3}{x^3}$ (b) $\frac{4.23}{x^3}$

(c) $\frac{423}{x^3}$ (d) $\frac{212}{x^3}$

61. The number of moles of solute present in the solutions of I, II and III is respectively

(I) 500 mL of 0.2 M NaOH

(II) 200 mL of 0.1 NH_2SO_4

(III) 6 g of urea in 1 kg of water

(a) 0.1,0.01,0.1 (b) 0.1,0.02,0.1

(c) 0.2,0.01,0.1 (d) 0.1,0.01,0.2

62. 6 g of a mixture of naphthalene $(C_{10}H_8)$ and anthracene $(C_{14}H_{10})$ is dissolved in 300 gram of benzene. If the depression in freezing point is 0.70 K , the composition of naphthalene and anthracene in the mixture respectively in g are (molal depression constant of benzene is 5.1 K kg mol^{-1})

(a) 2.60,3.40 (b) 3.40, 2.60

(c) 2.90,3.10 (d) 3.10,2.90

63. Under which of the following conditions E value of the cell, for the cell reaction given is maximum?

$$Zn(s) + Cu^{2+}(aq, c_1) \rightleftharpoons Cu(s) + Zn^{2+}(aq, c_2)$$

$$\left(\frac{2.303RT}{F} \text{ at } 298\text{ K} = 0.059\text{ V}, E^\circ_{Zn^{2+}/Zn} = -0.76\text{ V}, E^\circ_{Cu^{2+}/Cu} = +0.34\text{ V}\right)$$

(a) $C_1 = 0.1M, C_2 = 0.01M$

(b) $C_1 = 0.01M, C_2 = 0.1M$

(c) $C_1 = 0.1M, C_2 = 0.2M$

(d) $C_1 = 0.2M, C_2 = 0.1M$

64. In the first order thermal decomposition of $C_2H_5I(g) \rightarrow C_2H_4(g) + HI(g)$, the reactant in the beginning exerts a pressure of 2 bar in a closed vessel at 600 K. If the partial perssure of the reactant is 0.1 bar after 1000 minutes at the same temperature the rate constant in min^{-1} is $(\log 2 = 0.3010)$

(a) 6.0×10^{-4} (b) 6.0×10^{-3}

(c) 3.0×10^{-3} (d) 3.0×10^{-4}

65. Identify the correct statements from the following:

I. Sulphur sol is an example of a multimolecular colloid.

II. Tyndall effect is observed when the diameter of the dispersed particles is not much smaller than the

wavelength of the light used.

III. The process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane is called peptisation.

IV. Eosin, gelatin are examples of negatively charged sols.

(a) I, II, III (b) I, II, IV

(c) I, III, IV (d) II, III, IV

66. Which of the following are carbonate ores?

(I) Magnetite **(II) Kaolinite**

(III) Siderite **(IV) Calamine**

(a) I, II, III (b) II, III, IV

(c) I, II only (d) III, IV only

67. Which of the following statements is not correct?

(a) From SO_2 to TeO_2 reducing power decreases

(b) The order of boiling points of hydrides of 16th group elements is $H_2S < H_2Se < H_2Te < H_2O$

(c) Rhombic sulphur has S_8 molecules while monoclinic sulphur has S_6 molecules.

(d) The bond angle in ozone molecule is 117°

68. Noble metals, like gold and platinum are soluble in which of the following mixtures?

(a) $1:1$ mixture of conc. HNO_3 and conc. H_2SO_4

(b) $1:3$ mixture of conc. HCl and conc. HNO_3

(c) $1:3$ mixture of conc. HNO_3 and conc. HCl

(d) $1:3$ mixture of conc. H_2SO_4 and conc. HCl

69. Identify the set of acidic oxides.

(a) Na_2O, CaO, BaO

(b) ZnO, PbO, BeO

(c) CO, NO, N_2O

(d) Mn_2O_7, CrO_3, V_2O_5

70. The wavelengths of light absorbed by the complexes $[Ni(H_2O)_6]^{2+}, [Ni(en)_3]^{2+}, [Ni(H_2O)_4en]^{2+}$ are $\lambda_1, \lambda_2, \lambda_3$ respectively. The correct order of wavelengths is

(a) $\lambda1 > \lambda2 > \lambda3$ (b) $\lambda3 > \lambda2 > \lambda1$

(c) $\lambda1 > \lambda3 > \lambda2$ (d) $\lambda2 > \lambda3 > \lambda1$

71. $KMnO_4$ oxidises $S_2O_3^{2-}$ to SO_4^{2-} in medium x and NO_2^- to NO_3^- in medium y, x and y are respectively

(a) acidic, basic (b) acidic, acidic

(c) acidic, neutral (d) neutral, acidic

72. Match the following:

LIST I	LIST II
(A) Teflon	I. $SnCl_2$
(B) Anionic polymerisation	II. C_2F_4
(C) Cationic polymerisation	III. Bakelite
(D) Thermosetting polymer	IV. Polystyrene
	V. RLi

The correct answer is

A B C D A B C D

(a) II I V III (b) II V I IV

(c) II V I III (d) V II I IV

73. Identify the correct set of monosaccharides present in sucrose (X), lactose (Y) and maltose (Z).

	X	Y	Z
(a)	glucose, fructose	galactose, glucose	glucose, fructose
(b)	glucose, fructose	galactose, glucose	glucose, glucose
(c)	glucose, glucose	galactose, glucose	glucose, glucose
(d)	galactose, glucose	glucose, fructose	glucose, glucose

