

Physics

1. Match the following fundamental forces of nature with their relative strength.

List-I	List-II
(A) Strong nuclear force	(i) 10^{-2}
(B) Weak nuclear force	(ii) 1
(C) Electromagnetic force	(iii) 10^{-39}
(D) Gravitational force	(iv) 10^{-13}

The correct match is

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

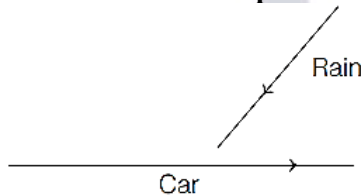
2. Identify the incorrect statement among the following.

- (a) A true length of 5.678 km has been measured in two experiments as 5.5 km and 5.51 km, respectively. The second measurement has more precision.
 (b) Length of 1 m and 0.5 m have been both measured with the same absolute error of 0.01 m. Both the measurement are equally accurate.
 (c) The numbers of significant digits in 1.6 and 0.60 are both two.
 (d) The number 2.445 can be rounded to two decimal place as 2.45.

3. Ball-1 is dropped from the top of a building from rest. At the same moment, ball-2 is thrown upward towards ball-1 with a speed 14 m/s from a point 21 m below the top of building. How far will the ball-1 have dropped when it passes ball-2. (Assume, acceleration due to gravity, $g = 10 \text{ m/s}^2$.)

- (a) $\frac{45}{4} \text{ m}$ (b) $\frac{52}{6} \text{ m}$
 (c) $\frac{37}{2} \text{ m}$ (d) $\frac{25}{2} \text{ m}$

4. Rain is falling at an angle of 30° from the vertical due to the wind with a speed of 40 m/s. A car is travelling horizontally in the direction opposite to the wind, at a speed of 40 m/s. At what angle from the vertical will it experience the rain falling from?

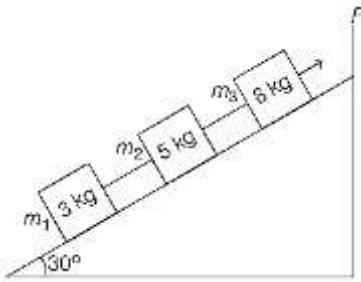


- (a) 30° (b) 60°
 (c) 90° (d) 120°

5. Two touching blocks 1 and 2 are placed on an inclined plane forming an angle 60° with the horizontal. The masses are m_1 and m_2 and the coefficient of friction between the inclined plane and the two blocks are 1.5μ and 1.0μ , respectively. The force of reaction between the blocks during the motion is ($g =$ acceleration due to gravity)

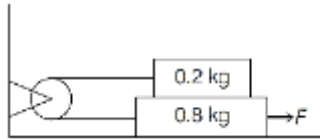
- (a) $(m_2 - m_1)\mu g$ (b) $(m_2 + m_1)\mu g$
 (c) $\frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} \mu g$ (d) $\frac{1}{4} \frac{m_1 m_2}{m_1 + m_2} \mu g$

6. Three blocks are connected by massless strings on a frictionless inclined plane of 30° as shown in the figure. A force of 104 N is applied upward along the incline to mass m_3 causing an upward motion of the blocks. What is the acceleration of the blocks? (Assume, acceleration due to gravity, $g = 10 \text{ m/s}^2$)



- (a) 6.0 m/s^2 (b) 4.5 m/s^2
(c) 3.0 m/s^2 (d) 1.5 m/s^2

7. Consider a system of two masses and a pulley shown in the figure. The coefficient of friction between the two blocks and also between block and table is 0.1. Find the force F , that must be given to the 0.8 kg block such that it attains acceleration of 5 m/s^2 . (Assume, acceleration due to gravity, $g = 10 \text{ m/s}^2$.)



- (a) 6.4 N (b) 7.1 N
(c) 6.0 N (d) 7.8 N

8. A box of mass 3 kg moves on a horizontal frictionless table and collides with another box of mass 3 kg initially at rest on the edge of the table at height 1 m. The speed of the moving box just before the collision is 4 m/s. The two boxes stick together and fall from the table. The kinetic energy just before the boxes strike the floor is (Assume, acceleration due to gravity, $g = 10 \text{ m/s}^2$)

- (a) 40 J (b) 80 J
(c) 96 J (d) 72 J

9. A ball of mass 2 kg is thrown from a tall building with velocity, $\mathbf{v} = (20 \text{ m/s})\hat{i} + (24 \text{ m/s})\hat{j}$ at time $t = 0$ s. Change in the potential energy of the ball after, $t = 8$ s is (The ball is assumed to be in air during its motion between 0 s and 8 s, $\hat{i}$ is along the horizontal and $\hat{j}$ is along the vertical direction. (Take $g = 10 \text{ m/s}^2$)

- (a) -2.56 kJ (b) 0.52 kJ
(c) 1.76 kJ (d) -2.44 kJ

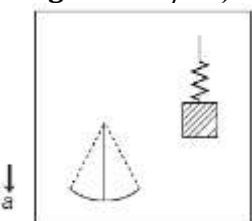
10. The balls A, B and C of masses 50 g, 100 g and 150 g, respectively are placed at the vertices of an equilateral triangle. The length of each side is 1 m. If A is placed at (0, 0) and B is placed at (1, 0)m, find the coordinates (x, y) for the centre of mass of this system of the balls

- (a) $\left(\frac{7}{12}, \sqrt{\frac{3}{4}}\right) \text{ m}$ (b) $\left(\frac{5}{18}, \sqrt{\frac{1}{4}}\right) \text{ m}$
(c) $\left(\frac{7}{12}, \sqrt{\frac{3}{2}}\right) \text{ m}$ (d) None of these

11. Three bodies, a ring, a solid disc and a solid sphere roll down the same inclined plane without slipping. The radii of the bodies are identical and they start from rest. If V_S , V_R and V_D are the speeds of the sphere, ring and disc, respectively when they reach the bottom, then the correct option is

- (a) $V_S > V_R > V_D$ (b) $V_D > V_S > V_R$
(c) $V_R > V_D > V_S$ (d) $V_S > V_D > V_R$

12. A vertical spring mass system has the same time period as simple pendulum undergoing small oscillations. Now, both of them are put in an elevator going downwards with an acceleration 5 m/s^2 . The ratio of time period of the spring mass system to the time period of the pendulum is (Assume, acceleration due to gravity, $g = 10 \text{ m/s}^2$)

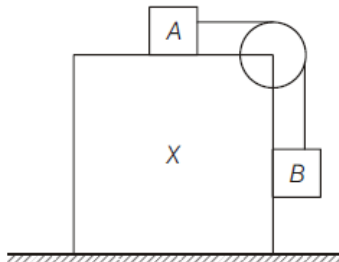


- (a) $\sqrt{\frac{3}{2}}$ (b) $\sqrt{\frac{2}{3}}$ (c) $\frac{1}{\sqrt{2}}$ (d) $\sqrt{2}$

13. Consider a spherical planet which is rotating about its axis such that the speed of a point on its equator is v and the effective acceleration due to gravity on the equator is $\frac{1}{3}$ of its value at the poles. What is the escape velocity for a particle at the pole of this planet?

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

14. Consider a system of blocks X, A and B as shown in the figure. The blocks A and B have equal mass and are connected by a massless string through a massless pulley. The coefficient of friction between block A and X or B and X is 0.5. If block X moves on the horizontal frictionless surface what should be its minimum acceleration such that blocks A and B remain stationary. (g = acceleration due to gravity.)



