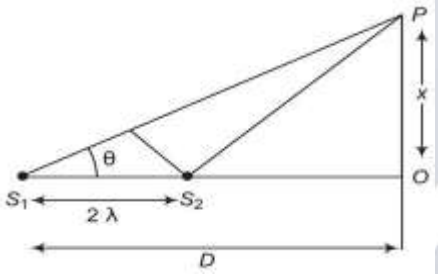
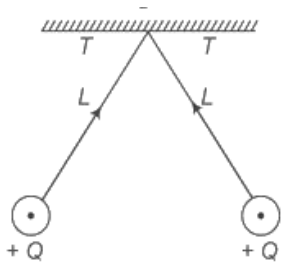
Physics

1. **A uniform rope of mass 0.1 kg and length 2.45 m hangs from a rigid support. The time taken by the transverse wave formed in the rope to travel through the full length of the rope is (Assume $g = 9.8\ m/s^2$)**
   (a) 0.5 s (b) 1.6 s
   (c) 1.2 s (d) 1.0 s
2. **When a vibrating tuning fork is placed on a sound box of a sonometer, 8 beats per second are heard when the length of the sonometer wire is kept at 101 cm or 100 cm . Then the frequency of the tuning fork is (Consider that the tension in the wire is kept constant)**
   (a) 1616 Hz (b) 1608 Hz
   (c) 1632 Hz (d) 1600 Hz
3. **The objective and eyepiece of an astronomical telescope are double convex lenses with refractive index 1.5. When the telescope is adjusted to infinity, the separation between the two lenses is 16 cm . If the space between the lenses is now filled with water and again telescope is adjusted for infinity, then the present separation between the lenses is**
   (a) 8 cm (b) 16 cm
   (c) 24 cm (d) 32 cm
4. **The dispersive powers of the materials of two lenses forming an achromatic combination are in the ratio of 4: 3. Effective focal length of the two lenses is +60 cm then the focal lengths of the lenses should be**
   (a) $-20\ cm, 25\ cm$ (b) $20\ cm, -25\ cm$
   (c) $-15\ cm, 20\ cm$ (d) $15\ cm, -20\ cm$
5. **Two coherent point sources S_1 and S_2 vibrating in phase emit light of wavelength λ. The separation between them is 2λ as shown in figure. The first bright fringe is formed at P due to interference on a screen placed at a distance D from $S_1 (D >> \lambda)$, then OP is**



(a) $\sqrt{2}D$ (b) $1.5D$
(c) $\sqrt{3}D$ (d) $2D$

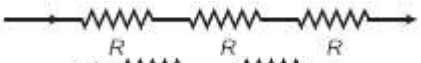
6. **At a certain place a magnet makes 30 oscillations per minute. At another place where the magnetic field is double, its time period will be**
   (a) 4 s (b) 2 s (c) $\frac{1}{2}$ s (d) $\sqrt{2}$ s
7. **A magnetic needle lying parallel to a magnetic field is turned through $60°$. The work done on it is W. The torque required to maintain the magnetic needle in the position mentioned above is**
   (a) $\sqrt{3}W$ (b) $\frac{\sqrt{3}}{2}W$
   (c) $\frac{W}{2}$ (d) $2W$
8. **A parallel plate capacitor has a capacity 80×10^{-6} F, when air is present between the plates. The volume between the plates is then completely filled with a dielectric slab of dielectric constant 20. The capacitor is now connected to a battery of 30 V by wires. The dielectric slab is then removed. Then, the charge that passes now through the wire is**
   (a) $45.6 \times 10^{-3}C$ (b) $25.3 \times 10^{-3}C$
   (c) $120 \times 10^{-3}C$ (d) $125 \times 10^{-3}C$
9. **Two small spheres each having equal positive charge Q (Coulomb) on each are suspended by two insulating strings of equal length L (metre) from a rigid hook (shown in figure). The whole set up is taken into satellite where there is no gravity. The two balls are now held by electrostatic forces in horizontal position, the tension in each string is then**

