Physics

1. The scientific principle that forms the basis of the tokamak technology is
   (a) controlled nuclear fission
   (b) motion of charged particles in electromagnetic fields
   (c) magnetic confinement of plasma
   (d) superconductivity

2. **If E and E_0 represent the energies, t and t_0 represent the times, then which of the following is dimensionally correct relation?**
   (a) $E = E_0 e^{-i}$ (b) $E = E_0 t_0 e^{-t/t_0}$
   (c) $E = E_0 t_0 e^{-t^2}$ (d) $E = E_0 e^{-t/t_0}$

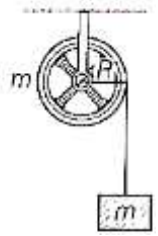
3. **A ball is dropped from a bridge that is 45 m above the water. It falls directly into a boat which is moving with constant velocity. The boat is 12 m away from the point of impact when the ball is dropped. The speed of the boat is (take, $g = 10\ m/s^2$)**
   (a) $2\ m/s$ (b) $3\ m/s$
   (c) $4\ m/s$ (d) $5\ m/s$

4. **A ball is dropped from a height H from rest. The ball travels $\frac{H}{2}$ in last 1.0 s . The total time taken by the ball to hit the ground is**
   (a) 3.85 s (b) 3.41 s
   (c) 2.55 s (d) 4.65 s

5. **A planet is moving in a circular orbit. It completes 2 revolutions in 360 days. What is its angular frequency?**
(a) 1.5×10^{-2}rad/ day (b) 2.5×10^{-2}rad/day
(c) 3.5×10^{-2}rad/day (d) 4.5×10^{-2}rad/day

6. **The vector sum of two forces is perpendicular to their vector differences. In that case, the forces**
   (a) cannot be predicted
   (b) always are equal to each other
   (c) are equal to each other in magnitude
   (d) are not equal to each other in magnitude

7. **A mass m is supported by a massless string wound around a uniform hollow cylinder of mass m and radius R. If the string does not slip on the cylinder, then with what acceleration will the mass release?(Assume, g = acceleration due to gravity)**



(a) $\frac{2g}{3}$ (b) $\frac{g}{2}$ (c) $\frac{5g}{6}$ (d) g

8. **A particle of mass m_1 collides with a particle of mass m_2 at rest. After the elastic collision, the two particles moves at an angle of 90° with respect to each other. The ratio $\frac{m_2}{m_1}$ is**
   (a) 1.0 (b) 1.5
   (c) 2.0 (d) 2.5

9. **A block of mass 100 g moving at a speed of $2\ m/s$ compresses a spring through a distance 2 cm before its speed is halved. Find the spring constant of the spring.**
   (a) $1250\ N/m$ (b) $750\ N/m$
   (c) $1000\ N/m$ (d) $1500\ N/m$

10. **A bullet of mass m moving horizontally with speed v_0 hits a wooden block of mass M that is suspended from a massless string. The bullet gets lodged into the block and comes into halt. If the block-bullet**

combine swings to a maximum height h, then how much of the initial kinetic energy of the bullet is lost in the collision?

(a) $\frac{1}{2}mv_0^2\left(\frac{M}{m+M}\right)$ (b) $\frac{1}{2}mv_0^2\left(\frac{M+m}{M}\right)$

(c) $\frac{1}{2}mv_0^2\left(\frac{M^2}{(m+M)^2}\right)$ (d) $\frac{1}{2}mv_0^2\left(\frac{(M+m)^2}{M^2}\right)$

11. A ball of mass 100 g is dropped at time $t=0$. A second ball of mass 200 g is dropped from the same point at $t=0.2$ s. The distance between the centre of mass of two balls and the release point at $t=0.4$ s is (assume, $g=10\ m/s^2$)

(a) 0.4 m (b) 0.5 m

(c) 0.6 m (d) 0.8 m

12. A ball of mass M moving with a speed of $2\ m/s$ hits another ball of mass 1 kg moving in the same direction with a speed of $1\ m/s$. If the kinetic energy of centre of mass is $4/3$ J, then the magnitude of M is

(a) 1 kg (b) 0.25 kg

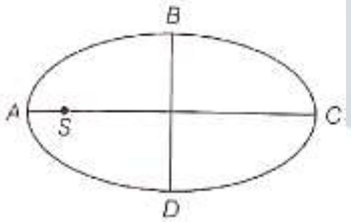
(c) 0.50 kg (d) 2 kg

13. A simple harmonic osculator of frequency 1 Hz has a phase of 1 rad. By how much should the origin be shifted in time, so as to make the phase of the oscillator vanish? [Time in seconds (s)].

(a) $-\frac{1}{\pi}$ s (b) $-\frac{1}{2\pi}$ s

(c) $-\frac{\pi}{2}$ s (d) $-\pi$s

14. A planct is revolving around the sun in which of the following is correct statement?



(a) The time taken in travelling DAB is less than that for BCD.
(b) The time taken in travelling DAB is greater than that for BCD.
(c) The time taken in travelling CDA is less than that for ABC.
(d) The time taken in travelling CDA is greater than that for ABC.

15. Which of the following statement is incorrect?

(a) The bulk modulus for solids is much larger than for liquids.
(b) Gases are least compressible.
(c) The incompressibility of the solids is due to the tight coupling between neighbouring atoms.
(d) The reciprocal of the bulk modulus is called compressibility.

16. The speed of the water in a river is v near the surface. If the coefficient of viscosity of water is η and the depth of the river is H, then the shearing stress between the horizontal layers of water is

(a) $\eta\frac{H}{V}$ (b) $\eta\frac{V}{H}$

(c) $\frac{v}{\eta H}$ (d) $\eta \vee H$

17. A steel rod at 25°C is observed to be 1 m long when measured by another metal scale which is correct at 0°C. The exact length of steel rod at 0°C is $\left(\alpha_{steel}=12\times10^{-6}/{}^\circ C \text{ and } \alpha_{metal}=20\times10^{-6}/{}^\circ C\right)$

(a) 1.00002 m (b) 1.0002 m

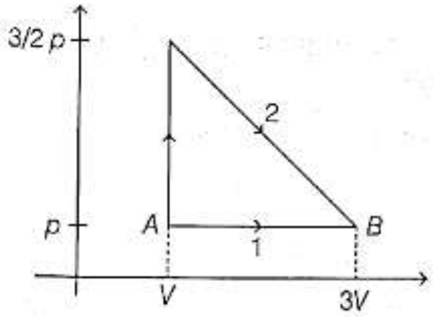
(c) 0.998 m (d) 0.9998 m

18. Latent heat of vaporisation of water is 22.6×10^5 J/kg. The amount of heat needed to convert 100 kg of water at 100°C into vapour at 100°C is

(a) 11.3×10^5 J (b) 11.3×10^6 J

(c) 22.6×10^6 J (d) 22.6×10^7 J

19. The $p-V$ diagram shown below indicates two paths along which a sample of gas can be taken from state A to state B. The energy equal to $5pV$ in the form of heat is required to be transferred, if the Path- 1 is chosen. How much energy in the form of heat should be transferred, if Path-2 is chosen?



