Physics

1. **Microwaves are used in**
   (a) TV
   (b) radio transmission
   (c) Radar
   (d) atmospheric research

2. **The lower half of a vessel of depth 2d cm is filled with a liquid of refractive index μ_1 and the upper half with a liquid of refractive index μ_2. The apparent depth of the vessel seen perpendicularly is**
   (a) $d\left(\frac{\mu_1\mu_2}{\mu_1+\mu_2}\right)$ (b) $d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$
   (c) $2d\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$ (d) $2d\left(\frac{1}{\mu_1\mu_2}\right)$

3. **The energy stored in a coil of inductance L carrying a steady current i is in the form**
   (a) magnetic
   (b) electrical
   (c) both magnetic and electrical
   (d) heat

4. **A resistor of resistance R is connected between the terminals of a cell of emf E and internal resistance r. If I is the current through the circuit. The terminal potential difference of the cell is given by**
   (a) IR (b) $E - Ir$
   (c) $\frac{ER}{R+r}$ (d) $\frac{E-R}{r}$

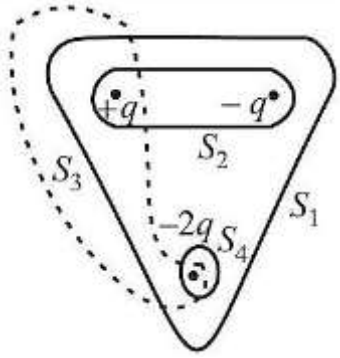
5. **When a body slides down on inclined plane with coefficient of friction μ, then its acceleration will be**
   (a) $g(\sin\theta - \mu\cos\theta)$ (b) $g(\sin\theta + \mu\sec\theta)$
   (c) $g(\mu\sin\theta - \cos\theta)$ (d) $g\mu(\sin\theta - \cos\theta)$

6. **The limit of resolution of an oil immersion objective microscope of numerical aperture 0.8 for light of wavelength 0.6μ m is**
   (a) $\frac{1.5}{8}\mu$ m (b) $\frac{3}{8}\mu$ m
   (c) $\frac{5}{8}\mu$ m (d) $\frac{7}{8}\mu$ m

7. **Four -point masses, each of mass M are placed at the corners of a square of side L. The moment of inertia of the system about one of its diagonals is**
   (a) $2ML^2$ (b) ML^2
   (c) $4ML^2$ (d) $6ML^2$

8. **A flywheel starts from rest and rotates at a constant acceleration of $2 rads^{-2}$. The number of revolutions that it makes in first 10 s is**
   (a) 16 (b) 24
   (c) 32 (d) 8

9. **Four closed surfaces S_1, S_2, S_3 and S_4 together with charges $+q, -q$ and $-2q$ are shown. Through which one of the surfaces the net flux is zero?**



(a) S_1 (b) S_2
(c) S_3 (d) S_4

10. **On producing the waves of frequency 1000 Hz in a Kundt's tube, the total distance between 6 successive nodes is 85 cm. Then, the speed of sound in the gas filled in the tube is**
    (a) $330\ ms^{-1}$ (b) $340\ ms^{-1}$
    (c) $350\ ms^{-1}$ (d) $300\ ms^{-1}$

11. 5 kg of water at 20°C is added to 10 kg of water at 60°C. Neglecting heat capacity of vessel and other losses, then resultant temperature will be nearly
(a) 35°C (b) 40°C
(c) 47°C (d) 28°C

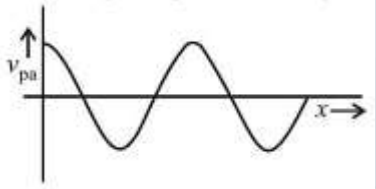
12. If ultraviolet radiation of 6.2 eV falls of an aluminium surface, then kinetic energy of the fastest emitted electron is (work-function $= 4.2$eV)
(a) 3.2×10^{-19} J (b) 3.2×10^{-21} J
(c) 7×10^{-25} J (d) 9×10^{-31} J

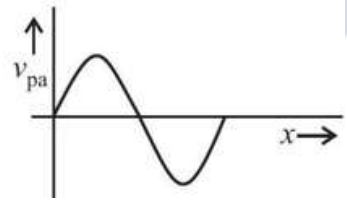
13. In the nuclear reaction, ${}^{11}_{6}\mathrm{C} \rightarrow {}^{11}_{5}\mathrm{B} + \beta + \mathrm{X}$, X stands for
(a) a neutron (b) an electron
(c) a neutrino (d) an anti-neutrino

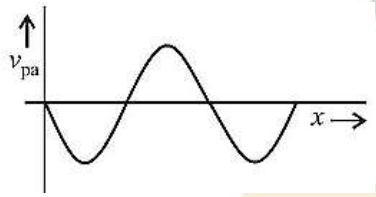
14. 1 kg of steam at 150°C is passed from a steam chamber is to a copper coil immersed in 20 L of water. The steam condenses in the coil and is returned to the steam chamber as water at 90°C. Latent heat of steam is 540 cal g^{-1} specific heat of the steam is cal $g^{-1o}c^{-1}$ Then, the rise in temperature of water is
(a) 75°C (b) 60°C
(c) 30°C (d) 20°C

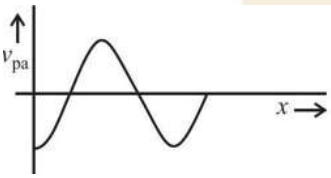
15. If a unit positive charge is taken from one point to another over an equipotential surface, then
(a) work is done on the charge
(b) work is done by the charge
(c) work done is constant
(d) no work is done

16. A plane wave $y = a\sin(\omega t - kx)$ propagates through a stretched string. The particle velocity versus x graph at $t = 0$ is

(a)


(b)


(c)


(d)


17. An airplane flies 400 m north and 300 m south and flies 1200 m upward, then net displacement is
(a) 1400 m (b) 1500 m
(c) 1200 m (d) 1100 m

18. A pure number which determines the types of flow of a liquid through a pipe is known as
(a) Reynold's number (b) Bernoulli's number
(c) Pascal's number (d) Torricelli's number