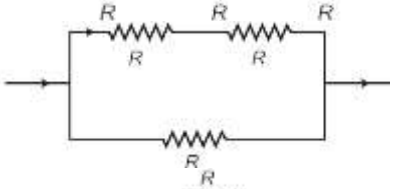


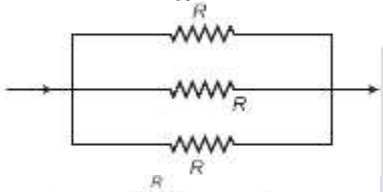
(a) $\frac{Q^2}{16\pi\varepsilon_0 L^2}$ (b) $\frac{Q^2}{8\pi\varepsilon_0 L^2}$

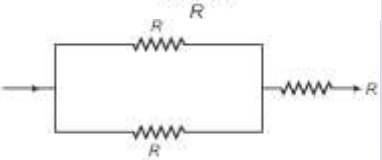
(c) $\frac{Q^2}{4\pi\varepsilon_0 L^2}$ (d) $\frac{Q^2}{2\pi\varepsilon_0 L^2}$

10. Three resistances of equal values are arranged in four different configurations as shown below. Power dissipation in the increasing order is

(I) 

(II) 

(III) 

(IV) 

(a) (III) < (II) < (IV) < (I)
(b) (II) < (III) < (IV) < (I)
(c) (I) < (IV) < (III) < (II)
(d) (I) < (III) < (II) < (IV)

11. Four resistors A, B, C and D form a Wheatstones bridge. The bridge is balanced, when $C = 100\Omega$. If A and B are interchanged, the bridge balances for $C = 121\Omega$. The value of D is

(a) 10Ω (b) 100Ω
(c) 110Ω (d) 120Ω

12. Total emf produced in a thermocouple does not depend on

(a) the metals in the thermocouple
(b) thomson coefficients of the metals in the thermocouple
(c) temperature of the junctions
(d) the duration of time for which the current is passed through thermocouple

13. A long -curved conductor carries a current I (I is a vector). A small current element of length dl, on the wire induces a magnetic field at a point, away from the current element. If the position vector between the current element and the point is r, making an angle with current element then, the induced magnetic field density; dB (vector) at the point is (μ_0 = permeability of free space)

(a) $\frac{\mu_0 Idl\times r}{4\pi r}$ (perpendicular to the current element dl)

(b) $\frac{\mu_0 I\times r\times dl}{4\pi r^2}$ (perpendicular to the current element dl)

(c) $\frac{\mu_0 I\times dl}{r}$ (perpendicular to the plane containing the current element and position vector r)

(d) $\frac{\mu_0 I\times dl}{4\pi r^2}$ (perpendicular to the plane containing current element and position vector r)

14. A primary coil and secondary coil are placed close to each other. A current, which changes at the rate of 25 A in a millisecond, is present in the primary coil. If the mutual inductance is 92×10^{-6}H, then the value of induced emf in the secondary coil is

(a) 4.6 V (b) 2.3 V
(c) 0.368 mV (d) 0.23 mV

15. The de-Broglie wavelength of an electron moving with a velocity of 1.5×10^8 m/s is equal to that of a photon. The ratio of kinetic energy of the electron to that of the photon ($c = 3 \times 10^8$ m/s)

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

16. A proton when accelerated through a potential difference of V, has a de-Broglie wavelength λ associated with it. If an α-particle is to have the same de-Broglie wavelength λ, it must be accelerated through a potential difference of

(a) $\frac{V}{8}$ (b) $\frac{V}{4}$ (c) 4V (d) 8 V

17. The half-life of Ra^{226} is 1620 years. Then the number of atoms decay in one second in 1 g of radium (Avogadro number $= 6.023 \times 10^{23}$)

(a) 4.23×10^9 (b) 3.16×10^{10}
(c) 3.61×10^{10} (d) 2.16×10^{10}

18. The half-life of a radioactive element is 10 h . The fraction of initial radioactivity of the element that will remain after 40 h is