(a) $\frac{11}{2}$ pv (b) 6pV

(c) $\frac{9}{2}$pV (d) 7 pV

20. Two vessels separately contain two ideal gases A and B at the same temperature. The pressure of gas A is three times the pressure of gas B. Under these conditions, the density of gas A is found to be two times the density of B. The ratio of molecular weights of gas A and B, i.e. M_A/M_B is

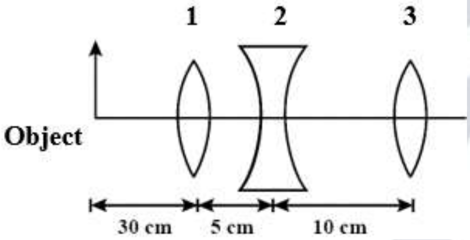
(a) 2/3 (b) 3/2

(c) 3/4 (d) 4/3

21. Two coherent plane waves of identical frequency and intensity (I) interfere at a point, where they differ in phase by 60°. What is the resulting intensity?

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

22. The position of final image formed by the given lens combination from the third lens will be at a distance of ($f_1 = +10$ cm, $f_2 = -10$ cm, and $f_3 = +30$ cm)



(a) 15 cm (b) infinity

(c) 45 cm (d) 30 cm

23. An object is placed at a distance of 40 cm in front of a concave mirror of focal length 20 cm . The image produced is

(a) real, inverted and smaller in size

(b) real, inverted and of same size

(c) real and erect

(d) virtual and inverted

24. Two beams of monochromatic light with intensities 64 mW and 4 mW interfere constructively to produce an intensity of 100 mW . If one of the beams is shifted by an angle θ, the intensity is reduced to 84 mW . The magnitude of θ is

(a) 30° (b) 60°

(c) 45° (d) $\cos^{-1}\left(\frac{1}{3}\right)$

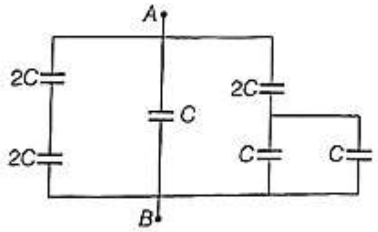
25. A particle of mass 2×10^{-6} kg with a charge 5×10^{-6}C is hanging in air above a similarly charged conducting surface. The charge density of the surface is (assume, $\varepsilon_0 = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$ and $g = 10 m/s^2$)

(a) $35.4 \times 10^{-12} C/m^2$

(b) $23.6 \times 10^{-12} C/m^2$

(c) $53.1 \times 10^{-12} \mathrm{c/m^2}$
(d) $17.7 \times 10^{-12} \mathrm{C/m^2}$

26. Find the equivalent capacitance between point A and B.

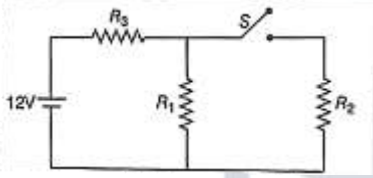


(a) 4C (b) 3C
(c) 2 C (d) 1 C

27. A circular wire has current density $J = \left(2 \times 10^{10} \frac{A}{m^2}\right) r^2$, where r is the radial distance, out of the wire radius is 2 mm . The end-to-end potential applied to the wire is 50 V . How much energy (in joule) is converted to thermal energy in 100 s ?

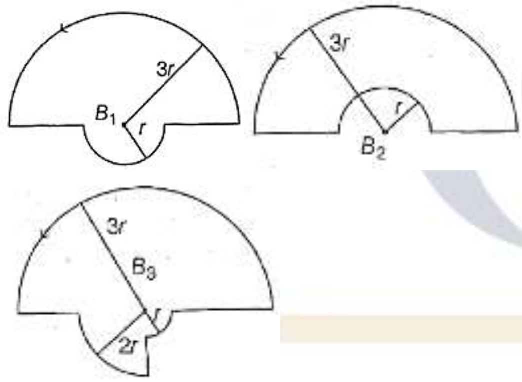
(a) 1200π (b) 800π
(c) 3200π (d) 600π

28. The resistance in following circuit are $R_1 = R_2 = R_3 = 6.0\Omega$. The emf of the battery is 12 V . When switch S is closed, the potential across resistance R_1 is changed by an amount.



(a) -2 V (b) +2V
(c) -4 V (d) +4 V

29. Figure below shows three circuits consisting of concentric circular arcs and straight radial lines. The centre of the circle is shown by the dot. Same current flows through each of the circuits. If B_1, B_2, B_3 are the magnitudes of the magnetic field at the centre. Which of the following is true?



(a) $B_1 > B_2 > B_3$ (b) $B_1 > B_3 > B_2$
(c) $B_3 > B_1 > B_2$ (d) $B_3 > B_2 > B_1$

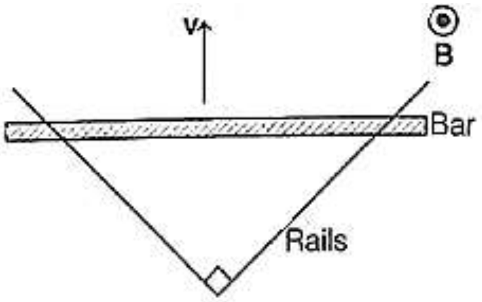
30. A charged particle moves through a magnetic field perpendicular to its direction. Then,

(a) kinetic energy changes but the momentum is constant
(b) the momentum changes but the kinetic energy is constant
(c) both momentum and kinetic energy of the particles are not constant
(d) both momentum and kinetic energy of the particles are constant

31. The length l of a magnet is large compared to its width and breadth. The time-period of its oscillation in a vibration magnetometer is 2 s . The magnet is cut into three equal parts of length $\frac{l}{3}$ each. If these parts are placed on each other with their like poles together, then the time-period of this combination is

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

32. Two straight conducting raus form a right angle as shown below. A conducting bar in contact with the rails starts at the vertex at time $t = 0$ and moves with constant velocity of $v = 5\ m/s$ along them. A magnetic field with $B = 0.1$ T is directed out of the page. The absolute value of the emf around the triangle at the time $t = 4$ s will be



(a) 10 V (b) 15 V
(c) 20 V (d) 30 V

33. A current of 6 A is flowing at 220 V in the primary coil of a transformer. If the voltage produced in the secondary coil is 1100 V and 40% of power is lost, then the current in the secondary coil will be

(a) 0.28 A (b) 0.36 A
(c) 0.48 A (d) 0.42 A

34. The phase difference between the following two waves y_2 and y_1 is

$$y_1 = a\sin(\omega t - kx); y_2 = b\cos\left(\omega t - kx + \frac{\pi}{3}\right)$$

(a) $\frac{\pi}{6}$ (b) $\frac{5\pi}{6}$ (c) $\frac{\pi}{3}$ (d) π

35. A beam of photons with an energy of 10.5 eV strike a metal plate. The photoelectrons are emitted with maximum velocity of 1.6×10^6 m/s. The work-function of the metal is (assume, mass of electron = 9×10^{-31} kg and charge of electron = 1.6×10^{-19}C)

(a) 3.0 eV (b) 3.1 eV
(c) 3.3 eV (d) 3.5 eV

36. In the hydrogen atom spectrum, let E_1 and E_2 are energies for the transition $n = 2 \to n = 1$ and $n = 3 \to n = 2$, respectively. The ratio E_2/E_1 is

(a) $\frac{2}{3}$ (b) $\frac{3}{2}$ (c) $\frac{2}{9}$ (d) $\frac{5}{27}$

37. What is the binding energy of $^{29}_{14}$Si, whose atomic mass is 28.976495 u ?
Mass of proton = 1.007276u
Mass of neutron = 1.008664u (neglect the electron mass) (assume, 1u = 931.5MeV)

(a) 237.84 MeV (b) 421.72 MeV
(c) 387.21 MeV (d) 116.35 MeV

38. Which of the following statements is incorrect?

(a) The resistance of intrinsic semiconductors decrease with increase of temperature.
(b) Doping pure Si with trivalent impurities give p-type semiconductors.
(c) The majority carriers in n-type semiconductors are holes.
(d) A p-n junction can act as a semiconductor device.