19. Work done
(a) can only be positive
(b) can only be negative

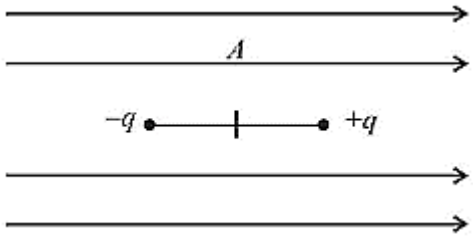
(c) can either be positive or negative
(d) cannot be assigned a sign

20. A gas volume 251 cm^3 at 20°C and pressure 78 cm of Hg. Find its volume at NTP.
(a) 420 cm^3 (b) 440 cm^3
(c) 263.8cm^3 (d) 100 cm^3

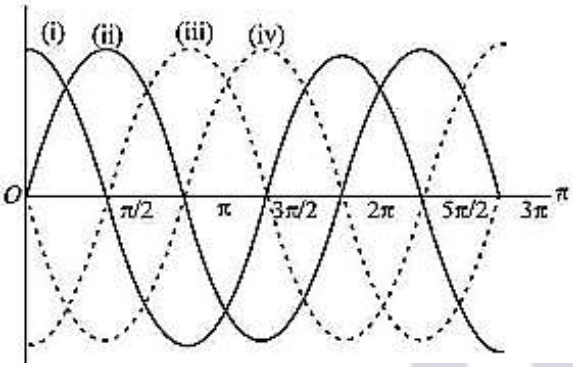
21. Frank and Hertz experiment proves that
(a) light move in the form of waves as well as particles
(b) the electron does not radiate energy, while moving in an orbit
(c) the energy states of an atom are quantised
(d) the whole of the positive charge of the atom is concentrated in the nucleus

22. An electric dipole is situated in an electric field as shown in figure. The dipole and electric field are both in the plane of paper. The dipole is rotated about an axis, perpendicular to the paper at point *A* in anti-clockwise direction. If the angle of rotation is measured with respect to the direction of the electric field, then the torque for different values of the angle of rotation θ is correctly represented by which graph among (i), (ii), (iii), (iv) given in Fig (B)?

(A)



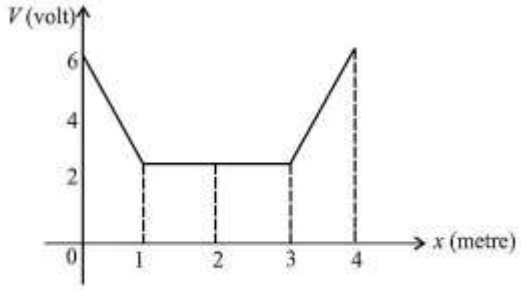
(B)



(a) (i) (b) (iii)
(c) (ii) (d) (iv)

23. When 50 g of water at 10°C is mixed with 50 g of water at 100°C. The resultant temperature is
(a) 80°C (b) 55°C
(c) 25°C (d) 45°C

24. The variation of electric potential with distance from a fixed point is shown in figure. What is the value of electric field at $x = 2$ m ?



(a) 0 (b) 3 (c) 2 (d) 6

25. A calorimeter contains 0.5 kg of water at 30°C. When 0.3 kg of water at 60°C is added to it, the resulting temperature is found to be 40°C. The water equivalent of the calorimeter is
(a) 0.25 kg (b) 0.1 kg
(c) 0.2 kg (d) 0.25 kg

26. If a vessel containing a fluid of density ρ upto height h is accelerated vertically downwards with acceleration a_0. Then, the pressure by fluid at the bottom of vessel is given by the equation ….. (p_0 denotes the atmospheric pressure and g denotes the acceleration due to gravity).

(a) $p = p_0 + \rho gh + \rho h a_0$ (b) $p = p_0 + \rho gh$

(c) $p = p_0 + \rho h(g - a_0)$ (d) $p = p_0 - \rho gh$

27. Weak nuclear force always operates between

(a) electrons and neutrino

(b) heavier elementary particles

(c) charged particles

(d) all the objects in the universe

28. A 3 m long steel wire is stretched to increase its length by 0.3 cm. Poisson's ratio for steel is 0.26. The lateral strain produced in the wire is

(a) 0.26×10^{-4} (b) 0.26×10^{-2}

(c) 0.26×10^{-3} (d) 0.26×10^{-1}

29. Why 220 V AC is more dangerous than 220 V DC?

(a) The DC attracts

(b) Peak voltage for AC is much larger

(c) The body offers less resistance to AC

(d) Due to some other reason

30. A body is moving with an initial velocity of $10\sqrt{2}$ ms^{-1} in the north-east direction. If it is subjected to an acceleration of 2 ms^{-2} directed towards the south, then velocity of the body after 5 s is

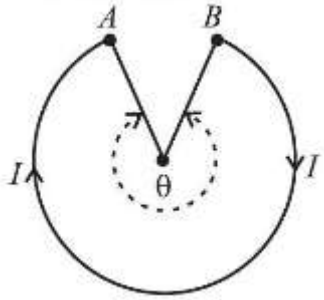
(a) 10 ms^{-1}, towards east

(b) 10 ms^{-1}, towards north

(c) 10 ms^{-1}, towards south

(d) 10 ms^{-1}, towards north-east

31. A current I a flows in a circular arc of radius r subtending an angle θ as shown in the figure. Find the magnetic field at the centre O of the circle.



(a) $\frac{\mu_0 I\theta}{4\pi r}$ (b) $\frac{2\mu_0 I \cdot \sin\theta}{4\pi r}$

(c) $\frac{2\mu_0 I \sin\theta}{2r}$ (d) $\frac{2\mu_0 I \sin\theta}{4r}$

32. The current in a coil changes from 3 A to 1 A in 0.1 s in coil of self-inductance 8 mH . The emf induced in the coil is

(a) 16 V (b) 1.6×10^{-2} V

(c) 16×10^{-2} V (d) 2 V

33. Acceleration due to gravity.

(a) increases with altitude

(b) decreases with altitude

(c) is independent of altitude

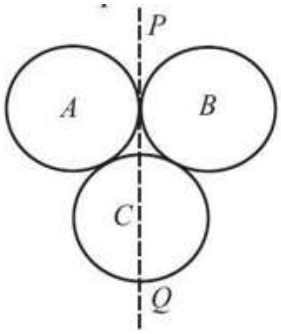
(d) first decrease and then increases with altitude

34. If mass, speed and radius of the circular path of the particle are increased by 100%, then the necessary force required to maintain the circular path will have to be increased by