(a) $\frac{1}{2}$ (b) $\frac{1}{16}$ (c) $\frac{1}{8}$ (d) $\frac{1}{4}$

19. In a transistor if $\frac{I_C}{I_E} = \alpha$ and $\frac{I_C}{I_B} = \beta$. If α varies between $\frac{20}{21}$ and $\frac{100}{101}$, then the value of β lies between

(a) $1 - 10$ (b) 0.95-0.99
(c) 20-100 (d) 200-300

20. Match Column A (layers in the ionosphere for skywave propagation) with Column B (their height range)

	Column A		Column B
(A)	D-layer	(I)	$250 - 400$ km
(B)	E-layer	(II)	$170 - 190$ km
(C)	F_1-layer	(III)	$95 - 120$ km
(D)	F_2-layer	(IV)	$65 - 75$ km

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

21. The gravitational field in a region is given by equation $E = (5i + 12j)$N/kg. If a particle of mass 2 kg is moved from the origin to the point (12 m, 5 m) in this region, the change in gravitational potential energy is

(a) -225 J (b) -240 J
(c) -245 J (d) -250 J

22. The time period of a particle in simple harmonic motion is 8 s . At $t = 0$, it is at the mean position. The ratio of the distances travelled by it in the first and second seconds is

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

23. A tension of 22 N is applied to a copper wire of cross-sectional area 0.02 cm^2 Young's modulus of copper is 1.1×10^{11} N/m^2 and Poisson's ratio 0.32 . The decrease in cross-sectional area will be

(a) 1.28×10^{-6} cm^2
(b) 1.6×10^{-6} cm^2
(c) 2.56×10^{-6} cm^2
(d) 0.64×10^{-6} cm^2

24. Drops of liquid of density d are floating half immersed in a liquid of density ρ. If the surface tension of the liquid is T, then the radius of the drop is

(a) $\sqrt{\frac{3T}{g(3d-\rho)}}$ (b) $\sqrt{\frac{6T}{g(2d-\rho)}}$
(c) $\sqrt{\frac{3T}{g(2d-\rho)}}$ (d) $\sqrt{\frac{3T}{g(4d-3\rho)}}$

25. A pipe having an internal diameter D is connected to another pipe of same size. Water flows into the second pipe through ' n ' holes, each of diameter d. If the water in the first pipe has speed v, the speed of water leaving the second pipe is
(a) $\frac{D^2v}{nd^2}$ (b) $\frac{nD^2v}{d^2}$
(c) $\frac{nd^2v}{D^2}$ (d) $\frac{d^2v}{nd^2}$

26. When a liquid is heated in copper vessel its coefficient of apparent expansion is $6\times10^{-6}/^\circ C$. When the same liquid is heated in a steel vessel its coefficient of apparent expansion is $24\times10^{-6}/^\circ C$. If coefficient of linear expansion for copper is $18\times10^{-6}/^\circ C$, the coefficient of linear expansion for steel is
(a) $20\times10^{-6}/^\circ C$ (b) $24\times10^{-6}/^\circ C$
(c) $36\times10^{-6}/^\circ C$ (d) $12\times10^{-6}/^\circ C$

27. When the temperature of a body increases from T to $T+\Delta T$, its moment of inertia increases from I to $I+\Delta I$. If α is the coefficient of linear expansion of the material of the body, then $\frac{\Delta I}{I}$ is (neglect higher orders of α)
(a) $\alpha\Delta T$ (b) $2\alpha\Delta T$
(c) $\frac{\Delta T}{\alpha}$ (d) $\frac{2\alpha}{\Delta T}$

28. A sound wave passing through an ideal gas at NTP produces a pressure change of 0.001 dyne $/cm^2$ during adiabatic compression. The corresponding change in temperature ($\gamma=1.5$ for the gas and atmospheric pressure is 1.013×10^6 dyne $/cm^2$) is
(a) 8.97×10^{-4} K (b) 8.97×10^{-6} K
(c) 8.97×10^{-8} K (d) 8.97×10^{-9} K

29. Work done to increase the temperature of one mole of an ideal gas by $30^\circ C$, if it is expanding under the condition $V\propto T^{2/3}$ is, ($R=8.314$ J/mol/K)
(a) 116.2 J (b) 136.2 J
(c) 166.2 J (d) 186.2 J