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

15. How much pressure (in atm) is needed to compress a sample of water by 0.4%? (Assume, Bulk modulus of water $\approx 2.0 \times 10^9$ Pa)

- (a) 60 atm (b) 70 atm
(c) 80 atm (d) 90 atm

16. The tension in a massless cable connected to an iron ball of 100 kg when it is submerged in sea water is ($\rho_{\text{iron}} = 8 \times 10^3 \text{ kg/m}^3$ and $\rho_{\text{sea water}} = 1000 \text{ kg/m}^3$, $g = 10 \text{ m/s}^2$)

- (a) 950 N (b) 846 N
(c) 875 N (d) 933 N

17. The area of a circular copper coin increases by 0.4% when its temperature is raised by 100°C . The coefficient of linear expansion of the coin is :

- (a) $1 \times 10^{-5}/^\circ\text{C}$ (b) $2 \times 10^{-5}/^\circ\text{C}$
(c) $3 \times 10^{-5}/^\circ\text{C}$ (d) $4 \times 10^{-5}/^\circ\text{C}$

18. A 210 W heater is used to heat 100 g water. The time required to raise the temperature of this water from 25°C to 100°C is (specific heat capacity of water = $4200 \text{ J/Kg} - ^\circ\text{C}$)

- (a) 100 s (b) 125 s
(c) 150 s (d) 200 s

19. One mole of nitrogen gas being initially at a temperature of $T_0 = 300 \text{ K}$ is adiabatically compressed to increase its pressure 10 times. The final gas temperature after compression is (Assume, nitrogen gas molecules as rigid diatomic and $100^{1/7} = 1.9$)

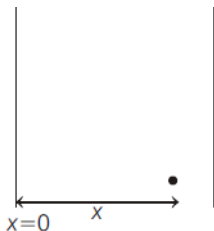
- (a) 120 K (b) 750 K
(c) 650 K (d) 570 K

20. Two gases A and B are contained in two separate, but otherwise identical containers. Gas A consists of monatomic molecules, each with atomic mass of $4u$ whereas Gas B consists of rigid diatomic molecules, each with atomic mass of $20u$. If gas A is kept at 27°C , at what temperature should gas B be kept so that both have the same rms speed?

- (a) 27°C (b) 54°C
(c) 270°C (d) 62°C

21. Standing waves are produced in a string 16 m long. If there are 9 nodes between the two fixed ends of the string and the speed of the wave is 32 m/s, what is the frequency of the wave?

- (a) 5 Hz (b) 10 Hz
(c) 30 Hz (d) 20 Hz
22. A highway truck has two horns A and B. When sounded together, the driver records 50 beats in 10 seconds. With horn B blowing and the truck moving towards a wall at a speed of 10 m/s, the driver noticed a beat frequency of 5 Hz with the echo. When frequency of A is decreased the beat frequency with two horns sounded together increases. Calculate the frequency of horn A. (Speed of sound in air = 330 m/s)
- (a) 75 Hz (b) 85 Hz
(c) 90 Hz (d) 95 Hz
23. When light of an unknown polarisation is examined with a polaroid, it is found to exhibit maximum intensity I_0 along y-axis and minimum intensity $\frac{2I_0}{3}$ along x-axis. The intensity transmitted through a polaroid with pass axis at 45° to y-axis (in x - y plane) is
- (a) $\frac{5}{8}I_0$ (b) $\frac{I_0}{2}$ (c) $\frac{5}{6}I_0$ (d) $\frac{I_0}{4}$
24. In a Young's double slit experiment, m th order and nth order of bright fringes are formed at point P on a distant screen, if monochromatic source of wavelength 400 nm and 600 nm are used respectively. The minimum value of m and n are respectively,
- (a) 4,6 (b) 3,2
(c) 2,3 (d) 4,2
25. Two small conducting balls of identical mass 20 g and identical charge 10^{-10}C hang from non-conducting threads of length, $L = 300\text{ cm}$. If the equilibrium separation of balls is x and $x \ll L$ then the magnitude of x is (Assume, $4\pi\epsilon_0 = \frac{1}{9 \times 10^9}\text{ F/m}$ and $g = 10\text{ m/s}^2$)
- (a) $\frac{2}{5^{1/3}}\text{ mm}$ (b) $\frac{3}{10^{1/3}}\text{ mm}$
(c) $\frac{3^{1/3}}{10}\text{ mm}$ (d) $\frac{3^{2/3}}{5}\text{ mm}$
26. The space between the two large parallel plates is filled with a material of uniform charge density ρ . Assume that one of the plate is kept at $x = 0$. The potential at any point x between these plates is given by (A and B are constants).

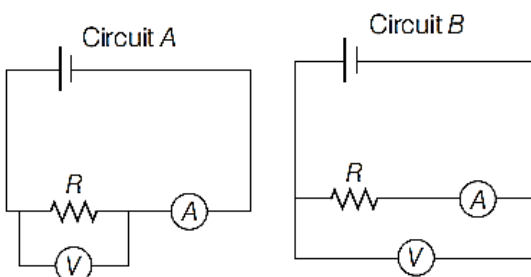


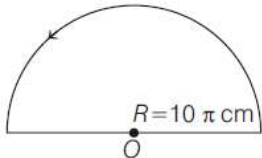
- (a) $-\frac{\rho x^3}{2\epsilon_0}$ (b) $-\left(\frac{\rho x^2}{2\epsilon_0} + Ax\right)$
(c) $-\left(\frac{\rho x^2}{2\epsilon_0} + Ax + B\right)$ (d) $-\left(\frac{\rho x^3}{4\epsilon_0} + Ax^2 + Bx\right)$

27. Identify the correct statement among the following.

- (a) Resistivity of metals decreases with temperature because more electrons are available for conduction.
(b) Resistivity of metals increases with temperature because number of electrons decreases.
(c) Resistivity of metals increases with temperature because number of collisions between electrons increases.
(d) Resistivity of metals decreases with temperature because superconductivity sets in.

28. For the circuits A and B as shown in the figure, identify the correct option.



- (a) Circuit A is for accurate measurement of high resistance and B is for low resistance.
 (b) Circuit A is for accurate measurement of low resistance and B is for high resistance.
 (c) Both circuits can accurately measured high resistance only.
 (d) Both circuits can accurately measured low resistance only.
29. Two infinitely long straight wires A and B, each carrying current I are placed on x and y -axis, respectively. The current in wires A and B flow along $-\hat{i}$ and $\hat{j}$ directions respectively. The force on a charged particle having charge q , moving from position, $\mathbf{r} = d(\hat{i} + \hat{j})$ with velocity $\mathbf{v} = v\hat{i}$ is
 (a) $\frac{\mu_0/qv}{2\pi d}\hat{j}$ (b) $\frac{\mu_0/qv}{\pi d}\hat{j}$
 (c) $\frac{\mu_0/qv}{\sqrt{2}\pi d}\hat{k}$ (d) 0
30. A long straight wire carrying current 16 A is bent at 90° such that half of the wire lies along the positive x -axis and other half lies along the positive y -axis. What is the magnitude of the magnetic field at the point, $\mathbf{r} = (-2\hat{i} + 0\hat{j})$ mm ? (Assume, $\frac{\mu_0}{4\pi} = 10^{-7} \text{Hm}^{-1}$)
 (a) 1.2 mT (b) 0.8 mT
 (c) 3.2 mT (d) 1.6 mT
31. The magnitude of the force vector acting on a unit length of a thin wire carrying a current $I = 8$ A at a point O, if the wire is bent as shown in the figure with a radius, $R = 10\pi$ cm is

 (a) 64μ N/m (b) 32μ N/m
 (c) 20μ N/m (d) 100μ N/m
32. A 10Ω coil of 180 turns and diameter 4 cm is placed in a uniform magnetic field so that the magnetic flux is maximum through the coil's cross-sectional area. When the field is suddenly removed a charge of $360\mu\text{C}$ flows through a 618Ω galvanometer connected to the coil, find the magnetic field.
 (a) 12 T (b) 6 T
 (c) 1 T (d) 8 T
33. An inductor coil is connected to a capacitor and an AC source of rms voltage 8 V in series. The rms current in the circuit is 16 A and is in phase with emf. If this inductor coil is connected to 6 V DC battery, the magnitude of steady current is
 (a) 8 A (b) 10 A
 (c) 12 A (d) 16 A
34. An electromagnetic wave of frequency 3.0 MHz passes from vacuum into a non-magnetic medium with permittivity, $\epsilon = 16\epsilon_0$. Where, ϵ_0 is the free space permittivity. The change in wavelength is
 (a) -75 m (b) $+75$ m
 (c) -50 m (d) $+50$ m
35. A particle of charge q , mass m and energy E has de-Broglie wavelength λ . For a particle of charge $2q$, mass $2m$ and energy $2E$, the de-Broglie wavelength is
 (a) $\frac{\lambda}{4}$ (b) 2λ (c) 8λ (d) $\frac{\lambda}{2}$
36. The collision of an electron with kinetic energy 5.5 eV and a hydrogen atom in its ground state can be described as
 (a) completely inelastic
 (b) may be completely inelastic
 (c) may be partially elastic
 (d) elastic
37. An alloy is composed of two radioactive materials A and B having equal weight. The half life of A and B are 10 yrs and 20 yrs respectively. After time t , the alloy was found to consist of $\left(\frac{1}{e}\right)$ kg of A and 1 kg of B. If the atomic weight of A and B are same, then the value of t is (Assume, $\ln 2 = 0.7$)