(a) 100% (b) 250%

(c) 300% (d) 400%

35. Three identical uniform solid spheres each of mass m and radius r are joined as shown in the figure, with centres lying in the same plane. The moment of inertia of the system about an axis lying in that plane and passing through the centre of sphere C is



(a) $\frac{16}{5}mr^2$ (b) $\frac{12}{5}mr^2$
(c) $4mr^2$ (d) $\frac{3}{5}mr^2$

36. Unit of pole strength of a magnet is
(a) Am^{-1} (b) Am^2
(c) Am^{-2} (d) Am

37. The ratio of the slopes of isothermal and adiabatic curves is
(a) 1 (b) γ (c) $\frac{1}{\gamma}$ (d) $\frac{3}{2}$

38. Kepler's second law (law of areas) is nothing but a statement of
(a) work-energy theory
(b) conservation of linear momentum
(c) conservation of angular momentum
(d) conservation of energy

39. In a potentiometer experiment the balancing length with a cell is 560 cm. When an external resistance of 10Ω is connected in parallel to the cell, then the balancing length changes by 60 cm. Find the internal resistance of the cell.
(a) 1Ω (b) 2Ω
(c) 1.2Ω (d) 2.1Ω

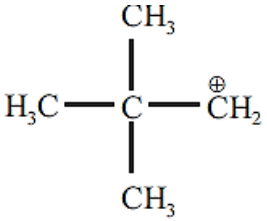
40. A particle is projected with a velocity v such that its range on the horizontal plane is twice the greatest height attained by it. The range of the projectile is (g = acceleration due to gravity)
(a) $\frac{4v^2}{5g}$ (b) $\frac{4g}{5v^2}$
(c) $\frac{v^2}{g}$ (d) $\frac{4v^2}{\sqrt{5}g}$

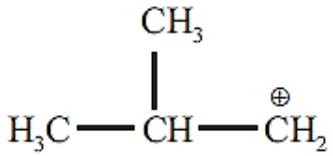
Chemistry

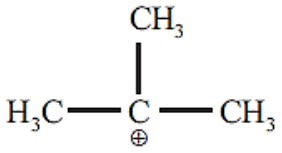
41. Choose the smallest ion from the following.
(a) Mg^{2+} (b) S^{2-}
(c) Na^+ (d) Cl^-

42. Examples for bactericidal and bacteriostatic antibiotics, respectively are
(a) penicillin, ofloxacin
(b) erythromycin, tetracycline
(c) penicillin, chloramphenicol
(d) tetracycline, penicillin

43. Which of the following is most stable form for the given structure, after rearrangement?



(a) 

(b) 

(c) $CH_3 - \overset{\oplus}{C}H - CH_2 - CH_3$

(d) None of these

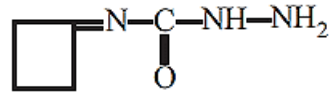
44. Which of the following chemicals can be added for sweetening of food items at cooking temperature and does not provide calories?

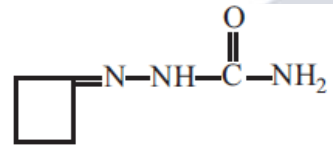
(a) Sucrose (b) Glucose
(c) Fructose (d) Sucralose

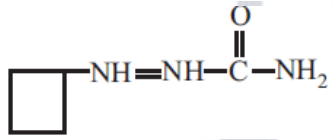
45. Which of the following sets of species have similar bond order?

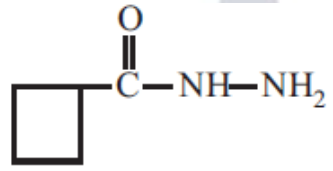
(a) N_2, O_2^{2-}, NO^+ (b) $N_2,\ F_2, O_2^{2-}$
(c) $N_2,\ N_2^{2-}, O_2^-$ (d) N_2, CO, NO^+

46. The cyclobutanone of semicarbazone is represented as

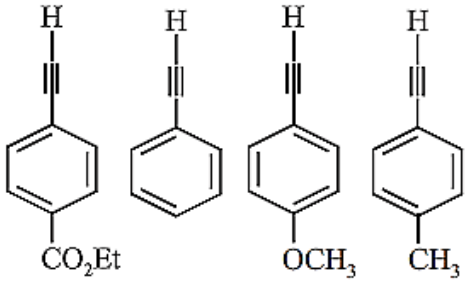
(a) 

(b) 

(c) 

(d) 

47. Decreasing order of acidity of the following terminal acetylenes is



(i) (ii) (iii) (iv)

(a) (i) > (iii) >(ii) > (iv) (b) (i) > (ii) > (iv) > (iii)
(c) (i) > (iv) > (ii) > (iii) (d) (i) > (iii) > (iv) > (ii)

48. In which of the following substances will hydrogen bonds be strongest?

(a) HCl (b) H_2O
(c) Hl (d) H_2 S

49. The geometry with respect to the central atom of the molecules $N(SiH_3)_3 \cdot Me_3$ N, $(SiH_3)_3P$, respectively are

(a) planar, pyramidal, planar
(b) planar, pyramidal, pyramidal

(c) pyramidal, pyramidal, pyramidal
(d) pyramidal,planar, pyramidal

50. A gaseous mixture of 3 gases A, B and C has a pressure 10 atm. The total number of moles are 10. If partial pressure of gases A and B are 3 atm and 1 atm respectively and if molar mass of gas C is 2. Calculate the weight of C in the mixture.
(a) 12 g (b) 24 g
(c) 8 g (d) 2 g

51. Choose the incorrect statement among the following.
(A) The reactivity of aromatic aldehydes and ketones is less than that of aliphatic carbonyl compounds toward nucleophilic addition reactions.
(B) Benzaldehyde does not give Fehling's test.
(C) The H -atoms in ethanal are acidic in nature.
(D) p-nitro benzaldehyde is less reactive than benzaldehyde towards nucleophilic addition reactions.
(a) A (b) B
(c) C (d) D

52. The solubility product of $Ni(OH)_2$ at 298 K is 2×10^{-15} mol^3dm^{-9}. The pH value if, its aqueous and saturated solution is
(a) 5 (b) 7.5
(c) 9 (d) 13

53. Assertion : Boron has a smaller first ionisation enthalpy than beryllium.
Reason : The penetration of a 2s-electron to the nucleus is more than the 2p-electron hence, 2p-electron is more shielded by the inner core of electrons than 2 s -electrons.
(a) Assertion and Reason both are correct statements but Reason is not correct explanation for Assertion.
(b) Assertion is correct statement but Reason is wrong statement.
(c) Assertion and Reason both are correct statements and Reason is correct explanation for Assertion
(d) Assertion and Reason both are wrong statements.