39. A piece of copper and another of germanium are cooled from room temperature to 77°K. The resistance of

(a) copper increases and germanium decreases
(b) both decreases
(c) both increases
(d) copper decreases and germanium increases

40. A carrier signal of frequency v_1 and peak voltage of V_1 is modulated by a message signal of frequency v_2 and peak voltage of V_2. Let m be the modulation index and v_+, v_- be side bands produced. Which of the correct statement?

(a) $m = \frac{V_1}{V_2}$ (b) $v_1 = \frac{v_+ + v_-}{2}$
(c) $v_2 = \frac{v_+ + v_-}{2}$ (d) $m > \frac{V_2}{V_1}$

Chemistry

41. Two series of spectral lines of atomic hydrogen which do not belong to infrared spectral region are
(a) Lyman and Paschen
(b) Balmer and Brackett
(c) Plund and Lyman
(d) Lyman and Balmer

42. Which of the activities can be compared to the concept of quantisation?
(a) A car is travelling on the road
(b) An apple is falling form the tree
(c) A person can stand on any step of a stair case
(d) Throwing a playing disc

43. What will be the IUPAC symbol and name for the element with atomic number 123 ?
(a) Unt and unniltrium (b) Ubq and unbiquadium
(c) Ubt and unbitrium (d) Unb and unnilbium

44. Which of the following statements is incorrect?
(a) The enthalpy of atomisation decreases down a group in s-block elements
(b) The enthalpy of atomisation decreases down a group in p-block elements
(c) The enthalpy of atomisation decreases down a group in d-block elements
(d) The enthalpy of atomisation increases down a group in d-block elements

45. Find out the correct order of ionic character in the following molecules.
(i) SO_2 **(ii) K_2O**
(iii) N_2 **(iv) LiF**
(a) (iV) > (ii) > (iii) > (i)
(b) (iv) > (ii) > (i) > (iii)
(c) (ii) > (iv) > (i) > (iii)
(d) (ii) > (iv) > (iii) > (i)

46. Find out the bond order in He_2, He_2^+, O_2 and O_2^+, respectively
(a) 0,0.5,2 and 3 (b) 0.5,0,3 and 2
(c) 0,0.5,2 and 1 (d) 0,0.5,2 and 2.5

47. One mole of an ideal gas occupies 12 L at $297^{\circ}C$. What is the pressure of the gas?
(a) 207 kPa (b) 395 kPa
(c) 395 Pa (d) 207 Pa

48. 4.4 grams of a gas at $0^{\circ}C$ and 0.82 atm pressure occupies a volume of 2.73 L . The gas can be
(a) O_2 (b) CO
(c) NO_2 (d) CO_2

49. How many moles of ammonia are produced by 5 moles of hydrogen?
(a) 2.3 (b) 8.3
(c) 10.3 (d) 3.3

50. C_2H_4 can react with H_2 in presence of a catalyst to form C_2H_6 as per the following reaction,
$$C_2H_4(g) + H_2(g) \xrightarrow{\text{catalyst}} C_2H_6(g)$$
The amount of C_2H_4 in grams required to produce 50 grams of C_2H_6 is
(a) 36.44 g (b) 22.18 g
(c) 46.67 g (d) 57.11 g

51. For which of the following systems, the difference between ΔH and ΔU is not significant?
(i) Solids
(ii) gases
(iii) Mixture of gases and liquids
(iv) Liquids
(a) (i) and (iv) (b) (i), (iii) and (iv)
(c) (ii) and (iv) (d) (ii) and (iii)

52. At $25^{\circ}C$, the ionisation constant for anilinium hydroxide is 5.00×10^{-10}. The hydrolysis constant of anilinium chloride is

(a) 2.00×10^{-5} (b) 4.00×10^{-3}
(c) 1.50×10^{-6} (d) 2.50×10^{-4}

53. For the given equilibrium reaction, $2A(g) \rightleftharpoons 2B(g) + C(g)$ the equilibrium constant (K_C) at 1000 K is 4×10^{-4}. Calculate K_p for the reaction at 800 K temperature

(a) 0.044 (b) 0.026
(c) 0.33 (d) 1

54. Hydrogen peroxide is stored away from light because it can get decomposed when exposed to light as

(a) H_2O and O_2 (b) H_2 and O_2
(c) H_2O and H_2 (d) H_2O and O_3

55. Which of the reactions represents "slaking of lime"?

(a) $CaCO_3 \rightleftharpoons CaO + CO_2$
(b) $CaO + CO_2 \longrightarrow CaCO_3$
(c) $CaO + H_2O \longrightarrow Ca(OH)_2$
(d) $CaO + SiO_2 \longrightarrow CaSiO_3$

56. H_3BO_3 is

(a) monobasic and weak Lewis acid
(b) monobasic and weak Bronsted acid
(c) monobasic and strong Lewis acid
(d) tribasic and weak Bronsted acid

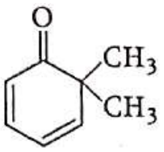
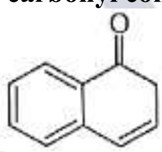
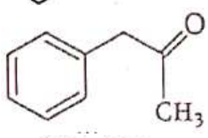
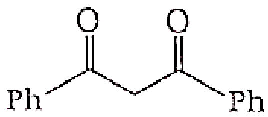
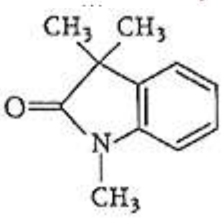
57. In CO_2 molecule, the hybridisations of carbon and oxygen atoms are respectively

(a) Carbon Oxygen
sp^2 sp^2
(b) Carbon Oxygen
sp^2 sp^2
(c) Carbon Oxygen
sp sp
(d) Carbon Oxygen
sp^2 sp^3

58. The consequence of global warming may be the following.

(a) Decrease in average temperature of the earth
(b) Melting of Himalayan glaciers
(c) Eutrophication
(d) Increased biochemcial oxygen demand

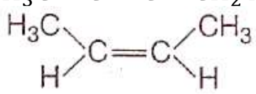
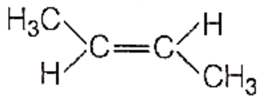
59. Which of the following carbonyl compounds will exhibit enolisation?