30. Power radiated by a black body at temperature T_1 is P and it radiates maximum energy at a wavelength λ_1. If the temperature of the black body is changed from T_1 to T_2, it radiates maximum energy at a wavelength $\frac{\lambda_1}{2}$. The power radiated at T_2 is
(a) 2P (b) 4P
(c) 8P (d) 16P

31. Two solid spheres A and B each of radius R are made of materials of densities ρ_A and ρ_B respectively. Their moments of inertia about a diameter are I_A and I_B respectively. The value of $\frac{I_A}{I_B}$ is
(a) $\sqrt{\frac{\rho_A}{\rho_B}}$ (b) $\sqrt{\frac{\rho_B}{\rho_A}}$
(c) $\frac{\rho_A}{\rho_B}$ (d) $\frac{\rho_B}{\rho_A}$

32. Assertion (A) The moment of inertia of a steel sphere is larger than the moment of inertia of a wooden sphere of same radius.
Reason (R) Moment of inertia is independent of mass of the body.
The correct one is
(a) Both (A) and (R) are true, and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true, and (R) is not the correct explanation of (A)
(c) (A) is true but (R) is wrong
(d) (A) is wrong but (R) is true

33. When the engine is switched off a vehicle of mass M is moving on a rough horizontal road with momentum p. If the coefficient of friction between the road and tyres of the vehicle is μ_k, the distance travelled by the vehicle before it comes to rest is

(a) $\frac{p^2}{2\mu_k M^2 g}$ (b) $\frac{2\mu_k M^2 g}{p^2}$

(c) $\frac{p^2}{2\mu_k g}$ (d) $\frac{p^2 M^2}{2\mu_k g}$

34. Choose correct statement

(A) The position of centre of mass of a system is dependent on the choice of coordinate system.

(B) Newton's second law of motion is applicable to the centre of mass of the system.

(C) Internal forces cannot change the state of centre of mass.

(D) Internal forces can change the state of centre of mass.

(a) Both (A) and (B) are correct

(b) Both (B) and (C) are wrong

(c) Both (A) and (C) are wrong

(d) Both (A) and (D) are wrong

35. A ball A of mass m moving along positive x-direction with kinetic energy K and momentum p undergoes elastic head on collision with a stationary ball B of mass M after collision the ball A moves along negative x-direction with kinetic energy $\frac{K}{9}$, final momentum of B is

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

36. A straight conductor of length 4 m moves at a speed of $10\ m/s$. When the conductor makes on angle of 30° with the direction of magnetic field of induction of $0.1\ Wb - m^2$, then induced emf is

(a) 8 V (b) 4 V

(c) 1 V (d) 2 V

37. The velocity v reached by a car of mass m at certain distance from the starting point driven with constant power P is such that

(a) $v \propto \frac{3P}{m}$ (b) $v^2 \propto \frac{2P}{m}$

(c) $v^3 \propto \frac{3P}{m}$ (d) $v \propto \left(\frac{3P}{m}\right)^2$

38. It is possible to project a particle with a given velocity in two possible ways so as to make them pass through a point p at a horizontal distance r from the point of projection. If t_1 and t_2 are times taken to reach this point in two possible ways, then the product $t_1 t_2$ is proportional to

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

39. Sum of magnitudes of two forces acting at a point is 16 N . If their resultant is normal to smaller force, and has a magnitude 8 N , then forces are

(a) 6 N, 10 N (b) 8 N, 8 N

(c) 4 N, 12 N (d) 2 N, 14 N

40. The length of a pendulum is measured as 1.01 m and time for 30 oscillations is measured as one minute 3 s . Error length is 0.01 m and error in time is 3 s . The percentage error in the measurement of acceleration due to gravity is