74. Which of the following are broad spectrum antibiotics?

Penicillin G (I) Chloram- phenicol (II) Ofloxacin (III) Ampicillin (IV)

(a) I, II only (b) I, II, III

(c) II, III, IV (d) I, III only

75. Arrange the following organic halides in correct order of reactivity towards S_N2 displacement.

$(CH_3)_2C(Br)CH_2CH_3$, (P) $BrCH_2(CH_2)_3CH_3$, (Q)

$CH_3CH(Br)(CH_2)_2CH_3$ (R)

(a) P > Q > R (b) R > P > Q

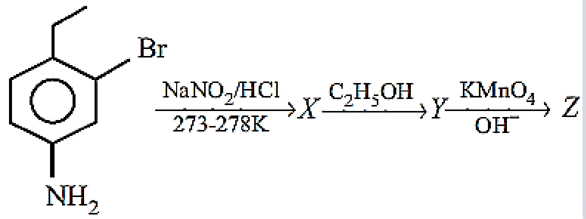
(c) P > R > Q (d) Q > R > P

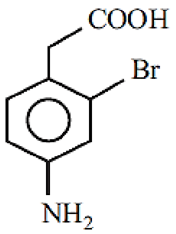
76. The bond angle between C − O and O − H bonds in alcohols is close to

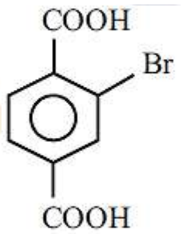
(a) 109° (b) 120°

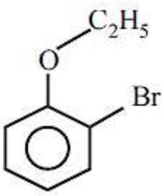
(c) 180° (d) 90°

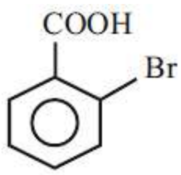
77. Identify Z in the following sequence of reactions.



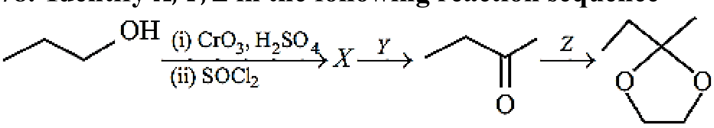
(a)


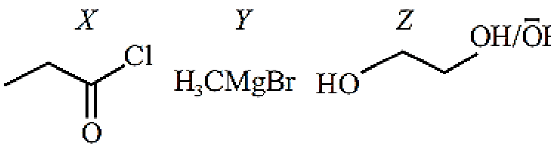
(b)


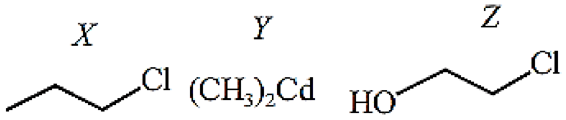
(c)


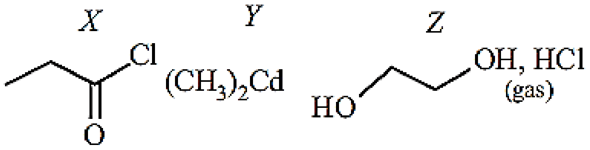
(d)


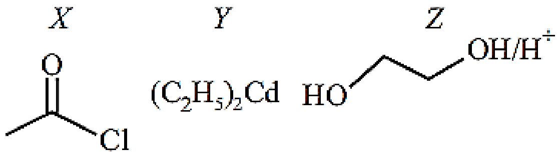
78. Identify X, Y, Z in the following reaction sequence



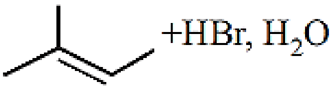
(a) 

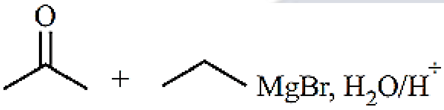
(b) 

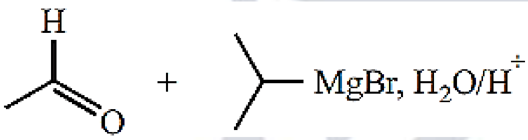
(c) 

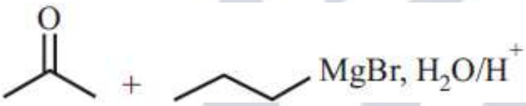
(d) 

79. 2-methyl-2-butene on hydration gave an alcohol X. Isomer of X could be prepared from which of the following?

(a) 

(b) 

(c) 

(d) 

80. Acetic acid on heating with NH_3 forms A. When A reacts with $LiAlH_4$ followed by hydrolysis gives B. When B is heated with chloroform in KOH medium gives C. What are B and C respectively?