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

(a) (i), (ii) and (iii) (b) (ii), (iii) and (iv)
(c) (iii), (iv) and (v) (d) (i), (iii) and (v)

60. The major product formed in the following reaction is

$$\mathbf{H_3C - C \equiv C - CH_3 + Na \xrightarrow{\text{Liquid } NH_3}}$$

(a) $H_3C - CH_2 - C \equiv C^- Na^+$
(b) $H_3C - C \equiv C - CH_2^- Na^-$
(c) 
(d) 

61. Which one of the following reactions gives the product with less number of carbon atoms than the starting material?

(a) $R - X \xrightarrow{\text{Na Ether}}$
(b) $RCO_2Na \xrightarrow{\text{NaoH ,Cao}}$
(c) $RCO_2\ K \xrightarrow{\text{Electrolysis}}$
(d) $R - X \xrightarrow{\text{Zn ,Hcl}}$

62. $LiCoO_2$ crystallises in a rhomobohedral structure. Consider a situation where 50% lithium (Li) is extracted from the lattice. To keep the crystal electrically neutral, change in average oxidation state of Co is

(a) 16.66% decrease (b) 16.66% increase
(c) 50% increase (d) 50% decrease

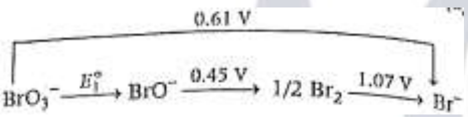
63. The freezing point depression of 0.001 M of $A_xB_y[Fe(CN)_6]$ is 5.58×10^{-3} K. If the oxidation state of Fe is +2 and $K_f = 1.86$ kg mol^{-1}, then the total number of possibilities for different types of A and B cations are

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

64. When 2.44 grams of benzoic acid (C_6H_5COOH) dissolved in 25 grams of benzene, it shows depression of freezing point equal to 2.2 K . Molal depression constant of benzene is 5.0 K kg mol^{-1} . What is the percentage association of acid, if it forms dimer in solution?

(a) 50% (b) 77%
(c) 95% (d) 90%

65.



The value of E_1^0 is

(a) 0.76 V (b) 0.535 V
(c) 0.428 V (d) 1.12 V

66. The rate of chemical reaction doubles with every 10°C rise in temperature. If the reaction is carried out in the vicinity of 22°C, the activation energy of the reaction is (given $R = 8.3$ J K^{-1} mol^{-1}, $\ln 2 = 0.69$ and $\ln 3 = 1.1$)

(a) 1.69 kJ mol^{-1} (b) 0.169 kJ mol^{-1}
(c) 49.8 kJ mol^{-1} (d) 498 J mol^{-1}

67. In an adsorption experiment, a graph between $\log(x/m)$ vs $\log p$ was found to be linear with a slope of 45°. The intercept on the $\log(x/m)$ axis was found to be 0.3 . The amount of the gas adsorbed per gram of charcoal under a pressure of 1 atm is

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

68. Ellingham diagram is drawn between

(a) change in potential of pH
(b) change in free energy and oxidation state
(c) change in free energy and temperature
(d) change in free energy and polarisability

69. Brown ring test is to detect the presence of

(a) NO_3^- (b) Cl^-

(c) I^- (d) Br^-

70. Oxidation state of S in $H_2S_2O_8$ is

(a) 8 (b) 6 (c) 4 (d) 7

71. Which of the following sets correctly represents the increase in the paramagnetic property of the ions?

(a) $Cu^{2+} < V^{2+} < Cr^{2+} < Mn^{2+}$

(b) $Cu^{2+} < Cr^{2+} < V^{2+} < Mn^{2+}$

(c) $Mn^{2+} < V^{2+} < Cr^{2+} < Cu^{2+}$

(d) $Mn^{2+} < Cu^{2+} < Cr^{2+} < V^{2+}$

72. The coordination complex $[Co(OH_2)_6]^{2+}$ has one unpaired electron, which of the following statements are true?

(i) The complex is octahedral.

(ii) The complex is an outer orbital complex.

(iii) The complex is diamagnetic.

(a) (i) and (iii) only (b) (i), (ii) and (iii)

(c) (i) and (ii) only (d) (ii) and (iii) only

73. Which one of the following is made by using step growth polymerisation?

(a) Nylon 6,6 (b) Teflon

(c) Rubber (d) Neoprene

74. Insulin and glucogen, which are responsible to maintain the blood glucose level, fall under

(a) antibodies (b) harmones

(c) enzymes(d) trasnport agents

75. Which one of the following statements is "not correct" about cationic detergents?

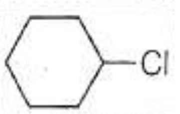
(a) Cationic detergents are quaternary ammonium salts

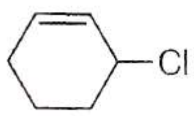
(b) Cationic part contains a long hydrocarbon chain

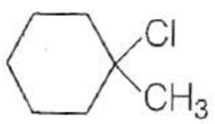
(c) Cationic detergents exhibit germicidal properties

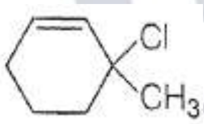
(d) Cationic detergents are cheap and are widely used

76. Which one of the following will be most reactive for S_N1 reaction?

(a) 

(b) 

(c) 

(d) 

77. Which of following alcohols gives white turbidity almost immediately with the Lucas reagent at room temperature?

(i) n-butanol **(ii) tert-butanol**

(iii) Benzyl alcohol **(iv) Allylic alcohol**

(a) (i), (ii) and (iii) (b) (i), (iii) and (iv)

(c) (ii), (iii) and (iv) (d) (i), (ii) and (iv)

78. Which one among the following reaction products gives iodoform test?

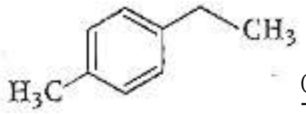
(a) $CH_3CH_2CH_2C \equiv N \xrightarrow[(ii)H_3O^+]{(i)C_2H_5MgBr}$

(b) $(C_6H_5)_2Cd \xrightarrow{CH_3COCl}$

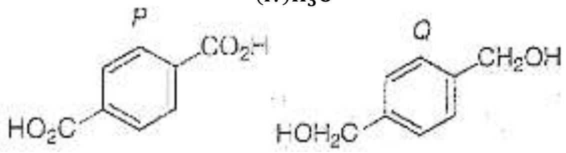
(c) $CH_2 = CHCH_2CH(OH)C_6H_5 \xrightarrow{PCC}$

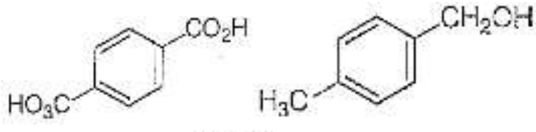
(d) $C_6H_5CH_2CN \xrightarrow[(ii)H_3O^+]{(i)C_2H_5MgBr}$

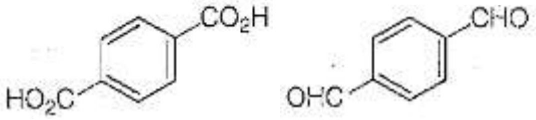
79. The major products P and Q in the following reaction sequence are

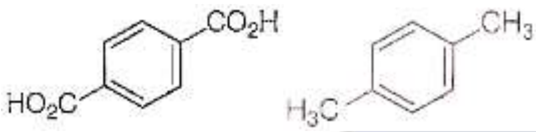


$\xrightarrow[\text{(ii)dil.}H_2SO_4]{\text{(i)}KMnO_4\text{(excess)}} P \xrightarrow[\text{(iv)}H_3O^+]{\text{(iii)}LiAlH_4} Q$

(a) 

(b) 

(c) 

(d) 