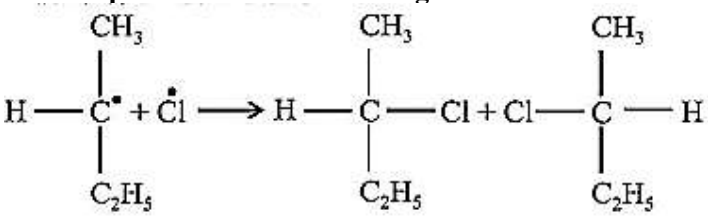
54. Among the following oxides, which one is weakly basic and yet a powerful oxidant?
(a) CO_2 (b) SnO_2
(c) SiO_2 (d) PbO_2

55. One mole of oxygen gas at STP is equal to
(a) 6.022×10^{23} molecules of oxygen
(b) 6.022×10^{23} atoms of oxygen
(c) 16 g of oxygen
(d) 3.2 g of oxygen

56. Find the correct equation among the following.
(a) $\ln k - \ln A = \frac{E_a}{RT}$
(b) $k = \frac{AE_a}{RT}$
(c) $\ln k + \ln A = \frac{E_a}{RT}$
(d) $\frac{E_a}{RT} = \ln A - \ln k$

57. Calculate the wave number and frequency of orange radiation having wavelength 6300Å.
(a) $1.587 \times 10^8\ m^{-1}, 4.761 \times 10^{16}\ s^{-1}$
(b) $1.587 \times 10^4\ m^{-1}, 4.761 \times 10^{14}\ s^{-1}$
(c) $1.587 \times 10^6\ m^{-1}, 4.761 \times 10^{14}\ s^{-1}$
(d) $1.587 \times 10^6\ m^{-1}, 4.761 \times 10^{16}\ s^{-1}$

58. The products in the reaction given below are ··' denotes a free radical.



(a) Meso forms (b) Racemic mixture
(c) d - and l-forms (d) Cis-trans isomers

59. 160 g of non-volatile solute ' A ' is dissolved in 54 mL of water at 373 K. What is the vapour pressure of aqueous solution of A. (Given, molecular weight of A $= 160\ g\ mol^{-1}$)
(a) 760 Torr(b) 720 Torr
(c) 570 Torr(d) 450 Torr

60. "The properties of elements are periodic functions of their atomic weights." This periodic law was given by
(a) Dobereiner (b) Lothar Meyer
(c) Mendeleev (d) Alexander

61. A 40%HCl solution has density $1.2\ g\ mL^{-1}$. The molarity of the solution is nearly …..
(a) 11 M (b) 12 M
(c) 13 M (d) 14 M

62. Copper matte is composed of……..
(a) Cu_2 S and Cu_2O (b) Cu_2 S and FeS
(c) $CuFeS_2$ and Cu_2 S (d) CuS and FeS

63. 10 g NaOH is dissolved in 500 mL of aqueous solution. Calculate the molarity of this solution. (Given, formula weight of NaOH $= 40$)
(a) 0.5×10^{-3}M (b) 0.4 M
(c) 0.25×10^{-3}M (d) 0.5 M

64. Which among the following statements is correct?
(A) There is a complete order of molecules in gases.
(B) There is a complete disorder of molecules in gases.
(C) Molecules are not always in random motion in gases.
(D) Molecules are fixed at respective position in gases.
(a) A (b) B
(c) C (d) D

65. In which of the following reactions of H_2O_2 acts as an oxidising agent (either in acidic, alkaline or neutral medium) ?
(i) $2Fe^{2+} + H_2O_2 \rightarrow$
(ii) $2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow$
(iii) $I_2 + H_2O_2 + 2OH^- \rightarrow$
(iv) $Mn^{2+} + H_2O_2 \rightarrow$
(a) (ii), (iii) (b) (i). (iv)
(c) (i), (iii) (d) (ii), (iv)

66. Glucose does not react with which of the following.
(a) NH_2OH (b) HCN
(c) Br_2/ Water (d) $NaHSO_3$

67. Find the observed EMF of the cell $Cd \mid Cd^{2+}(0.01M) \| Cu^{2+}(0.01M) \mid Cu$ under conditions, internal resistance of 4Ω and producing a current of 0.15 A .
(Given, $E^\circ_{Cu^{2+}/Cu} = 0.35\ V$ and $E^\circ_{Cd^{2+}/Cd} = -0.4\ V$)
(a) 0.75 V (b) 0.15 V
(c) 0.6 V (d) 0.9 V

68. Which among the following is most common in alkyl halides?
(a) Nucleophilic substitution
(b) Electrophilic substitution
(c) Electrophilic addition
(d) Nucleophilic addition

69. Which of the following is an extensive property?
(a) Temperature (b) Volume
(c) Density (d) Pressure

70. The correct statement about Cr^{2+} and Mn^{3+} among the following is
(Given, atomic number of Cr = 24 and Mn = 25)
(a) Cr^{2+} is a reducing agent.
(b) Mn^{3+} is a reducing agent.
(c) Both Cr^{2+} and Mn^{3+} exhibit d^5 outer electronic configuration.
(d) When Cr^{2+} is used as reducing agent, it attains d^5 configuration.

