Physics

1. **A closed pipe is suddenly opened and changed to an open pipe of same length. The fundamental frequency of the resulting open pipe is less than that of 3rd harmonic of the earlier closed pipe by 55 Hz . Then, the value of fundamental frequency of the closed pipe is**
(a) 165 Hz (b) 110 Hz
(c) 55 Hz (d) 220 Hz

2. **A convex lens has its radii of curvature equal. The focal length of the lens is f. If it is divided vertically into two identical plano-convex lenses by cutting it, then the focal length of the plano-convex lens is ($\mu =$ the refractive index of the material of the lens)**
(a) f (b) $\frac{f}{2}$
(c) 2f (d) $(\mu - 1)f$

3. **A thin converging lens of focal length $f = 25$ cm forms the image of an object on a screen placed at a distance of 75 cm from the lens. The screen is moved closer to the lens by a distance of 25 cm . The distance through which the object has to be shifted, so that its image on the screen in sharp again is**
(a) 37.5 cm (b) 16.25 cm
(c) 12.5 cm (d) 13.5 cm

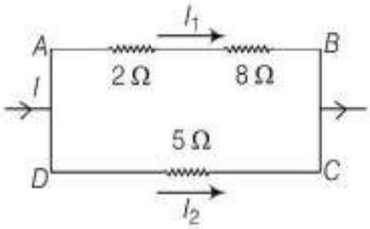
4. **In a double slit interference experiment, the fringe width obtained with a light of wavelength 5900Å was 1.2 mm for parallel narrow slits placed 2 mm apart. In this arrangement, if the slit separation is increased by one-and-half times the previous value, then the fringe width is**
(a) 0.9 mm (b) 0.8 mm
(c) 1.8 mm (d) 1.6 mm

5. **A charge Q is divided into two charges q and $Q - q$. The value of q such that the force between them is maximum, is**
(a) Q (b) $\frac{3Q}{4}$ (c) $\frac{Q}{2}$ (d) $\frac{Q}{3}$

6. **Two concentric hollow spherical shells have radii r and $R(R >> r)$. A charge Q is distributed on them such that the surface charge densities are equal. The electric potential at the centre is**
(a) $\frac{Q(R+r)}{4\pi\varepsilon_0(R^2+r^2)}$ (b) $\frac{Q(R^2+r^2)}{4\pi\varepsilon_0(R+r)}$
(c) $\frac{Q}{(R+r)}$ (d) zero

7. **Wires A and B have resistivities ρ_A and ρ_B, $(\rho_B = 2\rho_A)$ and have lengths l_A and l_B. If the diameter of the wire B is twice that of A and the two wires have same resistance, then $\frac{l_B}{l_A}$ is**
(a) 2 (b) 1 (c) $\frac{1}{2}$ (d) $\frac{1}{4}$

8. **In the circuit shown, the heat produced in 5Ω resistance due to current through is 50 J/s. Then, the heat generated per second in 2Ω resistance is**



(a) 5 J/s (b) 4 J/s
(c) 9 J/s (d) 10 J/s

9. **A steady current flows in a long wire. It is bent into a circular loop of one turn and the magnetic field at the centre of the coil is B. If the same wire is bent into a circular loop of n turns, the magnetic field at the centre of the coil is**
(a) $\frac{B}{n}$ (b) nB
(c) nB^2 (d) n^2B

10. **An electrically charged particle enters into a uniform magnetic induction field in a direction perpendicular to the field with a velocity v. Then, it travels**
(a) in a straight line without acceleration
(b) with force in the direction of the field

(c) in a circular path with a radius directly proportional to v^2
(d) in a circular path with a radius directly proportional to its velocity

11. At a certain place, the angle of dip is 60° and the horizontal component of the earth's magnetic field (B_H) is 0.8×10^{-4} T. The earth's overall magnetic field is
(a) 1.5×10^{-4} T (b) 1.6×10^{-3} T
(c) 1.5×10^{-3} T (d) 1.6×10^{-4} T

12. A coil of wire of radius r has 600 turns and a self inductance of 108 mH . The self- inductance of a coil with same radius and 500 turns is
(a) 80 mH (b) 75 mH
(c) 108 mH (d) 90 mH

13. A capacitor 50μ F is connected to a power source $V = 220\sin 50t$ (V in volt, t in second). The value of rms current (in ampere)
(a) $\frac{\sqrt{2}}{0.55}$ A (b) 0.55 A
(c) $\sqrt{2}$ A (d) $\frac{(0.55)}{\sqrt{2}}$ A

14. The electric field for an electro mangetic wave in free space is $E = i30\cos(kz - 5 \times 10^8 t)$, where magnitude of E is in V/m. The magnitude of wave vector, k is (velocity of em wave in free space = 3×10^8 m/s)
(a) $0.46 \text{rad} m^{-1}$ (b) 3 rad m^{-1}
(c) 1.66 rad m^{-1} (d) 0.83 rad m^{-1}

15. The energy of a photon is equal to the kinetic energy of a proton. If λ_1 is the de-Broglie wavelength of a proton, λ_2 the wavelength associated with the proton and if the energy of the photon is E, then (λ_1/λ_2) is proportional to
(a) E^4 (b) $E^{1/2}$ (c) E^2 (d) E

16. The radius of the first orbit of hydrogen is r_H, and the energy in the ground state is -13.6 eV . Considering a μ^--particle with a mass $207m_e$ revolving round a proton as in hydrogen atom, the energy and radius of proton and μ^-- combination respectively in the first orbit are (assume nucleus to be stationary)
(a) $-13.6 \times 207\text{eV}, \frac{r_H}{207}$
(b) $-207 \times 13.6\text{eV}, 207r_H$
(c) $-\frac{13.6}{207}\text{eV}, \frac{r_H}{207}$
(d) $-\frac{13.6}{207}\text{eV}, 207r_H$

17. If the radius of a nucleus with mass number 125 is 1.5 fermi, then radius of a nucleus with mass number 64 is
(a) 0.48 fermi (b) 0.96 fermi
(c) 1.92 fermi (d) 1.2 fermi

18. A crystal of intrinsic silicon at room temperature has a carrier concentration of $1.6 \times 10^{16}/m^3$. If the donor concentration level is $4.8 \times 10^{20}/m^3$, then the concentration of holes in the semiconductor is
(a) $53 \times 10^{12}/m^3$ (b) $4 \times 10^{11}/m^3$
(c) $4 \times 10^{12}/m^3$ (d) $5.3 \times 10^{11}/m^3$