80. Which one of the following compounds undergoes Hofmann degradation reaction?

(a) CH_3CN (b) $CH_3CONHCH_3$

(c) CH_3CONH_2 (d) CH_3NC

Mathematics

81. Match the items of List-I with those of the items of List-II

List-I	List-II
(A) Range of $\sec^{-1}[1+\cos^2 x]$ [.] denote greatest integer function	**(I) odd function**
(B) Domain of $f(x)$, where $f\left(x+\frac{1}{x}\right)=x^2+\frac{1}{x^2}$	**(II) $\left\{0,\frac{1}{2}\right\}$**
(C) $f(x+y)=f(x)+f(y); f(1)=5$	**(III) $\{\sec^{-1}5, \sec^{-1}4\}$**
(D) $\sin^{-1}x-\cos^{-1}x+\sin^{-1}(1-x)=0 \Rightarrow x\in$	**(IV) R- (-2 ,2)**
	(V) {Sec^{-1} 1 Sec^{-1}2

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

82. The domain of the function

$f(x)=\sec^{-1}(3x-4)+\tanh^{-1}\left(\frac{x+3}{5}\right)$ **is**

(a) $(-8,1)\cup\left(\frac{5}{3},2\right)$ (b) $\left(1,\frac{5}{3}\right)$

(c) $[-8,1]\cup\left[\frac{5}{3},2\right]$ (d) $(-8,1]\cup\left[\frac{5}{3},2\right)$

83. Let $m = (9n^2 + 54n + 80)(9n^2 + 45n + 54)(9n^2 + 36n + 35)$.
The greatest positive integer which divides m, for all Positive integers n, is
(a) 720 (b) 724
(c) 696 (d) 842

84. If A is a 3×3 matrix and the matrix obtained by replacing the elements of A with their corresponding cofactors is $\begin{bmatrix} 1 & -2 & 1 \\ 4 & -5 & -2 \\ -2 & 4 & 1 \end{bmatrix}$, then a possible value of the determinant of A is
(a) 4 (b) 3 (c) 2 (d) 1

85. If $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$, then $(A^2)^{-1} =$
(a) A^2 (b) 2 A
(c) A^3 (d) $\begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ -2 & 2 & -1 \end{bmatrix}$

86. The equations $x + y + z = 3, x + 2y + 2z = 6$ and $x + ay + 3z = b$ have
(a) No solution when $a \neq 3$, b is any value
(b) Infinite number of solutions when $b \neq 9$
(c) Unique solution when $a \neq 3$, b is any value
(d) Unique solution when $a = 3$ and $b \neq 9$

87. Let $z \in C$ and $i = \sqrt{-1}$, if $a, b, c \in (0, 1)$ be such that $a^2 + b^2 + c^2 = 1$ and $b + ic = (1 + a)z$, then $\frac{1+iz}{1-iz} =$
(a) $\frac{a+ib}{1+c}$ (b) $\frac{a-ib}{1+c}$
(c) $\frac{a-ib}{1-c}$ (d) $\frac{a+ib}{1-c}$

88. If $A = \{z = x + iy / \text{ real part of } \frac{\bar{z}-1}{\bar{z}-i} = 2\}$, then the locus of the point $P(x, y)$ in the cartesian plane is
(a) a pair of lines passing through $(-1, -1)$
(b) a circle of radius $\frac{1}{\sqrt{2}}$ and the centre $\left(\frac{-1}{2}, \frac{3}{2}\right)$
(c) a pair of lines passing through $(-1, -2)$
(d) a circle of radius $\frac{2}{3}\sqrt{2}$ and the centre $\left(-\frac{1}{3}, \frac{2}{3}\right)$.

89. If ω is a complex cube root of unity, then
$(1 - \omega + \omega^2)^6 + (1 - \omega^2 + \omega)^6 =$
(a) 0 (b) 6 (c) 64 (d) 128

90. If e^{ix} is a solution of the equation $z^n + p_1 z^{n-1} + p_2 z^{n-2} + \cdots \ldots + p_n = 0$, where p_i are real $(i = 1, 2, 3, \ldots, n)$, then $p_n \sin nx + p_{n-1} \sin(n-1)x + \cdots + p_1 \sin x + 1 =$
(a) $\cos(n + 1)x$ (b) $\sin(n(n + 1))x$
(c) 1 (d) 0

91. Assertion (A) $3x^2 - 16x + 4 > -16$ is satisfied for some values of real x in $\left(0, \frac{10}{3}\right)$.
Reason (R) $ax^2 + bx + c$ and a will have the same sign for some values of $x \in R$ when $b^2 - 4ac > 0$.
(a) (A) is true, (R) is true and (R) is the correct explanation for (A).
(b) (A) is true, (R) is true but (R) is not the correct explanation for (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true.

92. If the roots of the quadratic equation $ax^2 + bx + c = 0$ are imaginary, then for all real values of x, the minimum value of the expression $3a^2x^2 + 6abx + 2b^2$ is
(a) $< 4ab$ (b) $> 4ac$
(c) $> -4ac$ (d) $< -4ab$

93. Let α, β, γ be the roots of the equation $x^3 + px + q = 0$ and $f(x) = 3p^2x^2 + p^2x + 3q$. Then $\Sigma\alpha^2\beta + \Sigma\alpha^4 =$
(a) f(1) (b) f(−1)
(c) f(0) (d) f(2)

94. If α, β, γ are the roots of the equation $x^3 + ax^2 - bx + c = 0$, then $\Sigma\beta^2(\gamma + \alpha) =$

(a) $\frac{a^2+b-c}{3ab}$ (b) $ac + b^3$

(c) $\frac{bc+a^2}{3ab}$ (d) $ab + 3c$

95. If the number of all possible permutations of the letters of the word MATHEMATICS in which the repeated letters are not together is $982(X)$, then $X =$

(a) 5040 (b) 14400

(c) 21600 (d) 86400

96. There are 10 red and 5 yellow roses of different sizes. If x is the number of garlands that can be formed with all these flowers so that no two yellow roses come together and y is the number of garlands formed with all these flowers so that all the red roses coming together, then $\frac{2(x-y)}{10!} =$

(a) $\frac{9!}{5!} - 5!$ (b) $(11)^2 \cdot (4!)$

(c) 10 !- 6 ! (d) $6! \times (5! - 2)$

97. If $y = \frac{3}{4} + \frac{3 \cdot 5}{4 \cdot 8} + \frac{3 \cdot 5 \cdot 7}{4 \cdot 8 \cdot 12} + \cdots ..\infty$, then

(a) $y^2 - 2y + 5 = 0$ (b) $y^2 + 2y - 7 = 0$

(c) $y^2 - 3y + 4 = 0$ (d) $y^2 + 4y - 6 = 0$

98. If the coefficient of x^{13} in the expansion of $\frac{(1+x)^2}{(1-2x)^3}$ is $A \times 2^{10}$, then $A =$

(a) 862 (b) 1304

(c) 1360 (d) -268

99. If the partial decomposition of $\frac{x^2+1}{x^3+3x^2+3x+2}$ is $\frac{A}{x+2} + \frac{B}{x^2+x+1} + \frac{C}{(x+2)(x^2+x+1)}$

Then $A - B + C =$

(a) 0 (b) 2 (c) 3 (d) 4

100. If $\sqrt{x} + \frac{1}{\sqrt{x}} = 2\cos\theta$, then $x^6 + x^{-6} =$

(a) $2\cos 6\theta$ (b) $2\cos 12\theta$

(c) $2\cos 3\theta$ (d) $2\sin 3\theta$

101. If $A = \sin\theta|\sin\theta|$, $B = \cos\theta|\cos\theta|$ and $\frac{99\pi}{2} \leq \theta \leq \frac{100\pi}{2}$, then