(a) CH_3CONH_2, CH_3CH_2NC
(b) CH_3CH_2NH2, CH_3CH_2NC
(c) $CH_3CH_2NH_2, CH_3COOH$
(d) $CH_3CH_2CH_2NH_2, CH_3CH_2NC$

Mathematics

81. $f(x)=\frac{x}{e^x-1}+\frac{x}{2}+2\cos^3\frac{x}{2}$ on $R-\{0\}$ is

(a) one one function
(b) bijection
(c) algebraic function
(d) even function

82. Consider the following lists.

LIST- I	LIST -II
(A) $f(x)=\frac{\lvert x+2\rvert}{x+2}, x\neq -2$	(1) $\left[\frac{1}{3},1\right]$
(B) $g(x)=\lvert[x]\rvert, x\in R$	(2) Z
(C) $h(x)=\lvert x-[x]\rvert, x\in R$	(3) W
(D) $f(x)=\frac{1}{2-\sin 3x}, x\in R$	(4) $[0,1)$

	(5) $\{-1,1\}$

A B C D   A B C D
(a) 5 3 2 1   (b) 3 2 4 1
(c) 5 3 4 1   (d) 1 2 3 4

83. Assertion (A) : $(1)+(1+2+4)+(4+6+9)+(9+12+16)+\cdots+(81+90+100)=1000$
Reason (R) : $\sum_{r=1}^{n}\left(r^3-[r-1]^3\right)=n^3$ for any natural number n
(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true but (R) is not correct explanation of (A)
(c) (A) is true but (R) is false
(d) (A) is false but (R) is true

84. If $A=\begin{bmatrix}1 & 0\\0 & -1\end{bmatrix}$, $P=\begin{bmatrix}1 & 1\\0 & 1\end{bmatrix}$ and $X=APA^T$, then $A^TX^{50}A=$
(a) $\begin{bmatrix}0 & 1\\1 & 0\end{bmatrix}$ (b) $\begin{bmatrix}2 & 1\\0 & -1\end{bmatrix}$
(c) $\begin{bmatrix}25 & 1\\1 & -25\end{bmatrix}$ (d) $\begin{bmatrix}1 & 50\\0 & 1\end{bmatrix}$

85. If [x] is the greatest integer less than or equal to x and |x| is the modulus of x, then the system of three equations $2x+3|y|+5[z]=0, x+|y|-2[z]=4, x+|y|+[z]=1$ has
(a) a unique solution
(b) finitely many solutions
(c) infinitely many solutions
(d) no solution

86. Investigate the values of λ and μ for the system $x+2y+3z=6, x+3y+5z=9, 2x+5y+\lambda z=\mu$ and match the values in List-I with the items in List-II.

LIST- I	LIST- II
(A) $\lambda=8,\mu\neq 15$	(1) Infinitely many solutions
(B) $\lambda\neq 8,\mu\in R$	(2) No solution
(C) $\lambda=8,\mu=15$	(3) Unique solution

A B C   A B C
(a) 1 2 3   (b) 2 3 1
(c) 3 1 2   (d) 3 2 1

87. If $z=x+iy, x,y\in R, (x,y)\neq(0,-4)$ and $\arg\left(\frac{2z-3}{z+4i}\right)=\frac{\pi}{4}$, then the locus of z is
(a) $2x^2+2y^2+5x+5y-12=0$
(b) $2x^2-3xy+y^2+5x+y-12=0$
(c) $2x^2+3xy+y^2+5x+y+12=0$
(d) $2x^2+2y^2-11x+7y-12=0$

88. If $z=x+iy, x,y\in R$ and the imaginary part of $\frac{\bar{z}-1}{\bar{z}-i}$ is 1 , then the locus of z is
(a) $x+y+1=0$
(b) $x+y+1=0, (x,y)\neq(0,-1)$
(c) $x^2+y^2-x+3y+2=0$
(d) $x^2+y^2-x+3y+2=0, (x,y)\neq(0,-1)$

89. If ω represents a complex cube root of unity, then
$$\left(1+\frac{1}{\omega}\right)\left(1+\frac{1}{\omega^2}\right)+\left(2+\frac{1}{\omega}\right)\left(2+\frac{1}{\omega^2}\right)+\cdots+\left(n+\frac{1}{\omega}\right)\left(n+\frac{1}{\omega^2}\right)=$$
(a) $\frac{n(n^2+1)}{3}$ (b) $\frac{n(n^2+2)}{3}$
(c) $\frac{n(n^2-2)}{3}$ (d) $\frac{n^2(n-1)}{6}$

90. If ω is a complex cube root of unity, then $\sum_{r=1}^{9} r(r+1-\omega)(r+1-\omega^2) =$
(a) 5025 (b) 4020
(c) 2016 (d) 3015

91. If α and β are the roots of $x^2+7x+3=0$ and $\frac{2\alpha}{3-4\alpha}, \frac{2\beta}{3-4\beta}$ are the roots of $ax^2+bx+c=0$ and GCD of a, b, c is 1, then $a+b+c=$
(a) 11 (b) 0 (c) 243 (d) 81

92. If α, β are the roots of $x^2+bx+c=0$, γ, δ are the roots of $x^2+b_1x+c_1=0$ and $\gamma<\alpha<\delta<\beta$, then $(c-c_1)^2 <$
(a) $(b_1-b)(bc_1-b_1c)$
(b) 1
(c) $(b-b_1)^2$
(d) $(c-c_1)(b_1c-b_1c_1)$

93. Let a, b and c be the sides of a scalane triangle. If λ is a real number such that the roots of the equation $x^2+2(a+b+c)x+3\lambda(ab+bc+ca)=0$ are real, then the interval in which λ lies is
(a) $\left(-\infty, \frac{4}{3}\right)$ (b) $\left(\frac{5}{3}, \infty\right)$
(c) $\left(\frac{1}{3}, \frac{5}{3}\right)$ (d) $\left(\frac{4}{3}, \infty\right)$