71. Two metals A and B having similar ionic radii, react with oxygen to give only monoxides and react with nitrogen to give nitrides. Then, A and B respectively are
(a) Li and Na (b) Na and Ca
(c) Li and Mg (d) Na and Be

72. Isochores are drawn at…..
(a) constant volume, pressure vs temperature
(b) constant pressure, volume vs temperature
(c) constant temperature, pressure vs volume
(d) constant temperature, volume vs temperature

73. How many lone pairs of electrons are present in a hydroxyl ion?
(a) Two pairs (b) Three pairs
(c) One pair(d) Four pairs

74. The insecticide DDT is considered as …..
(a) greenhouse gas
(b) biodegradable pollutant
(c) non-biodegradable pollutant
(d) a fertiliser

75. Geometrical isomerism can be found in which of the following?
(a) Butyric acid (b) Aspartic acid
(c) Palmitic acid (d) Cinnamic acid

76. Which among the following polymers exhibit hydrogen bonding?
(a) Polyvinyl chloride (b) Nylon-6, 6
(c) Neoprene (d) Teflon

77. Acidity of BF_3 can be explained on the basis of which of the following concepts?
(a) Arrhenius concept
(b) Bronsted-Lowry concept
(c) Lewis concept
(d) Bronsted-Lowry as well as Lewis concept

78. The correct order for wavelengths of absorption in the visible region for the following complexes will be
(a) $[Ni(NH_3)_6]^{2+} < [Ni(H_2O)_6]^{2+} < [Ni(NO_2)_6]^{4-}$
(b) $[Ni(NO_2)_6]^{4-} < [Ni(NH_3)_6]^{2+} < [Ni(H_2O)_6]^{2+}$
(c) $[Ni(NH_3)_6]^{2+} < [Ni(NO_2)_6]^{4-} < [Ni(H_2O)_6]^{2+}$
(d) $[Ni(NO_2)_6]^{4-} < [Ni(H_2O)_6]^{2+} < [Ni(NH_3)_6]^{2+}$

79. Which of the compounds among $N_2O, NO, N_2O_3, NO_2, N_2O_4, N_2O_5$ are diamagnetic?
(a) NO, NO_2, N_2O_3
(b) $N_2O, N_2O_3, N_2O_4, N_2O_5$
(c) NO, NO_2
(d) N_2O_4, N_2O_5

80. BF_3 is used as a catalyst in several industrial processes due to its
(a) strong reducing nature
(b) weak reducing action
(c) strong Lewis acid nature
(d) weak Lewis acid character

Mathematics

81. $\int \frac{x^3-1}{x^3+x} dx =$

(a) $x + \log|x| + \frac{1}{2}\log(x^2+1) + \sin^{-1}(x) + c$

(b) $x - \log|x| + \frac{1}{2}\log(x^2+1) - \sin^{-1}(x) + c$

(c) $x + \log|x| - \frac{1}{2}\log(x^2+1) + \tan^{-1}(x) + c$

(d) $x - \log|x| + \frac{1}{2}\log(x^2+1) - \tan^{-1}(x) + c$

82. The values of x at the stationary points of $f(x) = x^3 + 3x^2 - 2$ are

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

(c) $0, -2$ (d) 1,1

83. The perimeter of $\triangle ABC$ is 36 cm and its in radius is 8 cm. Then, the area of the triangle is

(a) 144 cm^2 (b) 124 cm^2

(c) 164 cm^2 (d) 104 cm^2

84. Find the domain of the real valued function $f(x) = ([x]^2 - [x] - 2)^{-1/2}$, where $[\cdot]$ is the greatest integer function.

(a) $R - (-1,3]$ (b) $R - [-1,3)$

(c) $R - (-1,3)$ (d) $R - [-1,3]$

85. Find the value of k, if the angle between the straight lines represented by $2x^2 + 5xy + 3y^2 + 6x + 7y + 4 = 0$ is $\tan^{-1}(k)$.

(a) $\left(\frac{1}{5}\right)$ only (b) $\left(\frac{-1}{5}\right)$ only

(c) $\pm\frac{1}{5}$ (d) 0

86. The roots of the equation $|x^2 - x - 6| = x + 2$ are

(a) $-2,1,4$ (b) 0,2,4

(c) 0,1,4 (d) $-2,2,4$

87. Let a, b, c be real numbers. A set formed with a, b, c whose order of occurrence is pre-assigned is called …..

(a) An ordered triad

(b) An ordered pair

(c) Both ordered triad and ordered pair

(d) None of these

88. If $3f(x) - 2f\left(\frac{1}{x}\right) = x$, then $f'(2)$ is

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

89. $\int_1^{e^2} \frac{dx}{x(1+\log x)^2} =$

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

90. The constant term in the expansion of $\left(\frac{x}{2} + \frac{1}{x} + \sqrt{2}\right)^5$ is $\frac{a\sqrt{2}}{2}$, then a =

(a) 7 (b) 69

(c) 63 (d) 65

91. $\cos^2(x) + \cos^2\left(x + \frac{\pi}{3}\right) + \cos^2\left(x - \frac{\pi}{3}\right) =$

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

92. If one end of diameter of the circle $x^2 + y^2 - 4x - 6y + 11 = 0$ is $(3,4)$, then the other end of the diameter is

(a) (0,1) (b) (1,1)

(c) (1,2) (d) (1,0)

93. $\cos 48^\circ \cdot \cos 12^\circ =$

(a) $\frac{(3-\sqrt{5})}{8}$ (b) $\frac{(3+\sqrt{5})}{4}$

(c) $\frac{(3+\sqrt{5})}{2}$ (d) $\frac{(3+\sqrt{5})}{8}$

94. If $\sin(\theta) + \operatorname{cosec}(\theta) = 2$, then $\sin^{2020}(\theta) + \operatorname{cosec}^{2020}(\theta) = \cdots$ ....
(a) 2^{2020} (b) 20202^{2019}
(c) 2^{2019} (d) 2

95. Assuming $|x|$ to be so small, that x^2 and higher powers of x can be neglected, then $\frac{\sqrt{1+x}+(1-x)^{3/2}}{(1+x)+\sqrt{1+x}} =$
(a) $1+\frac{5x}{4}$ (b) $1-\frac{5x}{4}$
(c) $1+\frac{4x}{5}$ (d) $1-\frac{4x}{5}$

96. How many bijections $f: Z \to Z$ are there such that $f(x+y) = f(x) + f(y)$ for all $x, y \in Z$?
(a) One (b) Two
(c) Three (d) Infinitely many

97. The matrix $A = \begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{-1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} \end{bmatrix}$ is .....
(a) Unitary (b) Orthogonal
(c) Nilpotent (d) Involuntary

98. The length of the latus rectum of the parabola $169\{(x-1)^2 + (y-3)^2\} = (5x - 12y + 17)^2$ is
(a) $\frac{14}{13}$ (b) $\frac{12}{13}$
(c) $\frac{28}{13}$ (d) $\frac{56}{13}$