(a) 1 (b) 5 (c) 10 (d) 15

Chemistry

41. Benzene 4-hydroxy acetanilide belongs to which of the following?

(a) Antipyretic (b) Antacid

(c) Antiseptic (d) Antihistamine

42. The site of action of insulin is

(a) mitochondria (b) nucleus

(c) plasma membrane (d) DNA

43. The monomer of neoprene is

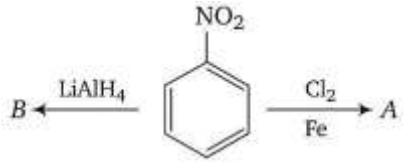
(a) 1,3-butadiene

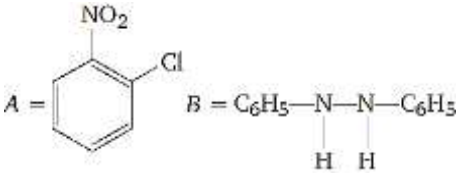
(b) 2-chloro-1,3-butadiene

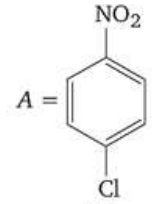
(c) 2-methyl-1,3-butadiene

(d) vinyl chloride

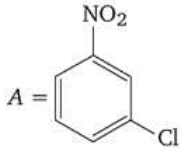
44. Identify A and B in the following reactions



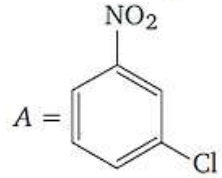
(a) 

(b) 

$B = C_6H_5 - N = N - C_6H_5$

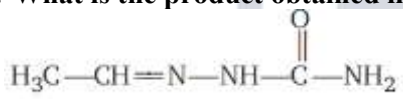
(c) 

$B = C_6H_5 - N = N - C_6H_5$

(d) 

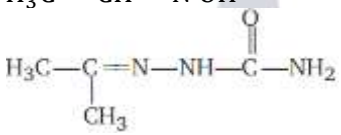
$B = C_6H_5 - NH_2$

45. What is the product obtained in the reaction of acetaldehyde with semicarbazide ?

(a) 

(b) $H_3C - CH = N - NH_2$

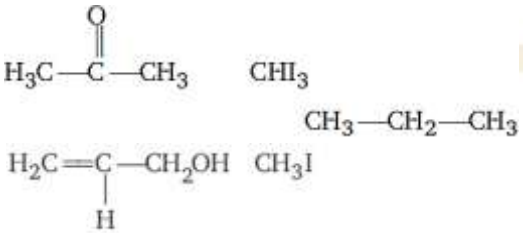
(c) $H_3C - CH = N\,OH$

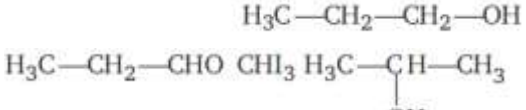
(d) 

46. Compound $A(C_3H_6O)$ undergoes following reactions to form B and C. Identify A, B and C.

$$C \xleftarrow{Zn-Hg/HCl} C_3H_6O \xrightarrow{I_2/NaOH} B$$

A **B** **C**

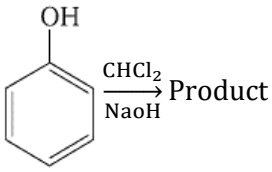
(a) 

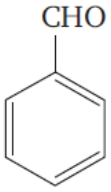
(b) 

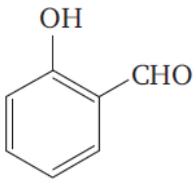
(c) 

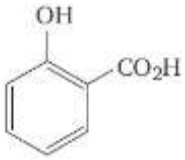
(d)

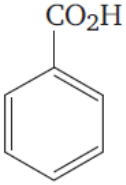
47. Identify the product in the following reaction.