94. The polynomial equation of degree 4 having real coefficients with three of its roots as $2\pm\sqrt{3}$ and $1+2i$, is
(a) $x^4-6x^3-14x^2+22x+5=0$
(b) $x^4-6x^3-19x+22x-5=0$
(c) $x^4-6x^3+19x-22x+5=0$
(d) $x^4-6x^3+14x^2-22x+5=0$

95. All the letters of the word ANIMAL are permuted in all possible ways and the permutations thus formed are arranged in dictionary order. If the rank of the word ANIMAL is x, then the permutation with rank x, among the permutation obtained by permuting the letters of the word PERSON and arranging the permutations thus formed in dictionary order is
(a) ENOPRS (b) NOSPRE
(c) NOEPRS (d) ESORNP

96. A student is allowed to choose atmost n books from a collection of $2n+1$ books. If the total number of ways in which he can select at least one book is 255, then the value of n is
(a) 4 (b) 5 (c) 6 (d) 7

97. The sum of all the coefficient in the binomial expansion of $(1+2x)^n$ is 6561. Let $R=(1+2x)^n=I+F$ where $I \in_{F} N$ and $0<F<1$. If $x=\frac{1}{\sqrt{2}}$, then $1-\frac{F}{1+(\sqrt{2}-1)^4}=$
(a) $(3\sqrt{2}-4$ (b) $4(3\sqrt{2}+4)$
(c) $(\sqrt{2}-1)^4$ (d) 1

98. If $\frac{(1-px)^{-1}}{(1-qx)} = a_0+a_1x+a_2x^2+a_3x^3+\cdots\ldots\ldots$, then $a_n=$
(a) $\frac{p^{n+1}-q^{n+1}}{q-p}$ (b) $\frac{p^{n+1}-q^{n+1}}{p-q}$
(c) $\frac{p^n-q^n}{q-p}$ (d) $\frac{p^n-q^n}{p-q}$

99. If $\frac{3}{(x-1)(x^2+x+1)} = \frac{1}{x-1} - \frac{x+2}{x^2+x+1} = f_1(x)-f_2(x)$

$$\frac{x+1}{(x-1)^2(x^2+x+1)} = Af_1(x) + \left(B+\frac{D}{x-1}\right)$$

$$f_2(x) + \frac{C}{(x-1)^2} A+B+C+D =$$

(a) 1 (b) $\frac{-1}{3}$ (c) 0 (d) $\frac{1}{3}$

100. Let M and m respectively denote the maximum and the minimum values of $[f(\theta)]^2$, where $f(\theta) = \sqrt{a^2\cos^2\theta+b^2\sin^2\theta} + \sqrt{a^2\sin^2\theta+b^2\cos^2\theta}$. Then $M-m=$
(a) a^2+b^2 (b) $(a-b)^2$
(c) a^2b^2 (d) $(a+b)^2$

101. If $\cos A = \frac{-60}{61}$ and $\tan B = -\frac{7}{24}$ and neither A nor B is the second quadrant, then the angle $A + \frac{B}{2}$ lies in the quadrant

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

102. $\cos^2 5^\circ - \cos^2 15^\circ - \sin^2 15^\circ + \sin^2 35^\circ + \cos 15^\circ \sin 15^\circ - \cos 5^\circ \sin 35^\circ =$

(a) 0 (b) 1 (c) $\frac{3}{2}$ (d) 2

103. If $\cos\theta \neq 0$ and $\sec\theta - 1 = (\sqrt{2} - 1)\tan\theta$, then $\theta =$

(a) $n\pi + \frac{\pi}{8}, n \in Z$

(b) $2n\pi + \frac{\pi}{4}$ or $2n\pi, n \in Z$

(c) $2n\pi + \frac{\pi}{8}, n \in Z$

(d) $2n\pi - \frac{\pi}{4}$, or $2n\pi, n \in Z$

104. $\cot\left[\sum_{n=3}^{32} \cot^{-1}\left(1 + \sum_{k=1}^{n} 2k\right)\right] =$

(a) $\frac{10}{3}$ (b) $\frac{8}{3}$ (c) $\frac{14}{3}$ (d) $\frac{16}{3}$

105. If $\sin x \cos hy = \cos\theta, \cos x \sin hy = \sin\theta$ and $4\tan x = 3$. Then, $\sin h^2 y =$

(a) $\frac{4}{5}$ (b) $\frac{9}{16}$

(c) $\frac{9}{25}$ (d) $\frac{16}{25}$

106. In triangle ABC, if $\frac{b+c}{9} = \frac{c+a}{10} = \frac{a+b}{11}$, then $\frac{\cos A + \cos B}{\cos C} =$

(a) $\frac{9}{10}$ (b) $\frac{10}{11}$ (c) $\frac{11}{12}$ (d) $\frac{12}{13}$

107. In a $\triangle$ ABC, with usual notation, match the items in List-I with the items in List-II and choose the correct option,

LIST - I	LIST – II
(A) $r_1 r_2 \sqrt{\left(\frac{4R - r_1 - r_2}{r_1 + r_2}\right)}$ 1. b	1. b
(B) $\frac{r_2(r_3 + r_1)}{\sqrt{r_1 r_2 + r_2 r_3 + r_3 r_1}}$	2. a^2, b^2, c^2 are in AP
(C) $\frac{a}{c} = \frac{\sin(A-B)}{\sin(B-C)}$	3. Δ
(D) $bc \cos^2 \frac{A}{2}$	4. $Rr_1 r_2 r_3$
	5. $s(s-a)$