- (a) $\left(\frac{200}{7}\right)$ yrs (b) $\left(\frac{10}{7}\right)$ yrs
(c) 7 yrs (d) 70 yrs

38. When a zener diode is used as a regulator with zener voltage of 10 V , nearly five times the load current passes through the zener diode. What should be the series resistance for the zener diode. If load resistance is 2k Ω and the unregulated voltage supplied is 16 V .

- (a) 500 Ω (b) 100 Ω
(c) 200 Ω (d) 800 Ω

39. The logic circuit below has the truth table, same as that of



- (a) NOR gate (b) NAND gate
(c) AND gate (d) OR gate

40. A message signal is used to modulate a carrier frequency. If the peak voltages of message signal and carrier signals are increased by 0. 1% and 0. 3% respectively, then the percentage change in modulation index is

- (a) 0.4 (b) 0.0
(c) -0.4 (d) -0.2

Chemistry

41. From the following energy levels of hydrogen atom, the values of E_{∞} and E_3 in J are, respectively

- $-E_{\infty} =$
 $-E_3 = \dots\dots\dots$
 $-E_2 = -0.545 \times 10^{-18} \text{ J}$
 $-E_1 = -2.18 \times 10^{-18} \text{ J}$

- (a) 1, -0.242×10^{-18}
(b) ∞ , -0.726×10^{-18}
(c) 0, -0.242×10^{-18}
(d) 0, -0.321×10^{-18}

42. Match the following.

List-I		List-II	
(A)	Nodes	(I)	Three - dimensional shape of the orbital
(B)	Subsidiary quantum number	(II)	Significant only for motion of microscopic objects
(C)	White light	(III)	$ \psi ^2$ is zero
(D)	Heisenberg uncertainty principle	(IV)	Spin state of electron
		(V)	Continuous spectrum

A B C D

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

43. In which group of the periodic table the element with $Z = 120$ be placed?

- (a) 2 (b) 1 (c) 14 (d) 15

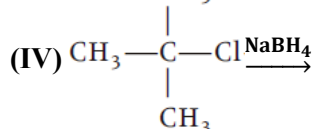
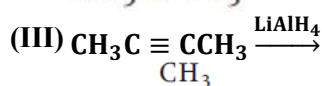
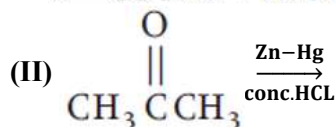
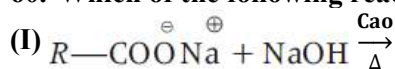
44. Common oxidation state of f-block elements is III. The other stable oxidation states of ^{63}Eu and ^{65}Tb are respectively

- (a) II, IV (b) IV, II
(c) II, V (d) V, II
45. How many of the following species are diamagnetic?
 $\text{He}_2^+, \text{H}_2, \text{H}_2^+, \text{H}_2^-, \text{He}$
(a) 1 (b) 2 (c) 3 (d) 0
46. In which of the following hydrogen bonding is strongest?
(a) $\text{O} - \text{H} \cdots \text{N}$ (b) $\text{O} - \text{H} \cdots \text{O}$
(c) $\text{O} - \text{H} \cdots \text{F}$ (d) $\text{F} - \text{H} \cdots \text{F}$
47. What is the approximate most probable velocity of oxygen? If the kinetic energy of one mole of oxygen is 3741.3 J.
(a) $\sqrt{43851} \text{ J kg}^{-1}$ (b) $\sqrt{48321} \text{ J kg}^{-1}$
(c) $\sqrt{155887} \text{ J kg}^{-1}$ (d) $\sqrt{3950} \text{ J kg}^{-1}$
48. What is the correction term in the pressure for real gas in comparison to the ideal gas?
(a) $\frac{n^2}{V^2}$ (b) $\frac{aV^2}{n^2}$ (c) $\frac{an^2}{V^2}$ (d) $\frac{an^2}{V} - nb$
49. In a 1 L vessel, 10 moles of methane and 50 moles of O_2 are present. The number of moles of O_2 , water and CO_2 present in the vessel are respectively after the vessel was heated to burn methane completely.
(a) 30,20,20 (b) 30,20,10
(c) 20,30,10 (d) 20,10,30
50. Identify the oxidation states of Mn, when MnO_4^{2-} ion undergoes disproportionation reaction under acidic medium.
(a) +2, +7 (b) +2, +5
(c) +4, +4 (d) +7, +4
51. Find the heat required to make water of 30°C from 10 g of ice at 0.0°C . (Enthalpy of fusion of ice = 333.55 J g^{-1} , C_p of water = $4.18 \text{ J g}^{-1} \text{ K}^{-1}$)
(a) 4.0 kJ (b) 5.0 kJ
(c) 3.59 kJ (d) 4.59 kJ
52. For the reaction, $0.5\text{C(s)} + 0.5\text{CO}_2(\text{g}) \rightleftharpoons \text{CO(g)}$ the equilibrium pressure is 12 atm. If, CO_2 conversion is 50%, the value of K_p , in atm is
(a) 4 (b) 1 (c) 0.5 (d) 2
53. What is the solubility product (K_{sp}) of calcium phosphate in pure water? [S = molar solubility]
(a) $108S^5$ (b) $72S^3$
(c) $6S^5$ (d) $121S^2$
54. What is the approximate volume (in mL) of 10 vol H_2O_2 solution that will react completely with 1 L of 0.02M KMnO_4 solution in acidic medium?
(a) 56.05 (b) 113.5
(c) 90.8 (d) 75.75
55. Which of the following products are formed on hydrolysis of NaO_2 ?
(A) NaOH (B) H_2O_2
(C) O_2 (D) H_2O
(a) A, D (b) A, C, D
(c) A, B, D (d) A, B, C
56. The oxidation state (n) and coordination number (CN) of Al and number of valence electrons around Al(N) in Al_2Cl_6 are respectively
(a) 3, 3, 6 (b) 3, 4, 8
(c) 4, 4, 8 (d) 3, 4, 6
57. ΔH_f° values (in kJ mol^{-1}) for graphite, diamond and C_{60} are respectively
(a) 0; 1.9; 38.1 (b) 1.8; 1.9; 38.1
(c) 0; 0; 21.4 (d) 1.8; 1.9; 2.0
58. What is the formula of the product formed when F^- reacts with enamel on teeth?
(a) $\text{CaSO}_4, \text{CaF}_2$
(b) $3\text{Ca}_3(\text{PO}_4)_2, \text{PF}_5$
(c) $\text{Ca}_2\text{SO}_4 \cdot \text{CaF}_2$
(d) $3[\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2]$

59. Which one of the following methods can be used to find out the percentage composition of halogen present in an organic compound?