99. If $\tan h(x) = \frac{1}{3}$, then $\tan h(3x)$ is
(a) $\frac{8}{9}$ (b) $\frac{7}{9}$
(c) 1 (d) $\frac{2}{3}$

100. A square is formed by the lines $x = 0, y = 0, x = 1, y = 1$. Then, the equations of its diagonals will be
(a) $y = x, x + y = 2$
(b) $2y = x, x + y = \frac{1}{2}$
(c) $y = x, x + y = 1$
(d) $y = 2x, x + y = \frac{1}{4}$

101. The equation of a circle with centre $(5, 4)$ and touch the Y-axis is
(a) $x^2 + y^2 - 10x - 8y - 16 = 0$
(b) $x^2 + y^2 - 10x - 8y - 16 = 0$
(c) $x^2 + y^2 + 10x + 8y + 16 = 0$
(d) $x^2 + y^2 - 10x - 8y + 16 = 0$

102. Let X be a random variable such that $X(x)$ is the number of heads is X for each $x \in S$, where S is the sample space of random experiment of tossing three fair coins simultaneously. Find the value of $\rho(X^{-1}(2))$.
(a) $\frac{3}{8}$ (b) $\frac{5}{8}$
(c) $\frac{1}{8}$ (d) $\frac{3}{4}$

103. If p and q are length of the perpendicular from origin to the lines $x\sec(\theta) + y\operatorname{cosec}(\theta) = k$ and $x\cos(\theta) - y\sin(\theta) = k\cos(2\theta)$ respectively, then
(a) $p^2 + 4q^2 = k^2$ (b) $4p^2 + q^2 = k^2$
(c) $p^2 + q^2 = 4k^2$ (d) $p^2 + q^2 = k^2$

104. If $x^2 + y^2 + 6x + 2ky + 25 = 0$ to touch Y-axis, then $k =$
(a) ± 20 (b) $-1, -5$
(c) ± 5 (d) 4

105. Find the number of ways of selecting 4 pens and 3 pencils from a packet of 8 pens and 5 pencils,
(a) 700 (b) ${}^8P_4 \times {}^5P_3$
(c) ${}^8P_4 + {}^5P_3$ (d) $700 \times {}^8P_4$

106. $\frac{x^4}{x^3-3x+2}$ is a.....
(a) proper fraction (b) improper fraction
(c) mixed fraction (d) not a fraction

107. **In how many ways one can send 6 new-year greeting cards to 4 people?**
(a) 360 (b) 180 (c) 720 (d) 90

108. **If $[a, b]$ is the range of the function $\frac{x+2}{2x^2+3x+6}$ for $x \in R$, then**
(a) $a < 0, b < 0$ (b) $a < 0, b > 0$
(c) $a > 0, b > 0$ (d) $a < 0, b < 0$

109. **The point on the circle $x^2 + y^2 = 4$ whose distance from the line $4x + 3y - 12 = 0$ is $4/5$ units is equal to**
(a) $\left(\frac{12}{25}, \frac{36}{25}\right)$ (b) (4,0)
(c) (2,0) (d) $\left(\frac{-14}{25}, \frac{48}{25}\right)$

110. **Let a, b and c be the lengths of the sides of triangle with its opposite angles A, B and C respectively. If $\angle C = 60^\circ$, then the value of $\frac{c(a+b)+(a^2+b^2)}{(b+c)(c+a)}$ is**
(a) $\frac{1}{2}$ (b) $\frac{\sqrt{3}}{2}$
(c) 1 (d) $\sqrt{3}$

111. **If $f(x)$ is a polynomial of the second degree in x such that $f(0) = f(1) = 3f(2) = -3$. Then $\int \frac{f(x)}{x^3-1} dx =$**
(a) $\log\left(\frac{x^2+x+1}{|x-1|}\right) + \frac{1}{\sqrt{3}}\tan^{-1}\left(\frac{2x+1}{\sqrt{3}}\right) + c$
(b) $\log\left(\frac{x^2+x+1}{|x-1|}\right) - \frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2x+1}{\sqrt{3}}\right) + c$
(c) $\log\left(\frac{x^2+x+1}{|x-1|}\right) - \frac{1}{\sqrt{3}}\tan^{-1}\left(\frac{2x+1}{\sqrt{3}}\right) + c$
(d) $\log\left(\frac{x^2+x+1}{|x-1|}\right) + \frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2x+1}{\sqrt{3}}\right) + c$

112. **If $x \in R$, then one of the solutions of $\sqrt{x+1} - |\sqrt{x-1}| = \sqrt{4x-1}$ among the following is**
(a) $x = \frac{5}{4}$ (b) $x = \frac{-5}{4}$
(c) $x = 0$ (d) $x = 1$

113. **Let p, q and r be such that $r \neq 0, p \times q = r, q \times p$, then**
(i) p, q, r are pair-wise orthogonal vectors
(ii) $|q| = |r| = |p|$
(a) (i) is correct, (ii) is incorrect
(b) (i) is incorrect, (ii) is correct
(c) Both (i) and (ii) are incorrect
(d) Both (i) and (ii) are correct

114. **The domain of**
$f(x) = \cos^{-1}\left(\frac{x-3}{2}\right) - \log_{10}(4-x)$ is
(a) (1,4) (b) [1,4)
(c) (1,4] (d) [1,4]

115. $\int \left(1 + \frac{x}{1!} + \frac{x^2}{2!} + \cdots \infty\right) dx =$
(a) $\log(x+1) + c$ (b) $\frac{1}{x+1} + c$
(c) $e^x + c$ (d) $-e^{-x} + c$

116. **Find $|a \times b|^2$, if $|a| = 2, |b| = 3$ and $(a, b) = \frac{\pi}{6}$**
(a) -9 (b) 9
(c) 3 (d) -3

117. **The general solution of $\cos(x) - \sin(x) = 0$ is**
(a) $n\pi - \frac{\pi}{4}, n \in Z$ (b) $2n\pi + \frac{\pi}{4}, n \in Z$
(c) $n\pi + \frac{\pi}{4}, n \in Z$ (d) $2n\pi - \frac{\pi}{4}, n \in Z$