A B C D A B C D

(a) 4 3 1 5 (b) 5 4 3 2

(c) 3 1 125 (d) 4 5 2 1

108. If a, b and c are the sides of $\triangle$ ABC for which $r_1 = 8, r_2 = 12$ and $r_3 = 24$, then the ordered triad $(a, b, c) =$

(a) (12,20,16) (b) (12,16,20)

(c) (16,12,20) (d) (20,16,12)

109. If $4\hat{i} + 7\hat{j} + 8\hat{k}, 2\hat{i} + 3\hat{j} + 4\hat{k}, 2\hat{i} + 5\hat{j} + 7\hat{k}$ are respectively the position vectors of the vertices A, B, C of $\triangle$ ABC, then the position vector of the point where the bisector of angle A meet BC is

(a) $2\hat{i} + \frac{13}{3}\hat{j} + 2\hat{k}$ (b) $2\hat{i} - \frac{13}{3}\hat{j} + 6\hat{k}$

(c) $2\hat{i} + 13\hat{j} + 6\hat{k}$ (d) $2\hat{i} + \frac{13}{3}\hat{j} + 6\hat{k}$

110. The equation of the plane passing through the point $\hat{i} + 2\hat{j} - \hat{k}$ and perpendicular to the line of intersection of the planes $r.(3\hat{i} - \hat{j} + \hat{k}) = 1$ and $r.(\hat{i} + 4\hat{j} - 2\hat{k}) = 2$, is

(a) $r.(-2\hat{i} - 5\hat{j} + \hat{k}) = 0$

(b) $\mathbf{r}\cdot(\hat{\mathbf{i}}+7\hat{\mathbf{j}}+4\hat{\mathbf{k}})=0$
(c) $\mathbf{r}.(2\hat{\mathbf{i}}-7\hat{\mathbf{j}}-13\hat{\mathbf{k}})=1$
(d) $\mathbf{r}.(-2\hat{\mathbf{i}}+7\hat{\mathbf{j}}+13\hat{\mathbf{k}})=0$

111. If the position vectors of the vertices A, B and C of $\triangle$ ABC are $\hat{\mathbf{i}}+2\hat{\mathbf{j}}-5\hat{\mathbf{k}}, -2\hat{\mathbf{i}}+2\hat{\mathbf{j}}+\hat{\mathbf{k}}$ and $2\hat{\mathbf{i}}+\hat{\mathbf{j}}-\hat{\mathbf{k}}$ respectively, then $\angle B=$

(a) $\cos^{-1}\left(\frac{7}{3\sqrt{10}}\right)$ (b) $\cos^{-1}\left(\frac{8}{\sqrt{105}}\right)$
(c) $\cos^{-1}\left(\frac{1}{\sqrt{42}}\right)$ (d) $\cos^{-1}\left(-\frac{7}{3\sqrt{10}}\right)$

112. If the position vectors of the vertices of a $\triangle$ ABC are $OA=3\hat{\mathbf{i}}+\hat{\mathbf{j}}+2\hat{\mathbf{k}}$, $OB=\hat{\mathbf{i}}+2\hat{\mathbf{j}}+3\hat{\mathbf{k}}$ and $OC=2\hat{\mathbf{i}}+3\hat{\mathbf{j}}+\hat{\mathbf{k}}$ then the length of the altitude of $\triangle$ ABC drawn from A is

(a) $\sqrt{\frac{3}{2}}$ (b) $\frac{3}{\sqrt{2}}$ (c) $\frac{\sqrt{3}}{2}$ (d) $\frac{3}{2}$

113. A new tetrahedron is formed by joining the centroids of the faces of a given tetrahedron OABC. Then the ratio of the volume of the new tetrahedron to that of the given tetrahedron is

(a) $\frac{3}{25}$ (b) $\frac{1}{27}$ (c) $\frac{5}{62}$ (d) $\frac{1}{162}$

114. Let $A=2\hat{\mathbf{i}}+\hat{\mathbf{j}}-2\hat{\mathbf{k}}$ and $B=\hat{\mathbf{i}}+\hat{\mathbf{j}}$. If C is a vector such that $A\cdot C=|C|, |C-A|=2\sqrt{2}$ and the angle between $A\times B$ and C is 30°, then the value of $|(A\times B)\times C|$ is

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

115. If $a_0, a_1, \dots, a_{11}$ are in an arithmetic progression with common difference d, then their mean deviation from their arithmetic mean is

(a) $\frac{30}{11}|d|$ (b) $2|d|$
(c) $3|d|$ (d) $12|d|$

116. The variance of the following continuous frequency distribution is

Class Interval	Frequency
$0-10$	2
$10-20$	3
$20-30$	4
$30-40$	1

(a) 201 (b) 62 (c) 19 (d) 84

117. If two sections of strengths 30 and 45 are formed from 75 students who are admitted in a school, then the probability that two particular students are always together in the same section is

(a) $\frac{66}{185}$ (b) $\frac{19}{37}$ (c) $\frac{29}{185}$ (d) $\frac{18}{37}$

118. A bag contains 2n coins out of which $n-1$ are unfair with heads on both sides and the remaining are fair. One coin is picked from the bag at random and tossed. If the probability that head falls in the toss is $\frac{41}{56}$, then the number of unfair coins in the bag is

(a) 18 (b) 15 (c) 13 (d) 14

119. Bag A contains 6 green and 8 red balls and bag B contains 9 green and 5 red balls. A card is drawn at random from a well shuffled pack of 52 playing cards. If it is a spade, two balls are drawn at random from bag A, otherwise two balls are drawn at random from bag B. If the two balls drawn are found to be of the same colour then the probability that they are drawn from bagA is