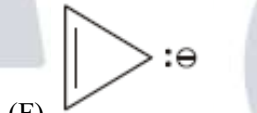
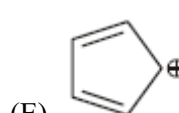
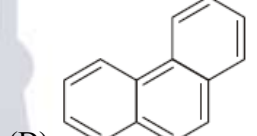
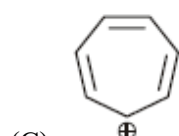
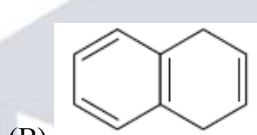
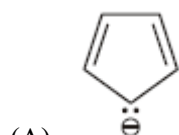
- (a) Kjeldahl method
- (b) Duma's method
- (c) Lassaigne's method
- (d) Carius method

60. Which of the following reaction produce alkane as the product?



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

61. Which of the following are not aromatic?



- (a) A, C, E
- (b) B, E, F
- (c) B, C, F
- (d) C, D, E

62. How many of the following compounds show ferrimagnetism?



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

63. The molality (in mol kg^{-1}) of 1 mole of solute in 50 g of solvent is

- (a) 10
- (b) 20
- (c) 30
- (d) 40

64. The freezing point of solution containing 10 mL of non-volatile and non-electrolyte liquid "A" in 500 g of water is -0.413°C . If K_f of water is $1.86 \text{ K kg mol}^{-1}$ and the molecular weight of A = 60 g mol^{-1} , what is the density of the solution in g mL^{-1} ? (Assume $\Delta_{\text{mix}} V = 0$)

- (a) 1.13
- (b) 1.3
- (c) 0.90
- (d) 0.993

65. A current of 19296 C is passed through an aqueous solution of copper sulphate using copper electrodes. What is the mass (in g) of copper deposited at the cathode? (Molar mass of Cu = 63.5 g mol^{-1})

- (a) 3.17
- (b) 1.58
- (c) 6.35
- (d) 0.79

66. For a zero-order reaction, the correct expression for rate constant (k) at half-life time ($t_{1/2}$) is (R_0 = initial concentration of reactant)

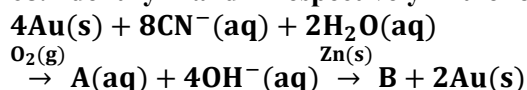
$$(a) k = \frac{2.303}{t_{1/2}} \log \frac{[R_0]}{\frac{[R_0]}{2}} \quad (b) k = \frac{2.303}{t} \log \frac{[R_0]}{[R_0]}$$

$$(c) k = \frac{[R_0] - \frac{1}{2}[R_0]}{t_{1/2}} \quad (d) k = \frac{2.303}{(t_2 - t_1)} \log [R_0]$$

67. Which one of the following is used as an eye lotion?

- (a) Milk of magnesia (b) Silver sol
(c) Colloidal antimony (d) Chromium salt sol

68. Identify A and B respectively in the following reactions :



- (a) $[\text{Au}(\text{CN})_2]^-$; $[\text{Zn}(\text{CN})_4]^{2-}$
(b) $\text{Au}(\text{CN})_4$; $[\text{Zn}(\text{CN})_4]^{2-}$
(c) HCN ; $[\text{Au}(\text{CN})_4]^{2-}$
(d) AuCN ; $[\text{HCN}]$

69. Statement (A) Sulphur vapour is paramagnetic.

Statement (B) Reaction of dil. HCl with finely divided iron forms FeCl_3 and H_2 gas.

The correct answer is

- (a) Statement (A) is correct, but (B) is wrong.
(b) Both the statements are correct.
(c) Statement (A) is wrong, but (B) is correct.
(d) Both the statements are wrong.

70. The reason for the noble gases to have low boiling and low melting point is

- (a) atoms of the noble gases have weak covalent interaction
(b) atoms of the noble gases have weak dipole interaction
(c) atoms of the noble gases have weak van der Waals' interaction
(d) atoms of the noble gases have weak dispersion forces

71. Match the following :

List I		List II	
(A)	Co^{2+}	(I)	Yellow
(B)	Fe^{2+}	(II)	Dark- green
(C)	Ni^{2+}	(III)	Blue
(D)	Cu^{2+}	(IV)	Pale- green
		(V)	Pink

The correct answer is

- | | | | | | | | | | |
|-----|---|----|----|-----|-----|---|----|-----|----|
| A | B | C | D | A | B | C | D | | |
| (a) | V | IV | II | III | (b) | I | II | III | IV |
| (c) | V | I | IV | II | (d) | I | V | IV | II |

72. Which one of following complex has the highest magnitude of crystal field splitting energy (Δ_o) ?

- (a) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ (b) $[\text{Co}(\text{NH}_3)_6]^{3+}$
(c) $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$ (d) $[\text{CoF}_6]^{3-}$

73. A polymer contains 50 molecules with molecular mass 5000, 100 molecules with molecular mass 10,000 and 50 molecules with molecular mass 15,000 . Calculate number average molecular mass?

- (a) 5,000 (b) 75,000
(c) 10,000 (d) 20,000

74. Which of the following are reducing sugars?

Sucrose, Maltose, Lactose, Fructose

- | | | | |
|-----|---------|-----|---------|
| (A) | (B) | (C) | (D) |
| (a) | A, B, C | (b) | A, B, D |
| (c) | A, C, D | (d) | B, C, D |

75. Identify opiates from the following

Codeine Thymine Epinephrine Morphine

(A) (B) (C) (D)

Thiamine Heroin

(E) (F)

(a) A, D, F (b) C, D, E

(c) B, E, F (d) A, B, C

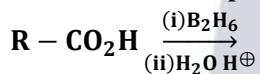
76. Match the following :

List I	List II (Major Product)
(A) $\text{CH}_3 - \text{CHBr} - \text{CH}_2\text{Br}$ $\xrightarrow{\text{KOH/C}_2\text{H}_5\text{OH}}$	(I) 1°-alkyl bromide
(B) $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2$ $\xrightarrow[\text{(C}_6\text{H}_5\text{CO)}_2\text{O}_2\Delta]{\text{HBr}}$	(II) 2-alkyl bromide
(C) $\text{CH}_3\text{CH}_2\text{CH}_3 \xrightarrow{\text{Br}_2, \text{h}\nu}$	(III) Allyl bromide
(D) $\text{CH}_3 - \text{CH} = \text{CH}_2 \xrightarrow[\Delta]{\text{NBS}}$	(IV) Alkenyl bromide

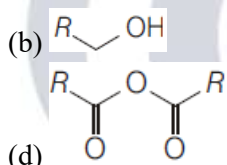
The correct answer is

- | | | | | |
|-----|----------|----------|----------|----------|
| | A | B | C | D |
| (a) | I | IV | II | III |
| (b) | IV | III | I | II |
| (c) | II | III | I | IV |
| (d) | IV | I | II | III |

77. Find the suitable product for the following reaction.



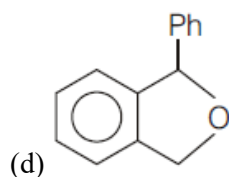
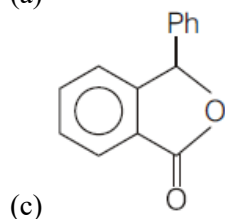
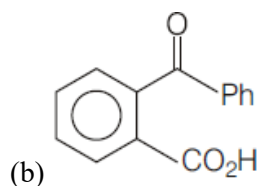
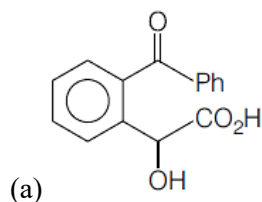
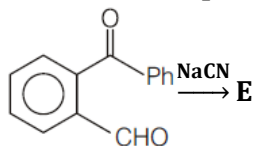
(a) $\text{R} \rightarrow \text{CHO}$



(c) $\text{R} - \text{CO}_2\text{R}$

(d)

78. What is the product E in the following reaction?

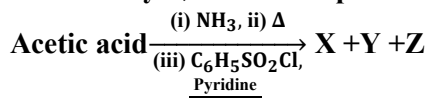


79. The decreasing order of acidic strength for following acids is

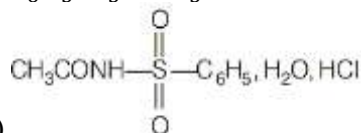
- (A) CH_3COOH (B) $\text{CH}_3\text{CHClCH}_2\text{COOH}$
(C) ClCH_2COOH (D) Cl_2CHCOOH