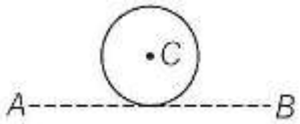
19. The output characteristics of an $n-p-n$ transistor represent, (I_C = collector current, V_{CE} = potential difference between collector and emitter, I_B = base current, V_{BB} = voltage given to base, V_{BE} = the potential difference between base and emitter)
(a) changes in I_C as I_B and V_{BB} are changed
(b) changes in I_C with changes in $V_{CE}(I_B = \text{constant})$
(c) changes in I_B with changes in V_{CE}
(d) change in I_C as V_{BE} is changed

20. A TV transmitting antenna is 128 m , tall. If the receiving antenna is at the ground level, the maximum distance between, them for satisfactory communication in line of sight mode is (radius of the earth 6.4×10^6 m)
(a) $64 \times \sqrt{10}$ km (b) $\frac{128}{\sqrt{10}}$ km
(c) $128 \times \sqrt{10}$ km (d) $\frac{64}{\sqrt{10}}$ km

21. A wheel which is initially at rest is subjected to a constant angular acceleration about its axis. It rotates through an angle of 15° in time tsec. The increase in angle through which it rotates in the next 2tsec is

(a) 90° (b) 120°
(c) 30° (d) 45°

22. A thin wire of length l having density ρ is bent into a circular loop with C as its centre, as shown in figure. The moment of inertia of the loop about the line AB is



(a) $\frac{5\rho l^3}{16\pi^2}$ (b) $\frac{\rho l^3}{16\pi^2}$
(c) $\frac{\rho l^3}{8\pi^2}$ (d) $\frac{3\rho l^3}{8\pi^2}$

23. The ratio between kinetic and potential energies of a body executing simple harmonic motion, when it is at a distance of $\frac{1}{N}$ of its amplitude from the mean position is

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

24. A satellite is revolving very close to a planet of density ρ. The period of revolution of satellite is

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

25. Two wires of the same material and length but diameters in the ratio 1:2 are stretched by the same force. The elastic potential energy per unit volume for the wires, when stretched by the same force will be in the ratio.

(a) 16: 1 (b) 1: 1
(c) 2: 1 (d) 4: 1

26. When a big drop of water is formed from n small drops of water, the energy loss is 3E, where, E is the energy of the bigger drop. If R is the radius of the bigger drop and r is the radius of the smaller drop, then number of smaller drops (n) is

(a) $\frac{4R}{r^2}$ (b) $\frac{4R}{r}$
(c) $\frac{2R^2}{r}$ (d) $\frac{4R^2}{r^2}$

27. A steam at 100°C is passed into 1 kg of water contained in a calorimeter of water equivalent 0.2 kg at 9°C till the temperature of the calorimeter and water in it is increased to 90°C. The mass of steam condensed in kg is nearly (specific heat of water = 1cal/g °C, latent heat of vaporisation = 540cal/g)

(a) 0.81 (b) 0.18
(c) 0.27 (d) 0.54

28. A very small hole in an electric furnace is used for heating metals. The hole nearly acts as a black body. The area of the hole is $200\ mm^2$. To keep a metal at 727°C, heat energy flowing through this hole per sec, in joules is ($\sigma = 5.67\times10^{-8} Wm^{-2}\ K^{-4}$)

(a) 22.68 (b) 2.268
(c) 1.134 (d) 11.34

29. Five moles of hydrogen initially at STP is compressed adiabatically so that its temperature becomes 673 K . The increase in internal energy of the gas, in kilo joule is ($R = 8.3\ J/mol-K; \gamma = 1.4$ for diatomic gas)

(a) 80.5 (b) 21.55
(c) 41.50 (d) 65.55

30. The volume of one mole of the gas is changed from V to 2V at constant pressure p. If γ is the ratio of specific heats of the gas, change in internal energy of the gas is

(a) $\frac{r.pV}{\gamma-1}$ (b) $\frac{r}{\gamma-1}$
(c) pV (d) $\frac{pV}{\gamma-1}$

31. A bus moving on a level road with a velocity v can be stopped at a distance of x, by the application of a retarding force F. The load on the bus is increased by 25% by boarding the passengers. Now, if the bus is moving with the same speed and if the same retarding force is applied, the distance travelled by the bus before it stops is

(a) 1.25x (b) x
(c) 5x (d) 2.5x

32. A cannon shell fired breaks into two equal parts at its highest point. One part retraces the path to the cannon with kinetic energy E_1 and kinetic energy of the second part is E_2, relation between E_1 and E_2 is

(a) $E_2 = 15E_1$ (b) $E_2 = E_1$
(c) $E_2 = 4E_1$ (d) $E_2 = 9E_1$

33. The force required to move a body up a rough inclined plane is double the force required to prevent the body from sliding down the plane. The coefficient of friction, when the angle of inclination of the plane is 60° is

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

34. A mass M kg is suspended by a weightless string. The horizontal force required to hold the mass at 60° with the vertical is

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

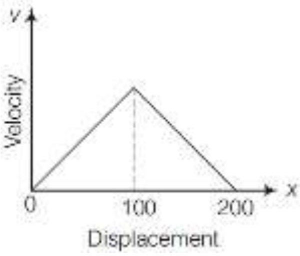
35. A body is projected at an angle θ so that its range is maximum. If T is the time of flight, then the value of maximum range is (acceleration due to gravity = g)

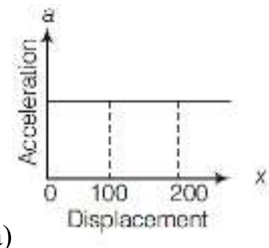
(a) $\frac{g^2T}{2}$ (b) $\frac{gT}{2}$ (c) $\frac{gT^2}{2}$ (d) $\frac{g^2T^2}{2}$

36. The path of a projectile is given by the equation $y = ax - bx^2$, where a and b are constants and x and y are respectively horizontal and vertical distances of projectile from the point of projection. The maximum height attained by the projectile and the angle of projection are respectively

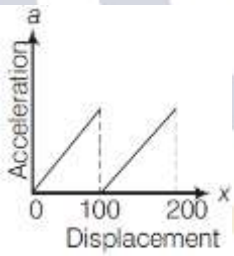
(a) $\frac{2a^2}{b}, \tan^{-1}(a)$ (b) $\frac{b^2}{2a}, \tan^{-1}(b)$
(c) $\frac{a^2}{b}, \tan^{-1}(2b)$ (d) $\frac{a^2}{4b}, \tan^{-1}(a)$

37. Velocity (v) versus displacement (x) plot of a body moving along a straight line is as shown in the graph. The corresponding plot of acceleration (a) as a function of displacement (x) is





(a)