(a) $A + B = 1$ (b) $A + B = -1$

(c) $B - A = 1$ (d) $B - A = -1$

102. If $\frac{\cos(\theta_1+\theta_2)}{\cos(\theta_1-\theta_2)} + \frac{\cos(\theta_3-\theta_4)}{\cos(\theta_3+\theta_4)} = 0$, then $\cot\theta_1 \cdot \cot\theta_2 \cdot \cot\theta_3 \cdot \cot\theta_4 =$

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

103. The equation $\sin^4 x - (K+3)\sin^2 x - K - 4 = 0$ has a solution if

(a) $K > 4$

(b) $-4 \leq K \leq -3$

(c) K is any positive integer

(d) $K = 0$

104. Let Z denote the set of integers. Then match the items in list-I, with those of the items in List-II.

List-I	**List-II**
(A) $\sin^{-1}\left(\frac{2\sqrt{2}}{3}\right) + \sin^{-1}\frac{1}{3}$	**(I)** $K\pi \pm (-1)^n\frac{\pi}{6}, n \in Z$
(B) $\sin^{-1}\left(\frac{(-1)^n}{2}\right) = x, n \in Z$	**(II)** $K\pi \pm 1, K \in Z$
(C) $\tan^{-1}\left(\sec\frac{\pi}{4} + \tan\frac{\pi}{4}\right)$	**(III)** $\frac{3}{2}$
(D) $\sin^{-1}\lvert\sin x\rvert = \sqrt{\sin^{-1}\lvert\sin x\rvert} \Rightarrow x \in$	**(IV)** $\frac{3\pi}{8}$

	(V) $\frac{\pi}{2}$

The correct match is

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

105. $\sinh^{-1}(-2) + \text{cosech}^{-1}(-2) + \coth^{-1}(-2) =$

(a) $\log\left(\frac{7-3\sqrt{5}}{2\sqrt{3}}\right)$ (b) $\log\left(\frac{3-\sqrt{5}}{2\sqrt{3}}\right)$

(c) $\log\left(\frac{7+3\sqrt{5}}{2\sqrt{3}}\right)$ (d) $\log\left(\frac{3+\sqrt{5}}{2\sqrt{3}}\right)$

106. **In $\triangle ABC$, if $a:b:c = 4:5:6$, then the ratio of the circumradius to its inradius is**

(a) $16:7$ (b) $7:16$

(c) $4:5$, (d) $5:4$

107. **In a $\triangle ABC$, if $b = 10$, $a\cos^2\frac{C}{2} + c\cos^2\frac{A}{2} = 15$, and the area of the triangle is $15\sqrt{3}$ sq. units, then $\cot\frac{B}{2} =$**

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

108. **If d_1, d_2, d_3 are the diameters of three ex-circles of a $\triangle ABC$, then $d_1 d_2 + d_2 d_3 + d_3 d_1 =$**

(a) $(a+b+c)^2$ (b) $ab + bc + ca$

(c) $4\Delta^2$ (d) $2s^2$

109. **$A(a), B(b), C(c), D(d)$ are four concyclic points, such that $xa + yb + zc + td = 0, x + y + z + t = 0$ where x, y, z, t are constants not all zero. If the chords AB and CD intersect at P, then**

(a) $|xy||a+c|^2 = |zt||b+d|^2$

(b) $|xy||a-b|^2 = |zt||c-d|^2$

(c) $|xt||a-c|^2 = |yz||b-c|^2$

(d) $|xz||b+d|^2 = |yt||a+c|^2$

110. **If a and b are two non collinear vectors, then $\frac{a\times(b\times a)}{|a|^2}$ represent**

(a) a vector perpendicular to the plane of a, b

(b) projection of b along a vector perpendicular to the vector a

(c) projection of a along the vector perpendicular to **b**

(d) a vector on the plane of a, b whose magnitude is equal to $|a| + |b|$

111. **If $A(1,2,3), B(3,7,-2), C(6,7,7)$ and $D(-1,0,-1)$ are points in a plane, then the vector equation of the line passing through the centroids of $\triangle ABD$ and $\triangle ACD$ is**

(a) $r = 2\hat{i} + 3\hat{j} + 3\hat{k} + t(\hat{i} + 3\hat{j})$

(b) $r = (1+t)\hat{i} + 3\hat{j} + 3t\hat{k}$

(c) $r = \hat{i} + \hat{j} + \hat{k} + t(2\hat{i} - \hat{j})$

(d) $r = 2\hat{i} - \hat{j} + t(\hat{j} + 4\hat{k})$

112. **If $a = \hat{i} + (\tan\theta)\hat{j} + \left(\frac{3}{\sqrt{\sin\theta/2}}\right)\hat{k}$ and $b = \tan\theta(\hat{j} - \hat{i}) - \left(2\sqrt{\sin\frac{\theta}{2}}\right)\hat{k}$ are orthogonal vectors and $c = (\sin 2\theta)\hat{i} - 2\hat{j} + 2\hat{k}$ makes an obtuse angle with X-axis, then $\theta =$**

(a) $(2n+1)\pi + \tan^{-1} 2, n \in Z$

(b) $n\pi - \tan^{-1} 2, n \in Z$

(c) $(2n+1)\pi - \tan^{-1} 3, n \in \mathbf{Z}$

(d) $(2n+1)\pi + \tan^{-1} 3, n \in \mathbf{Z}$

113. **If a, b and c be three non-coplanar vectors and p, q and r be defined by $p = \frac{b\times c}{a\cdot(b\times c)}, q = \frac{c\times a}{b\cdot(c\times a)}, r = \frac{a\times b}{c\cdot(a\times b)}$ such that $\alpha = (a+b)\cdot p + (b+c)\cdot q + (c+a)\cdot r$ and $\beta = \frac{(a+b)\cdot(b+c)\times(a+b+c)}{b\cdot(a\times c)}$, then $\alpha + \beta =$**

(a) 2 (b) 3 (c) 4 (d) 0

114. If $a + lb + l^2c = 0$ and $a \times b + b \times c + c \times a = 3(b \times c)$, then the minimum value of such l is

(a) 1 (b) -2 (c) $\frac{-9}{4}$ (d) 0

115. The mean deviation about the mean for the following data is

Class Interval	$0-4$	$4-8$	$8-12$	$12-16$
Frequency	4	3	2	1

(a) 6 (b) 3.6 (c) 3.2 (d) 10

116. The means of two groups of observations A and B are $\bar{x}, \bar{y}$ respectively and their standard deviations are respectively 2 and 3 . In order that the group A is to be more consistent than the group B $\frac{\bar{y}}{\bar{x}} >$

(a) $\frac{3}{2}$ (b) $\frac{5}{1}$ (c) $\frac{2}{3}$ (d) $\frac{6}{5}$

117. When two dice are rolled, let x be the probability of getting a sum of the numbers appear on the dice is at most 7. Let y be the probability of getting a sum 7 at least once when a pair of dice are rolled n times. In order to have $y > x$, the minimum n is

(a) 3 (b) 6 (c) 5 (d) 4

118. Two numbers are selected at random from the set $\{1, 2, 3, \dots \dots, 13\}$. If the sum of the selected numbers is even, the probability that both the numbers are odd is

(a) $\frac{2}{13}$ (b) $\frac{1}{2}$ (c) $\frac{7}{12}$ (d) $\frac{5}{26}$

119. Let X be the discrete random variable representing the number (x) appeared on the face of a biased die when it is rolled. The probability distribution of X is