118. **If $1, a, a^2, \ldots, a^{n-1}$ are the n^{th} roots of unity.**

Then $\sum_{i=1}^{n-1} \frac{1}{2-a^i}$ is equal to

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

(c) $\frac{(n-2)2^{n-1}}{2^n-1}$ (d) $\frac{1}{(n-2)2^n}$

119. Find the solution of the differential equation

$(e^{y-x})dy = (e^x - e^y)dx$

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

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

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

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

120. If $[x]$ denotes the greatest integer function on x, then the number of positive integral divisors of $[(2+\sqrt{3})^5]$ is

(a) 6 (b) 4 (c) 2 (d) 8

121. If a line makes angles α, β, γ with the positive direction of X, Y and Z-axes respectively, then the value of $\sin^2\alpha + \sin^2\beta + \sin^2\gamma =$

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

122. If $f(x) = \begin{vmatrix} x-3 & 2x^2-18 & 3x^3-81 \\ x-5 & 2x^2-50 & 4x^3-500 \\ 1 & 2 & 3 \end{vmatrix}$, then $f(1)f(3) + f(3)f(5) + f(5)f(1)$ is equal to

(a) f(1) (b) f(3)

(c) f(1) + f(3) (d) f(1) + f(5)

123. Foci of the ellipse $2x^2 + 3y^2 - 4x - 12y + 13 = 0$ are

(a) $\left(1+\frac{1}{\sqrt{6}}, 2\right)$ and $\left(1-\frac{1}{\sqrt{6}}, 2\right)$

(b) $\left(\frac{1}{\sqrt{6}}+1, 2\right)$ and $\left(\frac{1}{\sqrt{6}}-1, 2\right)$

(c) $\left(2, 1+\frac{1}{\sqrt{6}}\right)$ and $\left(2, 1-\frac{1}{\sqrt{6}}\right)$

(d) $\left(2, \frac{1}{\sqrt{6}}+1\right)$ and $\left(2, \frac{1}{\sqrt{6}}-1\right)$

124. $\frac{k^5}{5} + \frac{k^3}{3} + \frac{}{15}$ is. ……if $k \in N$

(a) a natural number (b) an integer

(c) a positive fraction (d) equal to zero

125. The equation of the circle passing through $(0, 0)$ and which makes intercepts a and b on the coordinates axes is

(a) $x^2 + y^2 + ax + by = 0$

(b) $x^2 + y^2 + ax - by = 0$

(c) $x^2 + y^2 - ax + by = 0$

(d) $x^2 + y^2 - ax - by = 0$

126. If pairs of straight lines $x^2 - 2pxy - y^2 = 0$ and $x^2 - 2qxy - y^2 = 0$ be such that each pair bisects the angle between the other pair, then

(a) $pq = 1$ (b) $pq = 2$

(c) $pq = -2$ (d) $pq = -1$

127. If P and Q are square matrices such that $P^{2006} = 0$ and $PQ = P + Q$, then $\det(Q)$ will be

(a) 0 (b) 1 only

(c) -1 only (d) ± 1

128. $\int \frac{2\tan(x)}{1+2\tan^2(x)} dx =$

(a) $\log|\cos^2 x + \sin^2 x| + c$

(b) $\log\left|\frac{\cos^2 x}{2}+\sin^2 x\right|+c$

(c) $\log\left|\cos^2 x+\frac{\sin^2 x}{2}\right|+c$

(d) $\log\left|\frac{\cos^2 x}{2}+\frac{\sin^2 x}{2}\right|+c$

129. **If $\theta \in \left[-\frac{\pi}{2},\frac{\pi}{2}\right]$, then $\cos^{-1}(\sin\theta)$ is equal to**

(a) $\frac{\pi}{2}-\theta$ (b) $\theta-\frac{\pi}{2}$

(c) $\frac{\pi}{2}+\theta$ (d) $\pi+\frac{\theta}{2}$

130. **If $a=\alpha\hat{i}+3\hat{j}-6\hat{k}$ and $b=2\hat{i}-\hat{j}+\beta\hat{k}$, then the value of α,β so that a and b may be collinear are**

(a) (5,3) (b) (6,2)

(c) $(2,-6)$ (d) $(-6,2)$

131. **If $2\alpha=-1-i\sqrt{3}$ and $2\beta=-1+i\sqrt{3}$, then $5\alpha^4+5\beta^4+7\alpha^{-1}\beta^{-1}$ is equal to**

(a) -1 (b) -2

(c) 0 (d) 2

132. **The direction cosines of the line which is perpendicular to the lines with direction cosines proportional to $(1,-2,-2)$ and $(0,2,1)$ is given by**

(a) $\left(\frac{2}{3},\frac{1}{3},\frac{2}{3}\right)$ (b) $\left(\frac{-2}{3},\frac{-1}{3},\frac{-2}{3}\right)$

(c) $\left(\frac{2}{3},\frac{1}{3},\frac{-2}{3}\right)$ (d) $\left(\frac{2}{3},\frac{-1}{3},\frac{2}{3}\right)$

133. **The value of x that satisfies the equation**

$\int_{\sqrt{2}}^{x}\frac{dt}{|t|\sqrt{t^2-1}}=\frac{\pi}{12}$ is

(a) 1 (b) 0

(c) $-\sqrt{2}$ (d) 2

134. **The angle between the lines $2x+11y-7=0$ and $x+3y+5=0$ is**

(a) $\tan^{-1}\left(\frac{17}{13}\right)$ (b) $\tan^{-1}\left(\frac{4}{35}\right)$

(c) $\tan^{-1}\left(\frac{1}{7}\right)$ (d) $\tan^{-1}(7)$

135. **The value of ' k ' so that the line $y=2x+k$ may touch the ellipse $3x^2+5y^2=15$ is**

(a) $\pm\sqrt{23}$ (b) $\pm\sqrt{13}$

(c) $\pm\sqrt{33}$ (d) $\pm\sqrt{32}$

136. **Let a,b,c be three vectors**

(i) $(a\times b)\times c=(a\cdot c)b-(b\cdot c)a$

(ii) $(a)\times(b\times c)=(a\cdot b)c-(a\cdot c)b$

(a) (i) is incorrect, (ii) is correct

(b) (i) is correct, (ii) is incorrect

(c) Both (i) and (ii) are correct

(d) Both (i) and (ii) are incorrect

137. **If $(1-x+x^2)^{10}=a_0+a_1x+a_2x^2+\cdots+a_{20}x^{20}$, then $2a_2+3a_3+4a_4+\cdots+20a_{20}=$**