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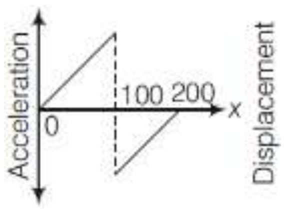

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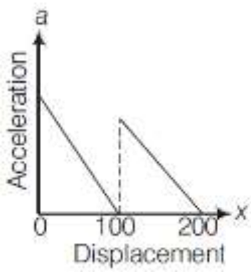


(d)

38. A person walks along a straight road from his house to a market 2.5 km away with a speed of 5 km/h and instantly turns back and reaches his house with a speed of 7.5 km/h. The average speed of the person during the time interval 0 to 50 min is (in m/s)

(a) $4\frac{2}{3}$ (b) $\frac{5}{3}$ (c) $\frac{5}{6}$ (d) $\frac{1}{3}$

39. If C the velocity of light, h Planck's constant and G gravitational constant are taken as fundamental quantities, then the dimensional formula of mass is
(a) $h^{-1/2}G^{1/2}C^{0}$ (b) $h^{1/2}C^{1/2}G^{-1/2}$
(c) $h^{-1/2}C^{1/2}G^{-1/2}$ (d) $h^{-1/2}C^{-1/2}G^{-1/2}$

40. Match the following (Take the relative strength of the strongest fundamental forces in nature as one)

	I	II
	Fundamental forces in nature	Relative strength
(A)	Strong nuclear force	(e) 10^{-2}
(B)	Weak nuclear force	(f) 1
(C)	Electromagnetic force	(g) 10^{10}
(D)	Gravitational force	(h) 10^{-13}
		(i) 10^{-39}

The correct match is
(a) A-f, B-i, C-e, D-h (b) A-f, B-h, C-e, D-h
(c) A-f, B-h, C-e, D-i (d) A-f, B-e, C-h, D-i

Chemistry

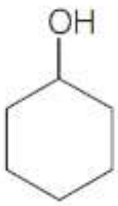
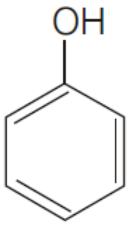
41. What is Z in the following reaction sequence?

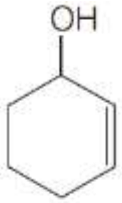
$$C_6H_5NH_2 \xrightarrow[\text{(iii) CO,HCl anhy.}AlCl_3]{\text{(i) }NaNO_2+HCl\text{ /273k, (ii)}H_3PO_2+H_2O} Z$$

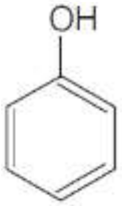
(a) $C_6H_5CO_2H$ (b) C_6H_5OH
(c) C_6H_5CHO (d) C_6H_6

42. $CH_3MgBr + CO_2 \xrightarrow{\text{Dry ether}} Y \xrightarrow{H_3O^{\oplus}} Z$
Identify Z from the following.
(a) Ethyl acetate (b) Acetic acid
(d) Propanoic acid (d) Methyl acetate

43. $X \xrightarrow{y}$ Benzoquinone
Identify X and Y in the above reaction.

	X	y
(a)		Zn
(b)		$Na_2Cr_2O_7/H_2SO_4$

(c)  $Na_2Cr_2O_7/H_2SO_4$

(d)  Zn

44. $\mathbf{C_6H_5 - O - CH_2CH_3 \xrightarrow[\Delta]{HI} Y + Z}$

Identify Y and Z in the above reaction.

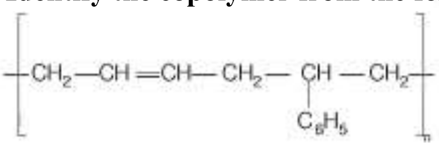
	X	Y
(a)	C_6H_5OH	H_3CCH_3
(b)	C_2H_5I	C_6H_5CHO
(c)	C_6H_5I	H_3CCH_2OH
(d)	C_6H_5OH	H_3CCH_2I

45. Which one of the following is more readily hydrolysed by S_N1 mechanism?
(a) $(C_6H_5)_2C(CH_3)Br$
(b) $C_6H_5CH_2Br$
(c) $C_6H_5CH(CH_3)Br$
(d) $(C_6H_5)_2CHBr$

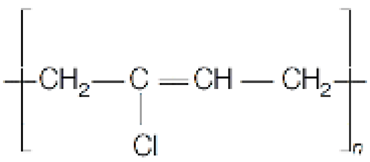
46. What are the substances which mimic the natural chemical messengers?
(a) Antibiotics (b) Antagonists
(c) Agonists (d) Receptors

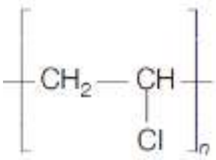
47. Lactose is disaccharide of
(a) α - D-glucose and α − D-fructose
(b) β-D-glucose and β-D-galactose
(c) α − D-glucose and β − D-ribose
(d) α − D-glucose and β − D-galactose

48. Identify the copolymer from the following

(a) 

(b) $\left[CF_2 - CF_2 \right]_n$

(c) 

(d) 

49. Match the following.

	Column I		Column II
A.	sp^3	(i)	$[Co(NH_3)_6]^{3+}$
B.	dsp^2	(ii)	$[Ni(CO)_4]$
C.	sp^3d^2	(iii)	$[Pt(NH_3)_2Cl_2]$
D.	d^2sp^3	(iv)	$[CoF_6]^{3-}$
		(v)	$[Fe(CO)_5]$

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

50. Which one of the following ions has same number of unpaired electrons as those present in V^{3+} ion?

(a) Fe^{3+} (b) Ni^{2+}

(c) Mn^{2+} (d) Cr^{3+}

51. The structure of $XeOF_4$ is

(a) trigonal bipyramidal (b) square planar

(c) square pyramidal (d) pyramidal

52. The charring of sugar takes place when treated with concentrated H_2SO_4. What is the type of reaction involved in it?