$X = x$	1	2	3	4	5	6
$P(X = x)$	0.1	0.15	0.3	0.25	k	k

Then variance of X is

(a) 1.64 (b) 1.93

(c) 2.16 (d) 2.28

120. 2n unbiased coins are tossed. The probability of having the number of heads is not equal to the number of tails, is

(a) $\frac{2n!}{(n!)^2}\left(\frac{1}{2}\right)^{2n}$ (b) $1 - \frac{2n!}{(n!)^2}$

(c) $\frac{2n!}{(n!)^2}$ (d) $1 - \frac{2n!}{(n!)^2} \cdot \frac{1}{4^n}$

121. Let $p(x)$ represent the probability mass function of a poisson distribution. If its mean $\lambda = 3.725$, then value of x at which $p(x)$ is maximum is

(a) 2 (b) 3 (c) 4 (d) 5

122. Let $A = (0, 4)$ and $B = (2\cos\theta, 2\sin\theta)$, for some $0 < \theta < \frac{\pi}{2}$. Let P divide the line segment AB in the ratio $2:3$ internally. The locus of P is

(a) Circle (b) Ellipse

(c) Parabola(d) Hyperbola

123. The transformed equation of $3x^2 - 4xy = r^2$, when the coordinate axes are rotated through an angle $\tan^{-1}(2)$ is

(a) $X^2 - 4Y^2 = r^2$ (b) $2XY + r^2 = 0$

(c) $4Y^2 - X^2 = r^2$ (d) $XY = r^2$

124. If $x\cos\theta + y\sin\theta = p$ is the normal form and $y = mx + c$ is the slope-intercept form of the line $x + 2y + 1 = 0$, then $\tan^{-1}(\tan\theta + m + c) =$

(a) 0 (b) $\frac{\pi}{2}$ (c) π (d) $\frac{\pi}{4}$

125. If the family of straight lines $ax + by + c = 0$, where $2a + 3b = 4c$ is concurrent at the point $P(l, m)$, then the foot of the perpendicular drawn from P to the line $x + y + 1 = 0$ is

(a) $\left(\frac{-3}{8}, \frac{-5}{8}\right)$(b) $\left(\frac{-2}{5}, \frac{-3}{5}\right)$

(c) $(3, -4)$ (d) $(-5,4)$

126. **$O(0,0), A(-3,-1)$ and $B(-1,-3)$ are the vertices of a $\triangle OAB$. P is a point on the perpendicular AD drawn from A on OB such that $\frac{AP}{PD}=\frac{3}{4}$. Then the equation of the line L parallel to OB and passing through P, is**

(a) $3x-y+3=0$ (b) $21x-7y+32=0$
(c) $15x-5y+32=0$ (d) $3x-y+35=0$

127. **A straight line passing through the point $(1,0)$ and not parallel to X-axis intersects the curve $2x^2+5y^2-7x=0$ at two points A and B. The angle subtended by the line segment AB at the origin is**

(a) 30° (b) 45° (c) 60° (d) 90°

128. **If (p,q) is the centroid of the triangle formed by the lines $8x^2-14xy+5y^2=0, x-2y+3=0$, then**

(a) $p+q=-1$ (b) $q=2p$
(c) $p=2q$ (d) $p=q$

129. **The area (in sq. units) of the triangle formed by the two tangents drawn from the external point $O(0,0)$ to the circle $x^2+y^2-2gx-2hy+h^2=0$ and their chord of contact is**

(a) $\frac{gh}{h^3+g^2}$ (b) $\frac{gh}{h^2+g^3}$
(c) $\frac{hg^3}{h^2+g^2}$ (d) $\frac{gh^3}{h^2+g^2}$

130. **If the circle $x^2+y^2-6x+2y=28$ cuts off a chord of length λ units on the line $2x-5y+18=0$, then the value of λ is**

(a) 3 (b) 6 (c) 12 (d) 9

131. **Consider the circles $S_1: x^2+y^2+2x+8y-23=0$ and $S_2: x^2+y^2-4x+10y+19=0$**
If the polars of the centre of a circle with respect to the another circle are L_1 and L_2, then L_1, L_2 are

(a) Parallel and separated by a distance of $4\sqrt{10}$ units
(b) Perpendicular and intersect at (1,3)
(c) Perpendicular and intersect at $(1,-5)$
(d) Parallel and separated by a distance of $2\sqrt{10}$ units

132. **If the circle $S \equiv x^2+y^2-4=0$ intersects another circle $S'=0$ of radius $\frac{5\sqrt{2}}{2}$ in such a manner that the common chord is of maximum length with slope equal to $1/4$, then the centre of $S'=0$ is**

(a) $(-1,4)$ or $(1,-4)$
(b) $\left(-\frac{\sqrt{2}}{2}, 2\sqrt{2}\right)$ or $\left(\frac{\sqrt{2}}{2}, -2\sqrt{2}\right)$
(c) $\left(-2\sqrt{2}, \frac{\sqrt{2}}{2}\right)$ or $\left(2\sqrt{2}, \frac{-\sqrt{2}}{2}\right)$
(d) $(4,-1)$ or $(-4,1)$

133. **If the angle between the circles $x^2+y^2-4x-6y+k=0$ and $x^2+y^2+8x-4y+11=0$ is $\frac{\pi}{3}$, then the value of k is**

(a) -3 (b) 36 (c) 3 (d) 2

134. **Let $A(1,2), B(4,-4), C(2,2\sqrt{2})$ be points on the parabola $y^2=4x$. If α and β respectively represent the area of $\triangle ABC$ and the area of the triangle formed by the tangents at A, B, C to the above parabola, then $\alpha\beta =$**

(a) 6 (b) $3\sqrt{2}$
(c) 9 (d) $6\sqrt{2}$

135. **If $x-2y+k=0$ is a tangent to the parabola $y^2-4x-4y+8=0$, then the slope of the tangent drawn at (l,k) on the given parabola is**

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

136. **The equation of the ellipse in the standard form whose length of the latus rectum is 4 and whose distance between the foci is $4\sqrt{2}$, is**

(a) $\frac{x^2}{2}+\frac{y^2}{3}=1$ (b) $2x^2+y^2=8$
(c) $x^2+2y^2=16$ (d) $x^2+5y^2=25$

137. **The value of b^2 in order that the foci of the hyperbola $\frac{x^2}{144}-\frac{y^2}{81}=\frac{1}{25}$ and the ellipse $\frac{x^2}{16}+\frac{y^2}{b^2}=1$ coincide is**

(a) 1 (b) 5 (c) 7 (d) 9

138. **If the pole of the line $3x - 16y + 48 = 0$ with respect to the hyperbola $9x^2 - 16y^2 = 144$ is (α, β), then $\alpha - \beta =$**
(a) 0 (b) -3 (c) 2 (d) -7

139. **$A(2,3,-4), B(-3,3,-2), C(-1,4,2)$ and $D(3,5,1)$ are the vertices of a tetrahedron. If E, F, G are the centroids of its faces containing the point A, then the centroid of the triangle EFG is**
(a) $\left(\frac{1}{9}, \frac{15}{9}, \frac{-3}{9}\right)$ (b) $\left(\frac{1}{4}, \frac{15}{4}, \frac{-3}{4}\right)$
(c) $\left(\frac{4}{9}, \frac{11}{3}, \frac{-10}{9}\right)$ (d) $\left(\frac{-1}{9}, \frac{12}{9}, \frac{1}{9}\right)$

140. **If l, m, n are the direction cosines of a line which makes angles α, β and γ with the coordinate axes X, Y, Z respectively, then $lm + mn + nl$ takes the maximum value when**
(a) α, β, γ are in Arithmetic progression
(b) $\alpha = \beta = \gamma$
(c) any two of α, β, γ are the same
(d) one of α, β, γ is zero and the remaining two are non-zero and unequal.