- (a) $B > C > A > D$ (b) $D > C > B > A$
(c) $D > B > C > A$ (d) $C > D > B > A$

80. Identify X, Y and Z respectively in the following reaction sequence :



- (a) $\text{C}_6\text{H}_5\text{SO}_3\text{H}$, CH_3NC , HCl



- (b)
(c) $\text{C}_6\text{H}_5\text{SO}_3\text{H}$, CH_3CN , HCl
(d) $\text{C}_6\text{H}_5\text{SO}_2\text{Cl}$, CH_3NC , H_2O

Mathematics

81. Match the functions of List-I with their nature in List-II and choose the correct option.

LIST - I	LIST - II
(A) $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = \cos(112x - 37)$	(I) Injection but not surjection
(B) $f: A \rightarrow B$ defined by $f(x) = x x $ when $A = [-2, 2]$ and $B = [-4, 4]$	(II) Surjection but not injection
(C) $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = (x - 2)(x - 3)(x - 5)$	(III) Bijection
(D) $f: \mathbb{N} \rightarrow \mathbb{N}$ defined by $f(n) = n + 1$	(IV) Neither injection nor surjection
	(V) Composite function

Then, the correct match is

- A B C D A B C D
(a) I II III IV (b) IV I II III
(c) IV III II V (d) IV III II I

82. If $[x]$ denotes the greatest integer function, then the domain of the function

$$f(x) = \sqrt{\frac{x - [x]}{\log(x^2 - x)}}, \text{ is}$$

- (a) $(1, \infty)$ (b) $(1, \infty) - \mathbb{Z}$
(c) $\mathbb{R} - \left[\frac{1-\sqrt{5}}{2}, \frac{1+\sqrt{5}}{2}\right]$ (d) $\left[\frac{1-\sqrt{5}}{2}, \frac{\sqrt{5}+1}{2}\right]$

83. Assertion (A) If $|x| < 1$, then

$$\sum_{n=0}^{\infty} (-1)^n x^{n+1} = \frac{x}{x+1}$$

Reason (R) If $|x| < 1$, then $(1+x)^{-1}$
 $= 1 - x + x^2 - x^3 + \dots$

Which one of the following is true?

- (a) (A) and (R) are true, (R) is a correct explanation of (A)
(b) (A) and (R) are true but (R) is not a correct explanation of (A)
(c) (A) is true, but (R) is false
(d) (A) is false, but (R) is true

84. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 3 & 5 \\ 2 & 1 & 6 \end{bmatrix}$, then $(\text{Adj}(\text{Adj}A))^{-1} =$

- (a) $\frac{1}{6} \begin{bmatrix} 8 & -6 & 3 \\ 5 & 1 & -2 \\ -5 & 3 & 1 \end{bmatrix}$ (b) $\frac{1}{6} \begin{bmatrix} 13 & -9 & 1 \\ 4 & 0 & -2 \\ -5 & 3 & 1 \end{bmatrix}$
 (c) $\frac{1}{36} \begin{bmatrix} 13 & -9 & 1 \\ 4 & 0 & -2 \\ -5 & 3 & 1 \end{bmatrix}$ (d) $\frac{1}{12} \begin{bmatrix} 4 & -3 & 2 \\ 3 & 4 & 2 \\ -5 & 2 & 1 \end{bmatrix}$

85. If $\begin{vmatrix} x^2 + 3x & x + 1 & x - 3 \\ x - 1 & 2 - x & x + 4 \\ x - 3 & x - 3 & 3x \end{vmatrix} = a_0 + a_1x + a_2x^2 + a_3x^3 + a_4x^4$, then

$(a_1 + a_3) + 2(a_0 + a_2 + a_4) =$
 (a) -1 (b) 0 (c) 1 (d) -29

86. Let $AX = D$ be a system of three linear non-homogeneous equations. If $|A| = 0$ and $\text{rank}(A) = \text{rank}([AD]) = \alpha$, then

- (a) $AX = D$ will have infinite number of solutions when $\alpha = 3$
 (b) $AX = D$ will have unique solution when $\alpha < 3$
 (c) $AX = D$ will have infinite number of solutions when $\alpha < 3$
 (d) $AX = D$ will have no solution when $\alpha < 3$

87. If $x + iy = (1 + i)^6 - (1 - i)^6$, then which one of the following is true?

- (a) $x + y = 16$ (b) $x + y = -16$
 (c) $x + y = -8$ (d) $x + y = 8$

88. $i^2 + i^3 + \dots + i^{4000} =$

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

89. If 1, ω and ω^2 are the cube roots of unity, then $(a + b + c)(a + b\omega + c\omega^2)(a + b\omega^2 + c\omega) =$

- (a) $a^3 + b^3 + c^3$
 (b) $a^3 + b^3 + c^3 - 3abc$
 (c) $(a + b + c)^3 - 3abc$
 (d) $a^3 + b^3 + c^3 + 3abc$

90. If $a_k = \cos \alpha_k + i \sin \alpha_k$, $k = 1, 2, 3$ and a_1, a_2, a_3 are the roots of the equation $x^3 + bx + c = 0$, then the real part of $b =$

- (a) -1 (b) 1 (c) 0 (d) None of these

91. The set of all values of 'a' for which the expression $\frac{ax^2 - 2x + 3}{2x - 3x^2 + a}$ assumes all real values for real values of x, is

- (a) [2,3] (b) $R - (2,3)$
 (c) ϕ (d) [1,5]

92. If both the roots of the equation $x^2 - 4ax + 1 - 3a + 4a^2 = 0$ exceed 1, then a lies in the interval

- (a) $(-\infty, \frac{7-\sqrt{17}}{8})$ (b) $(\frac{7+\sqrt{17}}{8}, \infty)$
 (c) $(\frac{7-\sqrt{17}}{8}, \frac{1}{2})$ (d) $(\frac{1}{2}, \frac{7+\sqrt{17}}{8})$

93. If the cubic equation $x^3 - ax^2 + ax - 1 = 0$ is identical with the cubic equation whose roots are the squares of the roots of the given cubic equation, then the non-zero real value of 'a' is

- (a) $\frac{1}{2}$ (b) 2 (c) 3 (d) $\frac{7}{2}$

94. If α, β, γ are the roots of the equation $x^3 + px^2 + qx + r = 0$, then

$(\alpha + \beta)(\beta + \gamma)(\gamma + \alpha) =$
 (a) $p - qr$ (b) $r - pq$
 (c) $q - rp$ (d) $r + pq$

95. Let x denote the number of ways of arranging m boys and m girls in a row so that no two boys sit together. If y and z give the number of ways of arranging m boys and m girls in a row and around a circular table respectively so that boys and girls sit alternately, then x : y : z =

- (a) $m + 1 : m : m - 1$ (b) 3 : 2 : 1
 (c) $m - 1 : m : 2$ (d) $(m + 1)m : 2m : 1$