(a) Dehydration reaction

(b) Hydrolysis reaction

(c) Addition reaction

(d) Disproportionation reaction

53. What is the role of limestone during the extraction of iron from haematite ore?

(a) Leaching agent (b) Oxidising agent

(c) Reducing agent (d) Flux

54. In an atom the order of increasing energy of electrons with quantum numbers

(i) $n = 4, l = 1$ (ii) $n = 4, l = 0$

(iii) $n = 3, l = 2$ and (iv) $n = 3, l = 1$ is

(a) iii < (i) < iv < ii (b) ii < iv < i < iii

(c) i < iii < ii < iv (d) iv < ii < iii < i

55. The number of angular and radial nodes of 4d orbital respectively are

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

(c) 3,0 (d) 2,1

56. The oxidation state and covalency of Al in $[AlCl(H_2O)_5]^{2+}$ are respectively

(a) +6,6 (b) +3,6

(c) +2,6 (d) +3,3

57. The increasing order of the atomic radius of Si, S, Na, Mg, Al is

(a) S < Si < Al < Mg < Na

(b) Na < Al < Mg < S < Si

(c) Na < Mg < Si < Al < S

(d) Na < Mg < Al < Si < S

58. The number of electrons is the valence shell of the central atom of a molecules is 8 . The molecule is

(a) BCl_3 (b) BeH_2

(c) SCl_2 (d) SF_6

59. Which one of the following has longest covalent bond distance?

(a) $C-C$ (b) $C-H$

(c) $C-N$ (d) $C-O$

60. The ratio of rates of diffusion of gases X and Y is $1:5$ and that of Y and Z is $1:6$. The ratio of rates of diffusion of Z and X is

(a) $1:30$ (b) $1:6$

(c) $30:1$ (d) $6:1$

61. The molecular interactions responsible for hydrogen bonding in HF

(a) ion-induced dipole

(b) dipole-dipole

(c) dipole-induced dipole

(d) ion-dipole

62. $KMnO_4$ reacts with KI , in basic medium to form I_2 and MnO_2. When 250 mL of 0.1 M KI solution is mixed with 250 mL of 0.02 M $KMnO_4$ in basic medium, what is the number of moles of I_2 formed?

(a) 0.015 (b) 0.0075

(c) 0.005 (d) 0.01

63. The oxide of a metal contains 40% of oxygen. The valency of metal is 2 . What is the atomic weight of metal?

(a) 24 (b) 13 (c) 40 (d) 36

64. The temperature of K at which $\Delta G=0$, for a given reaction with $\Delta H=-20.5$ kJ mol^{-1} and $\Delta S=-50.0 JK^{-1} mol^{-1}$ is

(a) -410 (b) 410

(c) 2.44 (d) -2.44

65. In a reaction, $A+B \rightleftharpoons C+D$, 40% of B has reacted at equilibrium, when 1 mole of A was heated with 1 mole of B in a 10 L closed vessel. The value of K_C is

(a) 0.44 (b) 0.18

(c) 0.22 (d) 0.36

66. If the ionic product of $Ni(OH)_2$ is 1.9×10^{-15}, the molar solubility of $Ni(OH)_2$ in 1.0 M NaOH is

(a) 1.9×10^{-18}M (b) 1.9×10^{-13}M

(c) 1.9×10^{-15}M (d) 1.9×10^{-14}M

67. Temporary hardness of water is removed in Clark's process by adding

(a) caustic soda (b) calgon

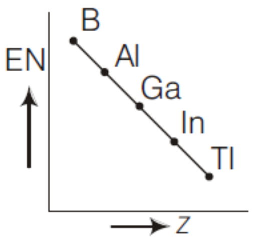
(c) borax (d) lime

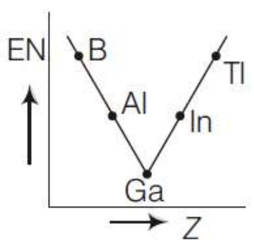
68. KO_2 exhibits paramagnetic behaviour. This is due to the paramagnetic nature of

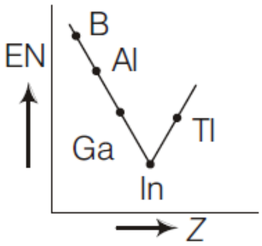
(a) KO^- (b) K^+

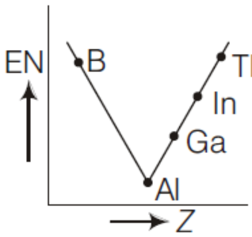
(c) O_2 (d) O_2^-

69. Which one of the following correctly represents the variation of electronegativity (EN) with atomic number (Z) of group 13 elements?

(a) 

(b) 

(c) 

(d) 

70. Which one of the following elements reacts with steam?

(a) C (b) Ge (c) Si (d) Sn

71. What are X and Y in the following reaction?

$\mathbf{CF_2Cl_2 \xrightarrow{UV} X + Y}$

(a) $^{\cdot}CF_2Cl, {}^{\cdot}Cl$ (b) $^{\cdot}C_2F_4, Cl_2$

(c) $^{\cdot}CFCl_2, \cdot F$ (d) CCl_2, F_2

72. What are the shapes of ethyne and methane?

(a) Square planar and linear

(b) Tetrahedral and trigonal planar

(c) Linear and tetrahedral

(d) Trigonal planar and linear

73. What is Z in the following reaction?

$\mathbf{CH_3 - CH_2 - CO_2^{\ominus}Na^{\oplus} \xrightarrow{NaOH/Cao} Z}$

(a) propane (b) n-butane

(c) ethane (d) ethyne

74. Which one of the following gives sooty flame on combustion?

(a) C_2H_4 (b) CH_4

(c) C_2H_6 (d) C_6H_6

75. Which one of the following elements on doping with germanium, make it a p-type semiconductor?

(a) Bi (b) Sb (c) As (d) Ga

76. The molar mass of a solute X in $\mathbf{g mol^{-1}}$, if its 1% solution is isotonic with a 5% solution of cane sugar (molar mass $= \mathbf{342\ g\ mol^{-1}}$), is

(a) 68.4 (b) 34.2

(c) 136.2 (d) 171.2

77. Vapour pressure in mm Hg of 0.1 mole of urea in 180 g of water at 25°C is (The vapour pressure of water at 25°C is 24 mm Hg)

(a) 2.376 (b) 20.76

(c) 23.76 (d) 24.76

78. At 298 K the molar conductivities at infinite dilution (Λ_m°) of NH_4Cl, KOH and KCl are 152.8, 272.6 and 149.8 S cm^2 mol^{-1} respectively. The Λ_m° of NH_4OH in Scm^2 mol^{-1} and % dissociation of 0.01MNH_4OH with $\Lambda_m = 25.1$ S cm^2 mol^{-1} at the same temperature are

(a) 275.6,0.91 (b) 275.6,9.1

(c) 266.6,9.6 (d) 30,84

79. In a first order reaction, the concentration of the reactant decrease from 0.6 M to 0.3 M in 15 min . The time taken for the concentration to change from 0.1 M to 0.025 M in minutes is

(a) 1.2 (b) 12 (c) 30 (d) 3

80. Assertion (A) van der Waals' forces are reponsible for chemisorptions.

Reason (R) High temperature is favourable for chemisorptions.