141. **The combined equation for a pair of planes is $s \equiv x^2 - 6y^2 - 12z^2 + 18yz + 2zx + xy = 0$. If one of the planes is parallel to $x + 2y - 2z = 5$, then the acute angle planes $S = 0$ is between the planes $S = 0$ is**
(a) $\cos^{-1}\left(\frac{16}{21}\right)$ (b) $\frac{\pi}{2}$
(c) $\frac{2\pi}{3}$ (d) $\sin^{-1}\left(\frac{7}{15}\right)$

142. **$f: R^+ \to R$ be an increasing function such that $f(x) > 0$ for all x. If $_{x\to\infty} \frac{f(9x)}{f(3x)} = 1$, then $\lim_{x\to\infty} \frac{f(6x)}{f(3x)} =$**
(a) 1 (b) 2
(c) 3/2 (d) 2/3

143. **Let [x] denotes the greatest integer less than or equal to x. Then, $f(x) = \frac{1+\sin([\cos x])}{\cos([\sin x])}$ is**
(a) continuous on $\left(0, \frac{\pi}{2}\right)$
(b) continuous on $(0, \pi)$
(c) discontinuous on $\left(\pi, \frac{3\pi}{2}\right)$
(d) continuous on $(\pi, 2\pi)$

144. **For $x \neq -1, y \neq -1$, if $x = \frac{1-\sqrt[3]{y}}{1+\sqrt[3]{y}}$, then $\frac{dx}{dy} =$**
(a) $\frac{-6(1-x)^2}{(1+x)^4}$ (b) $\frac{-(1+x)^4}{6(1-x)^2}$
(c) $\frac{4(1-x)^4}{(1+x)^6}$ (d) $\frac{-6(1+x)^2}{(1-x)^4}$

145. **Assertion (A) For $x < 0$, $\frac{d^2}{dx^2}(\log|x|) = \frac{1}{|x|^2}$ Reason (R) For $x < 0$. $|x| = -x$**
The correct option among the following is
(a) (A) is true, (R) is true and (R) is the correct explanation to (A).
(b) (A) is true, (R) is true but (R) is not a correct explanation to (A).
(c) (A) is true, (R) is false.
(d) (A) is false, (R) is true.

146. **If $ax^2 + 2hxy + by^2 = 0$, then $\frac{d^2y}{dx^2} =$**
(a) $\frac{h^2-ab}{(hx+by)^3}$ (b) $\frac{2(h^2-ab)}{(hx+by)^3}$
(c) $\frac{(hx+by)^3}{h^2-ab}$ (d) 0

147. **The number of points on the parabola $y^2 = x$ at which the slope of the normal drawn at the point is equal to the x-coordinate of that point is**
(a) ∞ (b) 1 (c) 2 (d) 0

148. **Let α, β be two roots of the quadratic equation $x^2 + ax - b = 0, b \neq 0$. If the straight line $x\cos\theta + y\sin\theta = C$ touches the curve $\left(\frac{x}{\alpha}\right)^n + \left(\frac{y}{\beta}\right)^n = 2$ at the point (α, β), then $\left(\frac{a}{b}\right)^2 + \frac{2}{b} =$**

(a) $1/2C^2$ (b) $4/C^2$
(c) $2/C^2$ (d) $1/C^2$

149. The number of admissible values of C obtained when the Lagrange's mean value theorem is applied for the function $f(x) = x$ on $[2, 5]$ is

(a) 0 (b) only one
(c) infinite (d) finitely many

150. The function $f(x) = x^3 - 4x^2 + 4x + 3$ defined on $[-1, 3]$ has

(a) minimum value -6 at $x = -1$
(b) minimum value 6 at $x = 3$
(c) minimum value 3 at $x = 2$
(d) maximum value 9 at $x = 3$

151. $\int \frac{\tan^{-1} x}{x^3} dx =$

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

152. If $\int \frac{1-(\cot x)^{2019}}{\tan x + (\cot x)^{2020}} dx = \frac{1}{n} \ln\left| (f(x))^n + (g(x))^n \right| + c$, then the value of $n[(f(x))^4 + (g(x))^4]_{x=\frac{\pi}{3}} =$

(a) $\frac{10105}{16}$ (b) $\frac{10012}{15}$
(c) $\frac{20210}{9}$ (d) $\frac{10105}{8}$

153.

$$\text{If } x \neq 1 \text{ and } \int \frac{(x^3 + x^2 - x - 1)}{(x^5 + x^4 + 3x^3 + 3x^2 + x + 1)\tan^{-1}\left(\frac{x^2+1}{x}\right)} dx$$

$= A\log(f(x)) + C$, then $A - \tan(f(2)) =$

(a) $-3/2$ (b) $-1/2$ (c) $7/2$ (d) -2

154. If $I_n = \int x^n \sin x dx$ and $I_6 - 360I_2 = f(x)\cos x + g(x)\sin x$, then $f(l) + g(l) =$

(a) -85 (b) 0 (c) -53 (d) 75

155. $\int_0^{\pi/2} x^3 \sin x dx =$

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

156. $\lim_{n\to\infty} \prod_{r=1}^{n} \left(1 + \frac{r^2}{n^2}\right)^{2r/n^2} =$

(a) $\log\left(\frac{4}{e}\right)$ (b) $\log\left(\frac{2}{e}\right)$
(c) $\frac{2}{e}$ (d) $\frac{4}{e}$

157. The larger of the two areas into which the circle $x^2 + y^2 = 16a^2$ is divided by the parabola $y^2 = 6ax$ is

(a) $\frac{4a^2}{3}(8\pi - \sqrt{3})$ (b) $\frac{4a^2}{3}(4\pi - \sqrt{3})$
(c) $\frac{2a^2}{3}(4\pi + \sqrt{3})$ (d) $\frac{4a^2}{3}(4\pi + \sqrt{3})$

158. The differential equation for which $\sqrt{1 + y^2} = Cxe^{\tan^{-1} x}$ is the general solution of

(a) $xy(1 + x^2)dy - e^{\tan^{-1} x}(1 + x + x^2)dx = 0$
(b) $xy(1 + y^2)dy - (1 + x^2)(1 + y + y^2)dx = 0$
(c) $(1 + y^2)\tan^{-1} x \frac{dy}{dx} = \frac{1+x^2}{xy}$
(d) $xy(1 + x^2)dy - (1 + y^2)(1 + x + x^2)dx = 0$

159. **The general solution of the differential equation $\frac{dy}{dx} = \frac{x+y-3}{x+y-7}$ is**

(a) $(x + y - 5)^2 = Ce^{y+x}$
(b) $(x + y - 5)^2 = Ce^{y-x}$
(c) $2\log(x + y - 5) = 3x + 2y + C$
(d) $\log(x + y - 3) = 3(x + y - 2)^2 + C$

160. **If $y = f(x)$ is the solution of the differential equation $x\frac{dy}{dx} = x^2 + 3y, x > 0, y(2) = 4$, then $f(4) =$**

(a) 48 (b) 260 (c) 80 (d) 36