96. The number of even numbers greater than 1000000 that can be formed using all the digits 1, 2, 0, 2, 4, 2 and 4 is
 (a) 120 (b) 240
 (c) 310 (d) 480
97. The greatest integer less than or equal to $(\sqrt{3} + 2)^5$ is
 (a) 721 (b) 722
 (c) 723 (d) 724
98. The sixth term in the expansion of $\left(3 - \sqrt{\frac{17}{4} + 3\sqrt{2}}\right)^{10}$ is a
 (a) positive rational number
 (b) negative rational number
 (c) positive irrational number
 (d) negative irrational number
99. Let $\frac{1}{(x^2-3)^2} = \frac{A_1}{x-\sqrt{3}} + \frac{A_2}{(x-\sqrt{3})^2} + \frac{A_3}{x+\sqrt{3}} + \frac{A_4}{(x+\sqrt{3})^2}$. Then, consider the following statements
 (i) All the A_i 's are not distinct
 (ii) There exists a pair, A_p and A_q such that $A_p^2 = A_q^2$ ($p \neq q$)
 (iii) $\sum_{i=1}^4 A_i = \frac{1}{6}$
 (iv) $\sum_{i=1}^4 A_i = 1$
 Which one of the following is true?
 (a) Only statement (iii) is false
 (b) Both the statements (ii) and (iv) are false
 (c) Only statement (iv) is false
 (d) Both the statements (i) and (iii) are false
100. The period of $\cos(x + 8x + 27x + \dots + n^3x)$ is
 (a) $\frac{2\pi}{n}$ (b) $\frac{2\pi}{n^2(n+1)^2}$
 (c) $\frac{8\pi}{n^2(n+1)^2}$ (d) $\frac{8\pi}{n^3(n+1)^2}$
101. $\sin^2(3^\circ) + \sin^2(6^\circ) + \sin^2(9^\circ) + \dots + \sin^2(84^\circ) + \sin^2(87^\circ) + \sin^2(90^\circ) =$
 (a) $\frac{31}{2}$ (b) $\frac{39}{2}$ (c) $\frac{59}{2}$ (d) 36
102. $\cos \frac{\pi}{7} - \cos \frac{2\pi}{7} + \cos \frac{3\pi}{7} - \cos \frac{4\pi}{7} + \cos \frac{5\pi}{7} - \cos \frac{6\pi}{7} =$
 (a) 0 (b) $\frac{3}{2}$ (c) $\frac{3}{4}$ (d) 1
103. The number of integral values of k for which the equation $7\cos x + 5\sin x = 2k + 1$ has a solution, is
 (a) 4 (b) 6 (c) 8 (d) 10
104. $\sec\left(\tan^{-1}\frac{y}{2}\right) =$
 (a) $\sqrt{\frac{4+y^2}{2}}$ (b) $\sqrt{\frac{4-y^2}{2}}$
 (c) $\frac{\sqrt{4+y^2}}{2}$ (d) $\frac{\sqrt{4-y^2}}{2}$
105. The number of roots of the equation $\sqrt{2} + e^{\cosh^{-1}x} - e^{\sinh^{-1}x} = 0$, is
 (a) 0 (b) 1 (c) 2 (d) 3
106. A wire of length 44 cm is bent into an arc of a circle of radius 12 cm. The angle (in degrees) subtended by the arc at the centre of the circle is
 (a) $\left(\frac{11}{3}\right)^\circ$ (b) $\left(\frac{660}{\pi}\right)^\circ$
 (c) 150° (d) $\left(\frac{5}{3}\right)^\circ$
107. In any triangle ABC, if $a : b : c = 2 : 3 : 4$, then $R : r =$
 (a) 8 : 3 (b) 16 : 9
 (c) 5 : 16 (d) 16 : 5

108. Corresponding to a triangle ABC, match the items given in List-I with the items given in List II.

List I	List II
(A) $r_1 r_2 = r_1 r_3$	(I) $\angle A = 90^\circ$
(B) $r_1 + r_2 = r_3 - r$	(II) $b^2 = c^2 + a^2$
(C) $r_1 = r + 2R$	(III) $\angle C = 90^\circ$
	(IV) $\angle B = 120^\circ$

The correct match is

- | | |
|--------------|--------------|
| A B C | A B C |
| (a) II III I | (b) II I III |
| (c) I IV III | (d) III I IV |

109. Let the position vectors of two points A and B be $a + b + c$ and $a - 2b + 3c$, respectively. If the points P and Q divide AB in the ratio 1:3 internally and externally respectively, then $3|AB| =$

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

110. If a, b and c are three non-collinear points and $ka + 2b + 3c$ is a point in the plane of a, b, c, then $k =$

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

111. If the vector $a = 3\hat{j} + 4\hat{k}$ is the sum of two vectors a_1 and a_2 , vector a_1 is parallel to $b = \hat{i} + \hat{j}$ and vector a_2 is perpendicular to b, then $a_1 =$

- (a) $\frac{1}{2}(\hat{i} + \hat{j})$ (b) $\frac{1}{3}(\hat{i} + \hat{j})$
(c) $\frac{2}{3}(\hat{i} + \hat{j})$ (d) $\frac{3}{2}(\hat{i} + \hat{j})$

112. The angle between the line of intersection of the two planes $r \cdot (2\hat{i} + 2\hat{j} - 3\hat{k}) = 5$, $r \cdot (3\hat{i} + 3\hat{j} - 5\hat{k}) = 3$ and the line $r = 3\hat{i} + 2\hat{j} + \hat{k} + t(5\hat{i} + 5\hat{j} - 7\hat{k})$ is

- (a) $\cos^{-1}\left(\frac{-1}{\sqrt{28}}\right)$ (b) $\cos^{-1}\left(\frac{41}{\sqrt{17}\sqrt{99}}\right)$
(c) $\frac{\pi}{2}$ (d) $\frac{\pi}{3}$

113. Let $x = \hat{i} + \hat{j}$ and $y = 3\hat{i} - 2\hat{k}$. Then, the vector r of magnitude $\sqrt{21}$ satisfying $r \times x = y \times x$ and $r \times y = x \times y$, is

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

114. The acute angle between $r = (-\hat{i} + 3\hat{k}) + \lambda(2\hat{i} + 3\hat{j} + 6\hat{k})$ and $r \cdot (10\hat{i} + 2\hat{j} - 11\hat{k}) = 3$, is

- (a) $\sin^{-1}\left(\frac{8}{21}\right)$ (b) $\cos^{-1}\left(\frac{8}{21}\right)$
(c) $\sin^{-1}\left(\frac{5}{21}\right)$ (d) $\cos^{-1}\left(\frac{5}{21}\right)$

115. In a data with 15 number of observations $x_1, x_2, x_3, \dots, x_{15}$, $\sum_{i=1}^{15} x_i^2 = 3600$ and $\sum_{i=1}^{15} x_i = 175$. If the value of one observation 20 was found wrong and was replaced by its correct value 40, then the corrected variance of that data is

- (a) 151 (b) 149
(c) 145 (d) 144

116. If the coefficient of variation and variance of a frequency distribution are 7.2 and 3.24 respectively, then its mean is