The correct answer is

(a) (A) ia false, but (R) is true

(b) Both (A) and (R) are correct and (R) is the correct explanation of A

(c) Both (A) and (R) are correct and (R) is not the correct explanation of (A)

(d) (A) is true, but (R) is false

Mathematics

81. The equation of a straight line, perpendicular to $3x - 4y = 6$ and forming a triangle of area 6 sq. units with coordinate axes, is
(a) $x - 2y = 6$
(b) $4x + 3y = 12$
(c) $4x + 3y + 24 = 0$
(d) $3x + 4y = 12$

82. If the image of $\left(\frac{-7}{5}, \frac{-6}{5}\right)$ in a line is $(1, 2)$, then the equation of the line is
(a) $4x + 3y = 1$ (b) $3x - y = 0$
(c) $4x - y = 0$ (d) $3x + 4y = 1$

83. If a line l passes through $(k, 2k)$, $(3k, 3k)$ and $(3, 1)$, $k \neq 0$, then the distance from the origin to the line l is
(a) $\frac{1}{\sqrt{5}}$ (b) $\frac{4}{\sqrt{5}}$ (c) $\frac{3}{\sqrt{5}}$ (d) $\frac{2}{\sqrt{5}}$

84. The area (in sq. units) of the triangle formed by the lines $x^2 - 3xy + y^2 = 0$ and $x + y + 1 = 0$, is
(a) $\frac{2}{\sqrt{3}}$ (b) $\frac{\sqrt{3}}{2}$ (c) $5\sqrt{2}$ (d) $\frac{1}{2\sqrt{5}}$

85. If $x^2 + \alpha y^2 + 2\beta y = a^2$ represents a pair of perpendicular lines, then β equals to
(a) 4a (b) a (c) 2a (d) 3a

86. A circle with centre at $(2, 4)$ is such that the line $x + y + 2 = 0$ cuts a chord of length 6 . The radius of the circle is
(a) $\sqrt{41}$ cm (b) $\sqrt{11}$ cm
(c) $\sqrt{21}$ cm (d) $\sqrt{31}$ cm

87. The point at which the circles $x^2 + y^2 - 4x - 4y + 7 = 0$ and $x^2 + y^2 - 12x - 10y + 45 = 0$ touch each other, is
(a) $\left(\frac{13}{5}, \frac{14}{5}\right)$ (b) $\left(\frac{2}{5}, \frac{5}{6}\right)$
(c) $\left(\frac{14}{5}, \frac{13}{5}\right)$ (d) $\left(\frac{12}{5}, 2 + \frac{\sqrt{21}}{5}\right)$

88. The condition for the lines $lx + my + n = 0$ and $l_1x + m_1y + n_1 = 0$ to be conjugate with respect to the circle $x^2 + y^2 = r^2$, is
(a) $r^2(I_1 + mm_1) = nn_1$
(b) $r^2(I_1 - mm_1) = nn_1$
(c) $r^2(II_1 + mm_1) + nn_1 = 0$
(d) $r^2(Im_1 + l_1m) = nn_1$

89. The length of the common chord of the two circles $x^2 + y^2 - 4y = 0$ and $x^2 + y^2 - 8x - 4y + 11 = 0$, is
(a) $\frac{\sqrt{145}}{4}$ cm (b) $\frac{\sqrt{11}}{2}$ cm
(c) $\sqrt{135}$ cm (d) $\frac{\sqrt{135}}{4}$ cm

90. The locus of the centre of the circle, which cuts the circle $x^2 + y^2 - 20x + 4 = 0$ orthogonally and touches the line $x = 2$, is
(a) $x^2 = 16y$ (b) $y^2 = 4x$
(c) $y^2 = 16x$ (d) $x^2 = 4y$

91. If a normal chord at a point t on the parabola $y^2 = 4ax$ subtends a right angle at the vertex, then t equals to
(a) 1 (b) $\sqrt{2}$ (c) 2 (d) $\sqrt{3}$

92. The slopes of the focal chords of the parabola $y^2 = 32x$, which are tangents to the circle $x^2 + y^2 = 4$, are
(a) $\frac{1}{2}, \frac{-1}{2}$ (b) $\frac{1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}$
(c) $\frac{1}{\sqrt{15}}, \frac{-1}{\sqrt{15}}$ (d) $\frac{2}{\sqrt{5}}, \frac{-2}{\sqrt{5}}$

93. If tangents are drawn from any point on the circle $x^2 + y^2 = 25$ to the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$, then the angle between the tangents is
(a) $\frac{2\pi}{3}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

94. An ellipse passing through $(4\sqrt{2}, 2\sqrt{6})$ has foci at $(-4, 0)$ and $(4, 0)$. Then, its eccentricity is
(a) $\sqrt{2}$ (b) $\frac{1}{2}$ (c) $\frac{1}{\sqrt{2}}$ (d) $\frac{1}{\sqrt{3}}$

95. A hyperbola passing through a focus of the ellipse $\frac{x^2}{169}+\frac{y^2}{25}=1$. Its transverse and conjugate axes coincide respectively with the major and minor axes of the ellipse. The product of eccentricities is 1 . Then, the equation of the hyperbola is

(a) $\frac{x^2}{144}-\frac{y^2}{9}=1$ (b) $\frac{x^2}{169}-\frac{y^2}{25}=1$
(c) $\frac{x^2}{144}-\frac{y^2}{25}=1$ (d) $\frac{x^2}{25}-\frac{y^2}{9}=1$

96. If the line joining $A(1,3,4)$ and B is divided by the point $(-2,3,5)$ in the ratio $1:3$, then B is

(a) $(-11,3,8)$ (b) $(-11,3,-8)$
(c) $(-8,12,20)$ (d) $(13,6,-13)$

97. If the direction cosines of two lines are given by $l+m+n=0$ and $l^2-5m^2+n^2=0$, then the angle between them is

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

98. If $A(3,4,5), B(4,6,3), C(-1,2,4)$ and $D(1,0,5)$ are such that the angle between the lines DC and AB is θ, then $\cos\theta$ is equal to

(a) $\frac{7}{9}$ (b) $\frac{2}{9}$ (c) $\frac{4}{9}$ (d) $\frac{5}{9}$

99. $\lim_{x\to 0}\frac{\sqrt{1+x^2}-\sqrt{1-x+x^2}}{3^x-1}$ is equal to

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

100. If $f:[-2,2]\to R$ is defined by $f(x)=\begin{cases}\frac{\sqrt{1+cx}-\sqrt{1-cx}}{x} & \text{for } -2\le x<0\\ \frac{x+3}{x+1} & \text{for } 0\le x\le 2\end{cases}$ is continuous on $[-2,2]$, then c is equal to