(a) 0 (b) 10

(c) 20 (d) -20

138. **If $y=\sin^{98}(x)\cdot\cos^{39}(x)$, then find $\frac{dy}{dx}$**

(a) $(98\cos^{99}x\cdot\sin^{38}x)+(39\sin^{40}x\cdot\cos^{97}x)$

(b) $(99\cos^{98}x\cdot\sin^{39}x)-(40\sin^{39}x\cdot\cos^{98}x)$

(c) $(98\cos^{99}x\cdot\sin^{38}x)-(39\sin^{40}x\cdot\cos^{97}x)$

(d) $(99\cos^{98}x\cdot\sin^{39}x)+(39\sin^{40}x\cdot\cos^{97}x)$

139. The derivative of $\tan^{-1}\left[\frac{x}{1+\sqrt{1-x^2}}\right]$ with respect to $\sec^{-1}\left(\frac{1}{2x^2-1}\right)$ is

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$

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

140. For a triangle with the sides of lengths 6,5 and 9 , then the radius of the circle is

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

141. If $a+bi=\frac{i}{1-i}$, then $(a,b)=$

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

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

142. ABC is a right-angled triangle in which $\max\{AB, BC, AC\} = BC$. If the position vectors of B and C are respectively $3\hat{i}-2\hat{j}+\hat{k}$ and $5\hat{i}+\hat{j}-3\hat{k}$, then $AB\cdot AC + BA\cdot BC + CA\cdot CB =$

(a) 28 (b) 29 (c) 27 (d) 25

143. If the lines $3x+4y-5=0, 2x+3y-4=0$ and $px+4y-6=0$ all meet at the same point, then p is equal to

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

144. If $a>0, n\in R$, then $\lim_{x\to a} x^n =$

(a) na^n (b) $(n-1)a^n$

(c) na^{n-1} (d) a^n

145. $\int_{-\pi}^{\pi} x^2(\sin x)dx =$

(a) π^2 (b) $\frac{\pi^2}{2}$ (c) 0 (d) $2\pi^2$

146. Find the solution of the following differential equation $\left\{x\cos\left(\frac{y}{x}\right)+y\sin\left(\frac{y}{x}\right)\right\}ydx = \left\{y\sin\left(\frac{y}{x}\right)-x\cos\left(\frac{y}{x}\right)\right\}xdy$

(a) $y\cos\left(\frac{x}{y}\right)=\pm e^{-c}$ (b) $x\cos\left(\frac{y}{x}\right)=\pm e^{-c}$

(c) $xy\cos\left(\frac{y}{x}\right)=\pm e^{-c}$ (d) $xy\sin(-)=\pm e$

147. The function $f(x)=(1/2)^x$ on R is

(a) Strictly decreasing

(b) Strictly increasing

(c) Decreasing

(d) Neither increasing nor decreasing

148. If the pair of straight lines $6x^2-5xy+y^2=0$ makes angles α and β with the X-axis, then $\tan(\alpha-\beta)=$

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

149. The slope of the tangent of the curve $\left(\frac{x}{31}\right)^n+\left(\frac{y}{1209}\right)^n=2$ at $(31,1209)$.....

(a) -39 (b) 39 (c) $\frac{1}{39}$ (d) $\frac{-1}{39}$

150. Tangents are drawn to the hyperbola $x^2-9y^2=9$ from point $(3,2)$. Then, the area of the triangle formed by the tangents and the chord of contact is ..... sq. units.

(a) 10 (b) 6 (c) 12 (d) 8

151. If the standard deviation of the numbers $2, 3, 2x$ and 11 is 3.5. Find the possible values of x.

(a) $2,\frac{7}{2}$ (b) $3,\frac{5}{3}$

(c) $2,\frac{5}{2}$ (d) $3,\frac{7}{3}$

152. If $x^{2019} \cdot y^{2020} = (x+y)^{4039}$, then $\frac{dy}{dx} =$

(a) 0 (b) $\frac{x}{y}$ (c) $\frac{y}{x}$ (d) 1

153. A bag consists of 3 red balls, 5 blue balls and 8 green balls. A ball is selected at random. What is the probability of not getting a blue -balls?

(a) $\frac{11}{16}$ (b) $\frac{3}{16}$ (c) $\frac{1}{2}$ (d) $\frac{5}{16}$

154. If $y = 5x^2 + 6x + 6, x = 2, \Delta x = 0.001$, then value of dy is

(a) 0.026 (b) 0.0026

(c) 0.062 (d) 0.0062

155. Find the value of $m + n$, if the circumference of the circle $x^2 + y^2 + 8x + 8y - m = 0$ is bisected by the circle $x^2 + y^2 - 2x + 4y + n = 0$.

(a) -56 (b) 56 (c) 50 (d) -34

156. Find the transformed equation of $x\cos\theta + y\sin\theta = p$, when the axes are rotated through an angle θ.

(a) $x = p$ (b) $y = p$

(c) $x + y = p$ (d) $x - y = p$

157. If $f(x) \in Q[x]$ be a non-zero polynomial such that all its roots are irrational, then the degree of $f(x)$ is

(a) an even number (b) an odd number

(c) 0 (d) can't determine

158. $\int \sin^3(x) \cdot \cos^3(x)dx =$

(a) $\sin^4(x) - \sin^6(x) + c$

(b) $\cos^4(x) - \cos^6(x) + c$

(c) $\frac{1}{4}\sin^4(x) - \frac{1}{6}\sin^6(x) + c$

(d) $\frac{1}{4}\cos^4(x) - \frac{1}{6}\cos^6(x) + c$

159. Find the number of different garlands that can be prepared using 5 different coloured flowers.

(a) 120 (b) 60

(c) 119 (d) 12

160. $\lim_{x\to 0} \frac{8}{\sin^8 x}$

$$\left\{1 - \cos\left(\frac{x^2}{2}\right) - \cos\left(\frac{x^2}{4}\right) + \cos\left(\frac{x^2}{2}\right)\cos\left(\frac{x^2}{4}\right)\right\} =$$

(a) $\frac{1}{16}$ (b) $\frac{1}{32}$ (c) $\frac{1}{64}$ (d) $\frac{1}{8}$