- (a) 45 (b) 25 (c) 20 (d) 16

117. If five dice are thrown simultaneously, then the probability that atleast three of them show the same numbered face is
 (a) $\frac{16}{6^4}$ (b) $\frac{452}{6^5}$ (c) $\frac{226}{6^4}$ (d) $\frac{276}{6^4}$
118. If two unbiased dice are rolled simultaneously until a sum of the number appeared on these dice is either 7 or 11, then the probability that 7 comes before 11, is
 (a) $\frac{3}{8}$ (b) $\frac{3}{4}$ (c) $\frac{5}{6}$ (d) $\frac{2}{9}$
119. A box contains 10 mangoes out of which 4 are spoiled. 2 mangoes are taken together at random. If one of them is found to be good, then the probability that the other is also good, is
 (a) $\frac{1}{3}$ (b) $\frac{2}{3}$ (c) $\frac{8}{15}$ (d) $\frac{5}{13}$
120. Two dice are rolled. If a random variable X is defined as the absolute difference of the two numbers that appear on them, then the mean of X is
 (a) 0 (b) $\frac{13}{18}$ (c) $\frac{19}{9}$ (d) $\frac{35}{18}$
121. If getting a head on a coin when it is tossed is considered as success, then the probability of having more number of failures when ten fair coins are tossed simultaneously, is
 (a) $\frac{105}{2^8}$ (b) $\frac{73}{2^7}$ (c) $\frac{193}{2^9}$ (d) $\frac{638}{2^{10}}$
122. The set of all points that forms a triangle of area 15 sq units with the points (1, -2) and (-5, 3) lies on
 (a) $5x + 6y + 23 = 0$
 (b) $(5x + 6y - 23)(5x + 6y + 37) = 0$
 (c) $25x^2 + 36y^2 + 24x - 30y - 227 = 0$
 (d) $5x + 6y - 37 = 0$
123. Suppose the new axes X, Y are generated by rotating the coordinate axes x, y about the origin through an angle of 30° in the anti-clockwise direction. Then, the transformed equation of $x^2 + 2\sqrt{3}xy - y^2 = 2a^2$ with respect to new axes X, Y is
 (a) $X^2 - Y^2 = a^2$
 (b) $X^2 + Y^2 = 2a^2$
 (c) $X^2 + 2\sqrt{3}XY - Y^2 = 2a^2$
 (d) $X^2 - Y^2 = 2a^2$
124. A line L makes intercepts a and b on the coordinate axes. The axes are rotated through an angle θ in the positive direction, keeping the origin fixed. If the line L makes intercepts p and q on the new coordinate axes, then $\frac{1}{a^2} + \frac{1}{b^2} =$
 (a) $\frac{1}{p^2q^2}$ (b) $\frac{1}{p^2} - \frac{1}{q^2}$
 (c) $\frac{1}{p^2} + \frac{1}{q^2}$ (d) $\frac{pq}{p^2+q^2}$
125. If m_1, m_2 ($m_1 > m_2$) are the slopes of the lines which make an angle of 30° with the line joining the points (1, 2) and (3, 4), then $\frac{m_1}{m_2} =$
 (a) $2 + \sqrt{3}$ (b) $2 - \sqrt{3}$
 (c) $7 + 4\sqrt{3}$ (d) $7 - 4\sqrt{3}$
126. If A(-2, 1), B(0, -2), C(1, 2) are the vertices of a triangle ABC, then the perpendicular distance from its circumcentre to the side BC is
 (a) $\frac{7\sqrt{13}}{22}$ (b) $\frac{3\sqrt{17}}{22}$
 (c) $\frac{5\sqrt{10}}{11}$ (d) $\frac{\sqrt{2026}}{22}$
127. If one of the lines $ax^2 + 2hxy + by^2 = 0$ bisects the angle between the positive coordinate axes, then
 (a) $a + b = 2h$ (b) $a - b = 2|h|$
 (c) $(a + b)^2 = 4h^2$ (d) $(a - b)^2 = 4h^2$
128. The equation of the pair of perpendicular lines passing through origin and forming an isosceles triangle with the line $2x + 3y = 6$, is
 (a) $5x^2 - 24xy - 5y^2 = 0$
 (b) $4x^2 - 12xy - 4y^2 = 0$
 (c) $6x^2 - 5xy - 6y^2 = 0$
 (d) $9x^2 + 5xy - 9y^2 = 0$

129. If one of the diameter of the circle $x^2 + y^2 - 2x - 6y + 6 = 0$ is a chord to the circle with centre $(2, 1)$, then the radius of the bigger circle is
 (a) 6 (b) 4 (c) 2 (d) 3
130. The line $3x - y + k = 0$ touches the circle $x^2 + y^2 + 4x - 6y + 3 = 0$. If $k_1, k_2 (k_1 < k_2)$ are the two values of k , then the equation of the chord of contact of the point (k_1, k_2) with respect to the given circle is
 (a) $19x + y - 18 = 0$ (b) $x + 19y - 3 = 0$
 (c) $x + 16y - 56 = 0$ (d) $20x + 18y - 7 = 0$
131. If the line $ax + by = 1$ is a tangent to the circle $S_r \equiv x^2 + y^2 - r^2 = 0$, then which one of the following is true?
 (a) (a, b) lies on the circle $S_1 = 0$
 (b) (a, b) lies inside the circle $S_{1/2} = 0$
 (c) (a, b) lies outside the circle $S_2 = 0$
 (d) (a, b) lies on the circle $S_3 = 0$
132. Each of the two orthogonal circles C_1 and C_2 passes through both the points $(2, 0)$ and $(-2, 0)$. If $y = mx + c$ is a common tangent to these circles, then
 (a) $c^2 = 4(1 + 2m^2)$
 (b) $c^2 = 2(1 + 2m^2)$
 (c) $c^2 = 1 + m^2$
 (d) $c^2 m^2 = 4(1 + m^2)$
133. The equation of the circle whose diameter is the common chord of the circles $x^2 + y^2 - 3x + y - 10 = 0$ and $x^2 + y^2 - x + 2y - 20 = 0$, is
 (a) $x^2 + y^2 - 3x + 6y + 15 = 0$
 (b) $x^2 + y^2 - 6x + 4y + 10 = 0$
 (c) $x^2 + y^2 - 9x + 2y + 20 = 0$
 (d) $x^2 + y^2 - 9x - 2y + 20 = 0$
134. Study the following statements.
 (I) The vertex of the parabola $x = ly^2 + my + n$ is $\left(n - \frac{m^2}{4l}, -\frac{m}{2l}\right)$
 (II) The focus of the parabola $y = lx^2 + mx + n$ is $\left(n + \frac{1 - m^2}{4l}, -\frac{m}{2l}\right)$
 (III) The pole of the line $lx + my + n = 0$ with respect to the parabola $x^2 = 4ay$ is $\left(-\frac{2al}{m}, \frac{n}{m}\right)$
 Then, the correct option among the following is
 (a) All the three statements are true
 (b) Statements I & II are true but III is false
 (c) Statements I & III are true but II is false
 (d) Statements II & III are true but I is false
135. Let P represent the point $(3, 6)$ on the parabola $y^2 = 12x$. For the parabola $y^2 = 12x$, if l_1 is the length of the normal chord drawn at P and l_2 is the length of the focal chord drawn through P, then $\frac{l_1}{l_2} =$
 (a) $2\sqrt{2}$ (b) 3
 (c) $4\sqrt{2}$ (d) 5
136. A tangent is drawn at $(3\sqrt{3}\cos\theta, \sin\theta)$ $(0 < \theta < \frac{\pi}{2})$ to the ellipse $\frac{x^2}{27} + \frac{y^2}{1} = 1$. The value of θ for which the sum of the intercepts on the coordinate axes made by this tangent attains the minimum, is
 (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{2\pi}{3}$ (d) $\frac{2\pi}{4}$
137. A line perpendicular to the X-axis cuts the circle $x^2 + y^2 = 9$ at A and the ellipse $4x^2 + 9y^2 = 36$ at B such that A and B lie in the same quadrant. If θ is the greatest acute angle between the tangents drawn to

the curves at A and B, then $\tan \theta =$

- (a) $\frac{1}{12}$ (b) $\frac{1}{2\sqrt{6}}$ (c) $\frac{5}{24}$ (d) $\frac{5}{4\sqrt{6}}$

138. If e_1 is the eccentricity of the ellipse $\frac{x^2}{16} + \frac{y^2}{25} = 1$ and e_2 is the eccentricity of a hyperbola passing through the foci of the given ellipse and $e_1 e_2 = 1$, then the equation of such a hyperbola among the following is

- (a) $\frac{x^2}{9} - \frac{y^2}{16} = 1$ (b) $\frac{y^2}{9} - \frac{x^2}{16} = 1$
(c) $\frac{x^2}{9} - \frac{y^2}{25} = 1$ (d) $\frac{x^2}{25} - \frac{y^2}{9} = 1$

139. If $(1, 0, 3)$, $(2, 1, 5)$, $(-2, 3, 6)$ are the mid-points of the sides of a triangle, then the centroid of the triangle is

- (a) $(\frac{1}{3}, \frac{4}{3}, -\frac{14}{3})$ (b) $(\frac{1}{3}, \frac{4}{3}, \frac{14}{3})$
(c) $(\frac{1}{3}, -\frac{4}{3}, \frac{14}{3})$ (d) $(-\frac{1}{3}, \frac{4}{3}, \frac{14}{3})$

140. If a plane P passes through the points $(1, 0, 0)$, $(0, 1, 0)$ and makes an angle $\frac{\pi}{4}$ with the plane $x + y = 3$, then the direction ratios of a normal to that plane P is

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

141. A variable plane is at a distance of 6 units from the origin. If it meets the coordinate axes in A, B and C, then the equation of the locus of the centroid of the $\triangle ABC$ is

- (a) $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = \frac{1}{4}$ (b) $x^2 + y^2 + z^2 = 4$
(c) $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = 1$ (d) $\frac{1}{x^2} + \frac{1}{y^2} - \frac{1}{z^2} = \frac{1}{4}$