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

101. If $f(x)=x\tan^{-1}x$, then $\lim_{x\to 1}\frac{f(x)-f(1)}{x-1}$ equals to

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

102. If $y=\tan^{-1}\left(\frac{\sqrt{1+a^2x^2}-1}{ax}\right)$,
then $(1+a^2x^2)y''+2a^2xy'$ is equal to

(a) $-2a^2$ (b) a^2
(c) $2a^2$ (d) 0

103. If $f(x)=\frac{x}{1+x}$ and $g(x)=f(f(x))$, then $g'(x)$ is equal to

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

104. If the curves $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ and $\frac{x^2}{25}+\frac{y^2}{16}=1$ cut each other orthogonally, then a^2-b^2 equals to

(a) 9 (b) 400
(c) 75 (d) 41

105. The condition that $f(x)=ax^3+bx^2+cx+d$ has no extreme value, is

(a) $b^2>3ac$ (b) $b^2=4ac$
(c) $b^2=3ac$ (d) $b^2<3ac$

106. If there is an error of ± 0.04 cm in the measurement of the diameter of a sphere, then the approximate percentage error in its volume, when the radius is 10 cm , is

(a) ± 1.2 (b) ± 0.06
(c) ± 0.006 (d) ± 0.6

107. The value of c in the Lagrange's mean value theorem for $f(x)=\sqrt{x-2}$ in the interval $[2,6]$ is

(a) $\frac{9}{2}$ (b) $\frac{5}{2}$ (c) 3 (d) 4

108. If $\int \frac{dx}{\sqrt{\sin^3 x \cos x}} = g(x) + c$, then $g(x)$ is equal to
(a) $\frac{-2}{\sqrt{\cot x}}$ (b) $\frac{-2}{\sqrt{\tan x}}$
(c) $\frac{2}{\sqrt{\cot x}}$ (d) $\frac{2}{\sqrt{\tan x}}$

109. If $\int \frac{dx}{(1+\sqrt{x})\sqrt{x-x^2}} = \frac{A\sqrt{x}}{\sqrt{1-x}} + \frac{B}{\sqrt{1-x}} + C$, where C is real constant, then A + B equals to
(a) 3 (b) 0 (c) 1 (d) 2

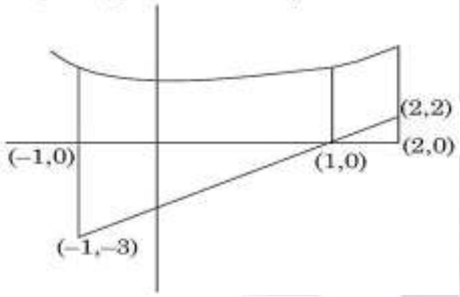
110. For any integer $n \geq 2$, let $I_n = \int \tan^n x dx$. If $I_n = \frac{1}{a}\tan^{n-1} x - bI_{n-2}$ for $n \geq 2$, then the ordered pair (a, b) equals to
(a) $\left(n-1, \frac{n-1}{n-2}\right)$ (b) $\left(n-1, \frac{n-2}{n-1}\right)$
(c) $(n, 1)$ (d) $(n-1, 1)$

111. If $\int \frac{(x^2-1)}{(x+1)^2\sqrt{x(x^2+x+1)}} dx = A\tan^{-1}\left(\sqrt{\frac{x^2+x+1}{x}}\right) + C$, in which C is a constant, then A equals to
(a) $\frac{1}{2}$ (b) 3 (c) 2 (d) 1

112. By the definition of the definite integral, the value $\lim_{n\to\infty}\left(\frac{1^4}{1^5+n^5} + \frac{2^4}{2^5+n^5} + \frac{3^4}{3^5+n^5} + \cdots + \frac{n^4}{n^5+n^5}\right)$ is
(a) $\log 2$ (b) $\frac{1}{5}\log 2$
(c) $\frac{1}{4}\log 2$ (d) $\frac{1}{3}\log 2$

113. $\int_0^{\pi/6} \cos^4 3\theta \cdot \sin^2 6\theta d\theta$ equals to
(a) $\frac{\pi}{96}$ (b) $\frac{5}{192}$ (c) $\frac{5\pi}{256}$ (d) $\frac{5\pi}{192}$

114. The area (in sq units) of the region bounded by $x = -1, x = 2, y = x^2 + 1$ and $y = 2x - 2$ is



(a) 10 (b) 7 (c) 8 (d) 9

115. The differential equation of the family of parabolas with vertex at $(0, -1)$ and having axis along the Y-axis is
(a) $yy' + 2xy + 1 = 0$
(b) $xy' + y + 1 = 0$
(c) $xy' - 2y - 2 = 0$
(d) $xy' - y - 1 = 0$

116. The solution of $x\frac{dy}{dx} = y + xe^{y/x}$ with $y(1) = 0$ is
(a) $e^{y/x} + \log x = 1$
(b) $e^{-y/x} = \log x$
(c) $e^{-y/x} + 2\log x = 1$
(d) $e^{-y/x} + \log x = 1$

117. The solution of $\cos y + (x\sin y - 1)\frac{dy}{dx} = 0$ is
(a) $x\sec y = \tan y + C$
(b) $\tan y - \sec y = Cx$
(c) $\tan y + \sec y = Cx$
(d) $x\sec y + \tan y = C$

118. If R is the set of all real numbers and $f: R - \{2\} \to R$ is defined by $f(x) = \frac{2+x}{2-x}$ for $x \in R - \{2\}$
(a) $R - \{-2\}$ (b) R
(c) $R - \{1\}$ (d) $R - \{-1\}$

119. Let Q be the set of all rational numbers in $[0,1]$ and $f:[0,1]\to[0,1]$ be defined by $f(x)=\begin{cases} x \text{ for } x\in Q \\ 1-x \text{ for } x\notin Q\end{cases}$ Then, the set $S=\{x\in[0,21]:(f\circ f)(x)\}$ is equal to
(a) $[0,1]$ (b) $-Q$
(c) $[0,1]-Q$ (d) $(0,1)$

120. $\sum_{k=1}^{2n+1}(-1)^{k-1}\cdot k^2$ equals to
(a) $(n-1)(2n-1)$
(b) $(n+1)(2n+1)$
(c) $(n+1)(2n-1)$
(d) $(n-1)(2n+1)$

121. If a, b, c and d are real numbers such that $a^2+b^2+c^2+d^2=1$ and $A=\begin{bmatrix} a+ib & c+id \\ -c+id & a-ib\end{bmatrix}$, then A^{-1} equals to
(a) $\begin{bmatrix} a+ib & -c-id \\ c-id & a-ib\end{bmatrix}$
(b) $\begin{bmatrix} a-ib & c+id \\ -c+id & a+ib\end{bmatrix}$
(c) $\begin{bmatrix} a-ib & -c-id \\ c-id & a+ib\end{bmatrix}$
(d) $\begin{bmatrix} a+ib & c+id \\ c-id & a-ib\end{bmatrix}$