(a) $\frac{43}{181}$ (b) $\frac{1}{4}$ (c) $\frac{48}{131}$ (d) $\frac{43}{138}$

120. A random variable X has the probability distribution

$X=x_i$	1	2	3	4	5	6

$P(X = x_i)$	0.2	0.3	0.12	0.1	0.2	0.08

If $A = \{x_i/x_i$ is a prime number $\}$,
$B = \{x_i/x_i < 4\}$ are two events, then
$P(A \cup B) =$
(a) 0.31 (b) 0.62
(c) 0.82 (d) 0.41

121. In a poisson distribution with unit mean, $\sum_{x=0}^{\infty} |x - \bar{x}| P(X = x) =$ ($\bar{x}$ is the mean of the distribution)
(a) e (b) $\frac{1}{e}$ (c) $\frac{2}{e}$ (d) $\frac{2}{3e}$

122. Two straight rods of lengths 2a and 2b move along the coordinate axes in such a way that their extremities are always concyclic. Then the locus of the centres of such circles is
(a) $2(x^2 + y^2) = a^2 + b^2$
(b) $2(x^2 - y^2) = a^2 + b^2$
(c) $x^2 + y^2 = a^2 + b^2$
(d) $x^2 - y^2 = a^2 - b^2$

123. When the coordinate axes are rotated about the origin in the positive direction through an angle $\frac{\pi}{4}$, if the equation $25x^2 + 9y^2 = 225$ is transformed to $\alpha x^2 + \beta xy + \gamma y^2 = \delta$, then $(\alpha + \beta + \gamma - \sqrt{\delta})^2 =$
(a) 3 (b) 9 (c) 4 (d) 16

124. The equation of the line through the point of intersection of the lines $3x - 4y + 1 = 0$ and $5x + y - 1 = 0$ and making equal non-zero intercepts on the coordinate axes is
(a) $2x + 2y = 3$ (b) $23x + 23y = 6$
(c) $23x + 23y = 11$(d) $2x + 2y = 7$

125. The line through $P(a, 2)$, where $a \neq 0$, making an angle 45° with the positive direction of the X-axis meets the curve $\frac{x^2}{9} + \frac{y^2}{4} = 1$ at A&D and the coordinate axes at B and C. If PA, PB, PC and PD are in a geometric progression, then $2a =$
(a) 13 (b) 7 (c) 1 (d) -13

126. The equation of the perpendicular bisectors of the sides AB and AC of a $\triangle$ ABC are $x - y + 5 = 0$ and $x + 2y + 5 = 0$, respectively. If A is $(1, -2)$, then the equation of the straight line BC is
(a) $14x + 23y - 40 = 0$
(b) $12x + 17y - 28 = 0$
(c) $14x - 29y - 30 = 0$
(d) $7x - 12y + 15 = 0$

127. If each line of a pair of lines passing through origin is at a perpendicular distance of 4 units from the point (3,4), then the equation of the pair of lines is
(a) $7x^2 + 24xy = 0$ (b) $7y^2 + 24xy = 0$
(c) $7y^2 - 24xy = 0$ (d) $7x^2 - 24xy = 0$

128. Variable straight lines $y = mx + c$ make intercepts on the curve $y^2 - 4ax = 0$ which subtend a right angle at the origin. Then the point of concurrence of these lines $y = mx + c$ is
(a) $(4a, 0)$ (b) $(2a, 0)$
(c) $(-4a, 0)$(d) $(-2a, 0)$

129. The abscissae of two points P, Q are the roots of the equation $2x^2 + 4x - 7 = 0$ and their ordinates are the roots of the equation $3x^2 - 12x - 1 = 0$. Then the centre of the circle with PQ as a diameter is
(a) $(-1,2)$ (b) $(-2,6)$
(c) $(1,-2)$ (d) $(2,-6)$

130. If the angle between a pair of tangents drawn from a point P to the circle $x^2 + y^2 + 4x - 6y + 9\sin^2 \alpha + 13\cos^2 \alpha = 0$ is 2α, then the equation of the locus of P is
(a) $x^2 + y^2 + 4x - 6y + 4 = 0$
(b) $x^2 + y^2 + 4x - 6y - 9 = 0$

(c) $x^2+y^2-4x+6y-4=0$
(d) $x^2+y^2+4x-6y+9=0$

131. **The equation of the circle whose radius is 3 and which touches internally the circle $x^2+y^2-4x-6y-12=0$ at the point $(-1,-1)$ is**
(a) $5x^2+5y^2+9x-6y-7=0$
(b) $5x^2+5y^2-8x-14y-32=0$
(c) $5x^2+5y^2-6x+8y-8=0$
(d) $5x^2+5y^2+6x-8y-12=0$

132. **Suppose that the circle**
$x^2+y^2+2gx+2fy+c=0$ has its centre on
$2x+3y-7=0$ and cuts the circles
$x^2+y^2-4x-6y+11=0$ and
$x^2+y^2-10x-4y+21=0$ orthogonally. Then $5g-10f+3c=$
(a) 0 (b) 1 (c) 3 (d) 9

133. **If the radical axis of the circles**
$x^2+y^2+2gx+2fy+c=0$ and $2x^2+2y^2+3x+8y+2c=0$ touches the circle $x^2+y^2+2x+2y+1=0$, then
$(4g-3)(f-2)=$
(a) 0 (b) -1 (c) 1 (d) 2