142. $\lim_{x \rightarrow \infty} \left(\frac{2x^2 + 3x + 4}{x^2 - 3x + 5} \right)^{\frac{3|x|+1}{2|x|-1}} =$

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

143. If 'a' is the point of discontinuity of the function

$$f(x) = \begin{cases} \cos 2x, & \text{for } -\infty < x < 0 \\ e^{3x}, & \text{for } 0 \leq x < 3 \\ x^2 - 4x + 3, & \text{for } 3 \leq x \leq 6 \\ \frac{\log(15x - 89)}{x - 6}, & \text{for } x > 6 \end{cases}$$

Then, $\lim_{x \rightarrow a} \frac{x^2 - 9}{x^3 - 5x^2 + 9x - 9} =$

- (a) 1 (b) 0 (c) 6 (d) 3

144. If $y = (x + 1)(x^2 + 1)(x^4 + 1)(x^8 + 1)$, then $\lim_{x \rightarrow -1} \frac{dy}{dx} =$

- (a) 0 (b) 2 (c) -4 (d) 8

145. $f(x)$ is a twice differentiable function such that $f''(x) = -f(x)$ and $f'(x) = g(x)$. If $h(x) = (f(x))^2 + (g(x))^2$ and $h(1) = 2$, then $h(2) =$

- (a) 0 (b) 1 (c) 2 (d) 4

146. If $y = \sqrt{x + \sqrt{y + \sqrt{x + \sqrt{y + \cdots \infty}}}}$, then $\frac{dy}{dx} =$

- (a) $\frac{y^3 - x}{2y^2 - 2xy + 1}$ (b) $\frac{x + y^3}{2y^2 - x}$
(c) $\frac{y + x}{y^2 - 2x}$ (d) $\frac{y^2 - x}{2y^3 - 2xy - 1}$

147. The tangent of the angle between the curves $xy = 1$ and $x^2 + 8y = 0$, is

- (a) $\frac{1}{7}$ (b) $\frac{2}{7}$ (c) $\frac{6}{7}$ (d) $\frac{3}{7}$

148. The slope of the tangent at (1, 2) to the curve $x = t^2 - 7t + 7$ and $y = t^2 - 4t - 10$, is

- (a) $\frac{8}{5}$ (b) $\frac{5}{8}$ (c) $-\frac{8}{5}$ (d) $-\frac{5}{8}$

149. Consider the function $f(x) = 2x^3 - 3x^2 - x + 1$ and the intervals $I_1 = [-1, 0]$, $I_2 = [0, 1]$, $I_3 = [1, 2]$, $I_4 = [-2, -1]$. Then,

- (a) $f(x) = 0$ has a root in the intervals I_1 and I_4 only
 (b) $f(x) = 0$ has a root in the intervals I_1 and I_2 only
 (c) $f(x) = 0$ has a root in every interval except in I_4
 (d) $f(x) = 0$ has a root in all the four given intervals

150. If $f(x) = \int_x^{x+1} e^{-t^2} dt$, then the interval in which $f(x)$ is decreasing is

- (a) $(-\frac{1}{2}, \infty)$ (b) $(-\infty, 2)$
 (c) $(-\infty, 0)$ (d) $(-2, 2)$

151. If $\int \frac{\cos x + x}{1 + \sin x} dx = f(x) + \int \frac{3\cos \frac{x}{2} - \sin \frac{x}{2}}{\cos \frac{x}{2} + \sin \frac{x}{2}} dx + c$, then $f(x) =$

- (a) $\frac{-2x}{1 + \tan \frac{x}{2}}$ (b) $\frac{-x \cos \frac{x}{2}}{\cos \frac{x}{2} + \sin \frac{x}{2}}$
 (c) $\frac{2x}{1 + \tan \frac{x}{2}}$ (d) $\frac{x \cos \frac{x}{2}}{\cos \frac{x}{2} + \sin \frac{x}{2}}$

152. $\int \frac{\sqrt{\cos 2x}}{\sin x} dx =$

- (a) $\frac{1}{2\sqrt{2}} \log \left| \frac{\sqrt{2} + \sqrt{1 - \tan^2 x}}{\sqrt{2} - \sqrt{1 - \tan^2 x}} \right| - \frac{1}{2} \log \left| \frac{1 - \sqrt{1 - \tan^2 x}}{1 + \sqrt{1 - \tan^2 x}} \right| + c$
 (b) $\frac{1}{\sqrt{2}} \log \left| \frac{\sqrt{2} + \sqrt{1 - \tan^2 x}}{\sqrt{2} - \sqrt{1 - \tan^2 x}} \right| - \frac{1}{2} \log \left| \frac{1 + \sqrt{1 - \tan^2 x}}{1 - \sqrt{1 - \tan^2 x}} \right| + c$
 (c) $\frac{1}{4\sqrt{2}} \log \left| \frac{\sqrt{2} - \sqrt{1 - \tan^2 x}}{\sqrt{2} + \sqrt{1 - \tan^2 x}} \right| + \frac{1}{2} \log \left| \frac{1 - \sqrt{1 - \tan^2 x}}{1 + \sqrt{1 - \tan^2 x}} \right| + c$
 (d) $\frac{1}{4\sqrt{2}} \log \left| \frac{2 - \sqrt{1 - \tan^2 x}}{2 + \sqrt{1 - \tan^2 x}} \right| + \frac{1}{2\sqrt{2}} \log \left| \frac{1 - \sqrt{1 - \tan^2 x}}{1 + \sqrt{1 - \tan^2 x}} \right| + c$

153. If $\int \frac{(2x+3)}{x(x+1)(x+2)(x+3)+1} dx = -\frac{1}{px^2 + qx + r} + c$, then $\frac{3p - q}{r} =$

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

154. $\int (\log x)^2 dx =$

- (a) $x \log x - 2x \log x + c$
 (b) $x \log x + 2x \log x + c$
 (c) $x(\log x)^2 - 2x(\log x - 1) + c$
 (d) $x(\log x)^2 + 2x(\log x - 1) + c$

155. $\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{k}{n^2 + k^2} =$

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

156. $\int_0^{10} (5 - \sqrt{10x - x^2}) dx =$

- (a) $50 - 25\pi$ (b) $(100 - 25\pi)$
 (c) $\frac{1}{2}(100 - 25\pi)$ (d) $\frac{1}{4}(100 - 25\pi)$

157. Area of the region (in sq units) bounded by the curves $y = \sqrt{x}$, $x = \sqrt{y}$ and the lines $x = 1$, $x = 4$, is

- (a) $\frac{8}{3}$ (b) $\frac{49}{3}$ (c) $\frac{16}{3}$ (d) $\frac{14}{3}$

158. The differential equation representing the family of circles of constant radius r is

- (a) $r^2 y'' = [1 + (y')^2]^2$
 (b) $r^2 (y'')^2 = [1 + (y')^2]^2$
 (c) $r^2 (y'')^2 = [1 + (y')^2]^3$
 (d) $(y'')^2 = r^2 [1 + (y')^2]^2$

159. The solution of the differential equation $(2x - 3y + 5)dx + (9y - 6x - 7)dy = 0$, is

- (a) $3x - 3y + 8\log |6x - 9y - 1| = c$
 (b) $3x - 9y + 8\log |6x - 9y - 1| = c$
 (c) $3x - 9y + 8\log |2x - 3y - 1| = c$
 (d) $3x - 9y + 4\log |2x - 3y - 1| = c$

160. The solution of the differential equation $\sqrt{1 - y^2}dx + xdy - \sin^{-1}y dy = 0$, is

- (a) $x = \sin^{-1}y - 1 + ce^{-\sin^{-1}y}$
 (b) $y = x\sqrt{1 - y^2} + \sin^{-1}y + c$
 (c) $x = 1 + \sin^{-1}y + ce^{\sin^{-1}y}$
 (d) $y = \sin^{-1}y - 1 + x\sqrt{1 - y^2} + c$