122. If the matrix $A=\begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 4 & 3 & 2 \\ 3 & 2 & 1 & 3 \\ 6 & 8 & 7 & \alpha\end{bmatrix}$ is of rank 3, then α equals to
(a) -5 (b) 5 (c) 4 (d) 1

123. If $k>1$ and the determinant of the matrix A^2, where $A=\begin{bmatrix} k & k\alpha & \alpha \\ 0 & \alpha & k\alpha \\ 0 & 0 & k\end{bmatrix}$, is k^2, then $|\alpha|$ equal to
(a) $\frac{1}{k^2}$ (b) k (c) k^2 (d) $\frac{1}{k}$

124. The number of solutions for $z^3+\bar{z}=0$, is
(a) 5 (b) 1 (c) 2 (d) 3

125. The least positive integer n for which $(1+i)^n=(1-i)^n$, is
(a) 8 (b) 2 (c) 4 (d) 6

126. If $x=p+q$, $y=p\omega+q\omega^2$ and $z=p\omega^2+q\omega$, where ω is a complex cube root of unity, then xyz equals to
(a) p^3+q^3 (b) p^2-pq+q^3
(c) $1+p^3+q^3$ (d) p^3-q^3

127. If $Z_r=\cos\left(\frac{\pi}{2^r}\right)+i\sin\left(\frac{\pi}{2^r}\right)$ for $r=1,2,3,\ldots$, then $Z_1Z_2Z_3\ldots\infty$ equals to
(a) -2 (b) 1 (c) 2 (d) -1

128. If x_1 and x_2 are the real roots of the equation $x^2-kx+c=0$, then the distance between the points $A(x_1,0)$ and $B(x_2,0)$ is
(a) $\sqrt{k^2+4c}$ (b) $\sqrt{k^2-c}$
(c) $\sqrt{c-k^2}$ (d) $\sqrt{k^2-4c}$

129. If x is real, then the minimum value of $y=\frac{x^2-x+1}{x^2+x+1}$ is
(a) 3 (b) $\frac{1}{3}$ (c) $\frac{1}{2}$ (d) 2

130. If p and q are distinct prime numbers and if the equation $x^2-px+q=0$ has positive integers as its roots, then the roots of the equation are
(a) $1,-1$ (b) 2,3
(c) 1,2 (d) 3,1

131. The cubic equation whose roots are the squares of the roots of $x^3-2x^2+10x-8=0$, is
(a) $x^3+16x^2+68x-64=0$
(b) $x^3+8x^2+68x-64=0$
(c) $x^3+16x^2-68x-64=0$
(d) $x^3-16x^2+68x-64=0$

132. **Out of thirty points in a plane, eight of them are collinear. The number of straight lines that can be formed by joining these points, is**
(a) 296 (b) 540
(c) 408 (d) 348

133. **If n is an integer with $0 \leq n \leq 11$, then the minimum value of $n!\,(11-1)!$ is attained when a value of n equals to**
(a) 11 (b) 5 (c) 7 (d) 9

134. **If $(a+bx)^{-3} = \frac{1}{27} + \frac{1}{3}x + \cdots$, then the ordered pair (a, b) equals to**
(a) $(3, -27)$ (b) $\left(1, \frac{1}{3}\right)$
(c) $(3, 9)$ (d) $(3, -9)$

135. **The term independent of x in the expansions of $\left(\sqrt{x} - \frac{2}{\sqrt{x}}\right)^{18}$ is**
(a) $-{}^{18}C_9 2^9$ (b) ${}^{18}C_9 2^{12}$
(c) ${}^{18}C_6 2^6$ (d) ${}^{18}C_6 2^8$

136. **If $\frac{2x^3+x^2-5}{x^4-25} = \frac{Ax+B}{x^2-5} + \frac{Cx+1}{x^2+5}$, then (A, B, C) equals to**
(a) $(1,1,1)$ (b) $(1,1,0)$
(c) $(1,0,1)$ (d) $(1,2,1)$

137. **If $\cos x = \tan y$, $\cot y = \tan z$ and $\cot z = \tan x$, then $\sin x$ equals to**
(a) $\frac{\sqrt{5}+1}{4}$ (b) $\frac{\sqrt{5}-1}{4}$
(c) $\frac{\sqrt{5}+1}{2}$ (d) $\frac{\sqrt{5}-1}{2}$

138. **$\tan 81^\circ - \tan 63^\circ - \tan 27^\circ + \tan 9^\circ$ equals to**
(a) 6 (b) 0 (c) 2 (d) 4

139. **If x and y are acute angles such that $\cos x + \cos y = \frac{3}{2}$ and $\sin x + \sin y = \frac{3}{4}$, then $\sin(x+y)$ equals to**
(a) $\frac{2}{5}$ (b) $\frac{3}{4}$ (c) $\frac{3}{5}$ (d) $\frac{4}{5}$

140. **The sum of the solutions in $(0, 2\pi)$ the equation $\cos x \cos\left(\frac{\pi}{3} - x\right) \cos\left(\frac{\pi}{3} + x\right) = \frac{1}{4}$ is**
(a) 4π (b) π (c) 2π (d) 3π

141. **If $x > 0, y > 0, z > 0, xy + yz + zx < 1$ and if $\tan^{-1} x + \tan^{-1} y + \tan^{-1} z = \pi$, then $x + y + z$ equals to**
(a) 0 (b) xyz
(c) 3xyz (d) $\sqrt{xyz}$

142. **$\operatorname{sech}^{-1}\left(\frac{1}{2}\right) - \operatorname{cosech}^{-1}\left(\frac{3}{4}\right)$ equals to**
(a) $\log_e(3(2+\sqrt{3}))$ (b) $\log_e\left(\frac{1+\sqrt{3}}{3}\right)$
(c) $\log_e\left(\frac{2+\sqrt{3}}{3}\right)$ (d) $\log_e\left(\frac{2-\sqrt{3}}{3}\right)$

143. **In any $\triangle ABC$, $\frac{(a+b+c)(b+c-a)(c+a-b)(a+b-c)}{4b^2c^2}$ equals to**
(a) $\sin^2 B$ (b) $\cos^2 A$
(c) $\cos^2 B$ (d) $\sin^2 A$