134. **The parabola $x^2=4ay$ makes an intercept of length $\sqrt{40}$ units on the line $y=1+2x$, then a value of $4a$ is**
(a) 2 (b) -2 (c) -1 (d) 4

135. **The locus of the points of intersection of perpendicular normals to the parabola $y^2=4ax$ is**
(a) $y^2-2ax+a^2=0$ (b) $y^2+ax+2a^2=0$
(c) $y^2-ax+2a^2=0$ (d) $y^2-ax+3a^2=0$

136. **P is a variable point on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ with foci F_1 and F_2. If A is the area of the triangle PF_1F_2, then the maximum value of A is**
(a) $\frac{e}{ab}$ (b) $\frac{ae}{b}$
(c) aeb (d) $\frac{ab}{e}$

137. **If the line joining the points $A(\alpha)$ and $B(\beta)$ on the ellipse $\frac{x^2}{25}+\frac{y^2}{9}=1$ is a focal chord, then one possible value of $\cot\frac{\alpha}{2}\cdot\cot\frac{\beta}{2}$ is**
(a) -3 (b) 3 (c) -9 (d) 9

138. **The equation of a tangent to the hyperbola $16x^2-25y^2-96x+100y-356=0$ which makes an angle 45° with its transverse axis is**
(a) $x-y+2=0$ (b) $x-y+4=0$
(c) $x+y+2=0$ (d) $x+y+4=0$

139. **If $P(0,7,10)$, $Q(-1,6,6)$ and $R(-4,9,6)$ are three points in the space, then PQR is**
(a) right angled isosceles triangle
(b) equilateral triangle
(c) isosceles but not right angled triangle
(d) scalene triangle

140. **$A(2,3,5)$, $B(\alpha,3,3)$ and $C(7,5,\beta)$ are the vertices of a triangle. If the median through A is equally inclined with the co-ordinate axes, then $\cos^{-1}\left(\frac{\alpha}{\beta}\right)=$**
(a) $\cos^{-1}\left(\frac{-1}{9}\right)$ (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{3}$ (d) $\cos^{-1}\left(\frac{2}{5}\right)$

141. The plane $3x + 4y + 6z + 7 = 0$ is rotated about the line $r = (\hat{i} + 2\hat{j} - 3\hat{k}) + t(2\hat{i} - 3\hat{j} + \hat{k})$ until the plane passes through origin. The equation of the plane in the new position is

(a) $x + y + z = 0$ (b) $6x + 3y - 4z = 0$

(c) $4x - 5y - 2z = 0$ (d) $x + 2y + 4z = 0$

142. If $\lim_{x\to\infty}\left\{\frac{x^3+1}{x^2+1} - (\alpha x + \beta)\right\}$ exists and equal to 2 , then the ordered pair (α, β) of real numbers is

(a) $(1, -1)$ (b) $(-2,1)$

(c) $(-1,1)$ (d) $(1, -2)$

143. For $k > 0, \sum_{x=0}^{\infty} \frac{k^x}{x!} \lim_{n\to\infty} \frac{n!}{(n-x)!}\left(1 - \frac{k}{n}\right)^{n-x}\left(\frac{1}{n}\right)^x =$

(a) 0 (b) k (c) x (d) 1

144. Let $f: R \to R$ be the function defined by $f(x) = \begin{cases} 5, & \text{if } x \le 1 \\ a + bx & \text{if } 1 < x < 3 \\ b + 5x, & \text{if } 3 \le x < 5 \\ 30, & \text{if } x \ge 5 \end{cases}$ then f is

(a) continuous if $a = 5$ and $b = 5$

(b) continuous if $a = 0$ and $b = 5$

(c) continuous if $a = -5$ and $b = 10$

(d) not continuous for any values of a and b

145. Let $[x]$ denote the greatest integer less than or equal to x. Then the number of points where the function $y = [x] + |1 - x|, -1 \le x \le 3$ is not differentiable is

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

146. If $\sqrt{1 - x^6} + \sqrt{1 - y^6} = a(x^3 - y^3)$, then $y^2 \frac{dy}{dx} =$

(a) $\sqrt{\frac{1-y^6}{1-x^6}}$ (b) $x\sqrt{\frac{1-y^6}{1-x^6}}$

(c) $x^2\sqrt{\frac{1-y^6}{1-x^6}}$ (d) $\frac{1}{x^2}\sqrt{\frac{1-y^6}{1-x^6}}$

147. If $y = f(x)$ is twice differentiable function such that at a point P, $\frac{dy}{dx} = 4, \frac{d^2y}{dx^2} = -3$ then $\left(\frac{d^2x}{dy^2}\right)_P =$

(a) $\frac{64}{3}$ (b) $\frac{16}{3}$

(c) $\frac{3}{16}$ (d) $\frac{3}{64}$

148. The time T of oscillation of a simple pendulum of length L is governed by $T = 2\pi\sqrt{\frac{L}{g}}$, where g is constant. The percentage by which the length be changed in order to correct an error of loss equal to 2 minutes of time per day is

(a) $-\frac{5}{18}$ (b) $-\frac{2}{9}$

(c) $\frac{1}{6}$ (d) $\frac{1}{9}$

149. Let A, G, H and S respectively denote the arithmetic mean, geometric mean, harmonic mean and the sum of the numbers $a_1, a_2, a_3, \ldots, a_n$. Then the value of x at which the function $f(x) = \sum_{k=1}^{n}(x - a_k)^2$ has minimum is