144. **If the point $P(1, 3)$ undergoes the following transformations successively.**
(i) Reflection with respect to the line $y = x$.
(ii) Translation through 3 units along the positive direction of the X-axis.
(iii) Rotation through an angle of $\frac{\pi}{6}$ about the origin in the clockwise direction.
Then, the final position of the point P is
(a) $\left(\frac{6\sqrt{3}+1}{2}, \frac{\sqrt{3}-6}{2}\right)$ (b) $\left(\frac{\sqrt{7}}{2}, \frac{-5}{\sqrt{2}}\right)$
(c) $\left(\frac{6+\sqrt{3}}{2}, \frac{1-6\sqrt{3}}{2}\right)$ (d) $\left(\frac{6+\sqrt{3}-1}{2}, \frac{6+\sqrt{3}}{2}\right)$

145. The locus of the centroid of the triangle with vertices at $(a\cos\theta, a\sin\theta)$, $(b\sin\theta, -b\cos\theta)$ and $(1, 0)$ is (here, θ is a parameter)
(a) $(3x+1)^2 + 9y^2 = a^2 + b^2$
(b) $(3x-1)^2 + 9y^2 = a^2 - b^2$
(c) $(3x-1)^2 + 9y^2 = a^2 + b^2$
(d) $(3x+1)^2 + 9y^2 = a^2 - b^2$

146. If the mean and variance of a binomial variate X are 8 and 4 respectively, then $P(X < 3)$ equals to
(a) $\frac{265}{2^{15}}$ (b) $\frac{137}{2^{14}}$
(c) $\frac{137}{2^{16}}$ (d) $\frac{265}{2^{16}}$

147. A random variable X has the probability distribution given below.

X	1	2	3	4	5
$P(X = x)$	K	2K	3K	2K	K

Its variance is
(a) $\frac{16}{3}$ (b) $\frac{4}{3}$ (c) $\frac{5}{3}$ (d) $\frac{10}{3}$

148. A candidate takes three tests in succession and the probability of passing the first test is p. The probability of passing each succeeding test is p or $\frac{p}{2}$ according as he passes or fails in the preceding one. The candidate is selected, if he passes atleast two tests. The probability that the candidate is selected, is
(a) $p^2(2-p)$ (b) $p(2-p)$
(c) $p + p^2 + p^3$ (d) $p^2(1-p)$

149. A six-faced unbiased die is thrown twice and the sum of the numbers appearing on the upper face is observed to be 7. The probability that the number 3 has appeared at least once, is
(a) $\frac{1}{5}$ (b) $\frac{1}{2}$ (c) $\frac{1}{3}$ (d) $\frac{1}{4}$

150. If A, B and C are mutually exclusive and exhaustive events of a random experiment such that $P(B) = \frac{3}{2}P(A)$ and $P(C) = \frac{1}{2}P(B)$, then $P(A \cup C)$ equals to
(a) $\frac{10}{13}$ (b) $\frac{3}{13}$ (c) $\frac{6}{13}$ (d) $\frac{7}{13}$

151. If $x_1, x_2, \ldots, x_n$ are n observations such that $\sum_{i=1}^{n} x_1^2 = 400$ and $\sum_{i=1}^{n} x_1 = 80$, then the least value of n is
(a) 18 (b) 12 (c) 15 (d) 16

152. The mean of four observations is 3 . If the sum of the squares of these observations is 48 , then their standard deviation is
(a) $\sqrt{7}$ (b) $\sqrt{2}$
(c) $\sqrt{3}$ (d) $\sqrt{5}$

153. The shortest distance between the skew lines $\hat{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + t(\hat{i} + 3\hat{j} + 2\hat{k})$ and $\hat{r} = (4\hat{i} + 5\hat{j} + 6\hat{k}) + t(2\hat{i} + 3\hat{j} + \hat{k})$ is
(a) $\sqrt{6}$ (b) 3
(c) $2\sqrt{3}$ (d) $\sqrt{3}$

154. If x, y and z are non-zero real numbers and $\hat{a} = x\hat{i} + 2\hat{j}$, $\hat{b} = y\hat{j} + 3\hat{k}$ and $\hat{c} = x\hat{i} + y\hat{j} + z\hat{j}$ are such that $\hat{a} \times \hat{b} = z\hat{i} - 3\hat{j} + \hat{k}$, then $[\hat{a}\hat{b}\hat{c}]$ equals to
(a) 3 (b) 10 (c) 9 (d) 6

155. If $\hat{a}, \hat{b}$ and $\hat{c}$ are vectors with magnitudes 2,3 and 4 respectively, then the best upper bound of $|\hat{a} - \hat{b}|^2 + |\hat{b} - \hat{c}|^2 + |\hat{c} - \hat{a}|^2$ among the given values is
(a) 93 (b) 97 (c) 87 (d) 90

156. The angle between the lines $\hat{r} = (2\hat{i} - 3\hat{j} + \hat{k}) + \lambda(\hat{i} + 4\hat{j} + 3\hat{k})$ and $\hat{r} = (\hat{i} - \hat{j} + 2\hat{k}) + \mu(\hat{i} + 2\hat{j} - 3\hat{k})$ is
(a) $\frac{\pi}{2}$ (b) $\cos^{-1}\left(\frac{9}{\sqrt{91}}\right)$
(c) $\cos^{-1}\left(\frac{7}{\sqrt{84}}\right)$ (d) $\frac{\pi}{3}$

157. **If $\hat{a}, \hat{b}$ and $\hat{c}$ are non-coplanar vectors and if $\hat{d}$ is such that $\hat{d} = \frac{1}{x}(\hat{a} + \hat{b} + \hat{c})$ and $\hat{d} = \frac{1}{y}(\hat{b} + \hat{c} + \hat{d})$ where x and y are non-zero real numbers, then $\frac{1}{xy}(\hat{a} + \hat{b} + \hat{c} + \hat{d})$ equals to**

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

158. **Three non-zero non-collinear vectors $\hat{a}, \hat{b}$ and $\hat{c}$ are such that $\hat{a} + 3\hat{b}$ is collinear with $\hat{c}$, while $\hat{c}$ is $3\hat{b} + 2\hat{c}$ collinear with $\hat{a}$. Then $\hat{a} + 3\hat{b} + 2\hat{c}$ equals to**

(a) 0 (b) $2\hat{a}$ (c) $3\hat{b}$ (d) $4\hat{c}$

159. **If in a $\triangle$ ABC, $r_1 = 2, r_2 = 3$ and $r_3 = 6$, then a equals to**

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

160. **If in the angles of a triangle are in the ratio $1:1:4$, then the ratio of the perimeter of the triangle to its largest side is**

(a) $\sqrt{2} + 2 : \sqrt{3}$ (b) $3 : 2$

(c) $\sqrt{3} + 2 : \sqrt{2}$ (d) $\sqrt{3} + 2 : \sqrt{3}$