(a) S (b) H (c) G (d) A

150. For $m > 1, n > 1$, the value of c for which the Rolle's theorem is applicable for the function $f(x) = x^{2m-1}(a - x)^{2n}$ in $(0, a)$ is

(a) $\frac{2am-1}{m+2n-1}$ (b) $\frac{a(m-n+1)}{2m+2n}$

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

151. If the function $f:[-1,1] \to R$ defined by

$$f(x)=\begin{cases}2^x+1, & \text{for } x\in[-1,0)\\ 1, & \text{for } x=0\\ 2^x-1, & \text{for } x\in(0,1]\end{cases}$$

then, in $[-1,1]$, $f(x)$ has

(a) a maximum
(b) a minimum
(c) both maximum and minimum
(d) neither maximum nor minimum

152. $\int \frac{x-1}{(x+1)\sqrt{x^3+x^2+x}}dx=$

(a) $2\tan^{-1}\left(\sqrt{\frac{1+x+x^2}{x}}\right)+c$

(b) $\tan^{-1}\left(\sqrt{\frac{1+x+x^2}{x}}\right)+c$

(c) $\tan^{-1}\left(\sqrt{\frac{x}{1+x+x^2}}\right)+c$

(d) $\tan^{-1}\left(\sqrt{\frac{1+x^2}{x}}\right)+c$

153. If $I(x)=\int x^2(\log x)^2dx$ and $I(1)=0$, then $I(x)$

(a) $\frac{x^3}{18}[8(\log x)^2-3\log x]+\frac{7}{18}$
(b) $\frac{x^3}{27}[9(\log x)^2+6\log x]-\frac{2}{27}$
(c) $\frac{x^3}{27}[9(\log x)^2-6\log x+2]-\frac{2}{27}$
(d) $\frac{x^3}{27}[9(\log x)^2-6\log x-2]+\frac{2}{27}$

154. $\int \frac{x^5dx}{(x^2+x+1)(x^6+1)(x^4-x^3+x-1)}=$

(a) $\log_e\left|\frac{x^6-1}{x^6+1}\right|+c$ (b) $\frac{1}{12}\log_e\left|\frac{x^6-1}{x^6+1}\right|+c$
(c) $\frac{1}{12}\log_e\left|\frac{x^4+1}{x^4-1}\right|+c$ (d) $\log_e\left|\frac{x^8+4}{x^6-1}\right|+c$

155. $\int \frac{dx}{x+\sqrt{x-1}}=$

(a) $\log_e|x+\sqrt{x-1}|-\frac{1}{\sqrt3}\tan^{-1}\left(\frac{2\sqrt{x-1}+1}{\sqrt3}\right)+c$
(b) $\frac{1}{\sqrt3}\log_e|x+\sqrt{x-1}|-\tan^{-1}\left(\frac{2\sqrt{x-1}+1}{\sqrt3}\right)+c$
(c) $\frac{2}{\sqrt3}\log_e|x+\sqrt{x-1}|-\tan^{-1}\left(\frac{2\sqrt{x-1}+1}{\sqrt3}\right)+c$
(d) $\log_e|x+\sqrt{x-1}|-\frac{2}{\sqrt3}\tan^{-1}\left(\frac{2\sqrt{x-1}+1}{\sqrt3}\right)+c$

156. $\int_{\log_e 2}^{x}\frac{dt}{\sqrt{e^t-1}}=\frac{\pi}{6}\Rightarrow x=$

(a) $2\cdot\log_e 2$ (b) $3\cdot\log_e 2$
(c) $4\cdot\log_e 2$ (d) $8\cdot\log_e 2$

157. $\int_0^1\frac{\log_e(1+x)}{1+x^2}dx=$

(a) $\frac{\pi}{4}\log_e 2$ (b) $\frac{\pi}{6}\log_e 6$
(c) $\frac{\pi}{2}\log_e 8$ (d) $\frac{\pi}{8}\log_e 2$

158. If the area of the circle $x^2+y^2=2$ is divided into two parts by the parabola $y=x^2$, then the area (in sq units) of the larger part is

(a) $\frac{3\pi}{2}-\frac{1}{3}$ (b) $6\pi-\frac{4}{3}$
(c) $\frac{4\pi}{3}-\frac{2}{3}$ (d) $4\pi-\frac{1}{4}$

159. If c is a parameter, then the differential equation of the family of curves $x^2=c(y+c)^2$ is

(a) $x\left(\frac{dy}{dx}\right)^3+y\left(\frac{dy}{dx}\right)^2-1=0$

(b) $x\left(\frac{dy}{dx}\right)^3-y\left(\frac{dy}{dx}\right)^2+1=0$

(c) $x\left(\frac{dy}{dx}\right)^3+y\left(\frac{dy}{dx}\right)^2+1=0$

(d) $x\left(\frac{dy}{dx}\right)^3-y\left(\frac{dy}{dx}\right)^2-1=0$

160. If $f(x), f'(x)f''(x)$, are positive functions and $f(0)=1, f'(0)=2$, then the solution of the differential equation $\begin{vmatrix} f(x) & f'(x) \\ f'(x) & f''(x) \end{vmatrix}=0$ is

(a) e^2x (b) $2\sin x+1$
(c) $\sin^2 x+2x+1$ (d) e^4x