(a) 

(b) 

(c) 

(d) 

48. With respect to chlorobenzene, which of the following statements is not correct ?

(a) Cl is ortho/para directing
(b) Cl exhibits +M effect
(c) Cl is ring deactivating
(d) Cl is meta directing

49. Match the following.

	Column I		Column II
(A)	**Acetaldehyde, vinyl alcohol**	**(1)**	**Enantiomers**
(B)	**Eclipsed and staggered ethane**	**(2)**	**Tautomers**
(C)	**(+)2-butanol, (-)2-butanol**	**(3)**	**Chain isomers**
(D)	**Methyl- n-propyl-amine and diethylamine**	**(4)**	**Conformational isomers**
		(5)	**Metamers**

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

50. Which of the following statements is not correct?

(a) The six carbons in benzene are sp^2 hybridised
(b) Benzene has $(4n + 2)\pi$ electrons
(c) Benzene undergoes substitution reactions
(d) Benzene has two carbon-carbon bond lengths, 1.54Å and 1.34Å

51. Different conformations of the same molecule are called
(a) isomers (b) epimers
(c) enantiomers (d) rotamers

52. The chlorination of ethane is an example for which type of the following reactions?
(a) Nucleophilic substitution
(b) Electrophilic substitution
(c) Free radical substitution
(d) Rearrangement

53. The pair of gases responsible for acid rain are
(a) H_2, O_3 (b) CH_4, O_3
(c) NO_2, SO_2 (d) CO, CH_4

54. In photoelectric effect, if the energy required to overcome the attractive forces on the electron, (work functions) of Li, Na and Rb are 2.41 eV , 2.30 eV and 2.09 eV respectively, the work function of ' K ' could approximately be in eV
(a) 2.52 (b) 2.20
(c) 2.35 (d) 2.01

55. The quantum number which explains the line spectra observed as doublets in case of hydrogen and alkali metals and doublets and triplets in case of alkaline earth metals is
(a) spin (b) azimuthal
(c) magnetic (d) principal

56. Which one of the following cannot form an amphoteric oxide?
(a) Al (b) Sn (c) Sb (d) *P*

57. The formal charges of C and O atoms in $CO_2(:\ddot{O}=C=\ddot{O}:)$ are, respectively
(a) $1, -1$ (b) $-1, 1$
(c) $2, -2$ (d) 0,0

58. According to molecular orbital theory, the total number of bonding electron pairs in O_2 is
(a) 2 (b) 3 (c) 5 (d) 4

59. One mole of N_2H_4 loses 10 moles of electrons to form a new compound Z. Assuming that all the nitrogens appear in the new compound, what is the oxidation state of nitrogen in Z ? (There is no change in the oxidation state of hydrogen.)
(a) -1 (b) -3 (c) +3 (d) +5

60. Which one of the following equations represents the variation of viscosity coefficient (η) with temperature (T) ?
(a) $\eta = Ae^{-E/RT}$ (b) $\eta = Ae^{E/RT}$
(c) $\eta = Ae^{-E/kT}$ (d) $\eta = Ae^{-E/T}$

61. The weight in grams of a non-volatile solute (mol. wt. 60) to be dissolved in 90 g of water to produce a relative lowering of vapour pressure of 0.02 is
(a) 4 (b) 8 (c) 6 (d) 10

62. The experimentally determined molar mass of a non-volatile solute, $BaCl_2$ in water by Cottrell's method, is
(a) equal to the calculated molar mass
(b) more than the calculated molar mass
(c) less than the calculated molar mass
(d) double of the calculated molar mass

63. The number of moles of electrons required to deposit 36 g of Al from an aqueous solution of $Al(NO_3)_3$ is (At. wt. of Al = 27)
(a) 4 (b) 2 (c) 3 (d) 1

64. The emf (in V) of a Daniell cell containing $0.1MZnSO_4$ and $0.01MCuSO_4$ solutions at their respective electrodes is $\left(E^\circ_{Cu^{2+}/Cu} = +0.34\ V; E^\circ_{Zn^{2+}/Zn} = -0.76\ V\right)$
(a) 1.10 (b) 1.16
(c) 1.13 (d) 1.07

65. Which one of the following elements, when present as an impurity in silicon makes it a p-type semiconductor?
(a) As (b) P (c) In (d) Sb

66. Which one of the following statements is correct for the reaction?

$CH_3COOC_2H_5(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + C_2H_5OH(aq)$

(a) Order is two, but molecularity is one
(b) Order is one but molecularity is two
(c) Order is one but molecularity is one
(d) Order is two but molecularity is two

67. The catalyst and promoter respectively used in the Haber's process of industrial synthesis of ammonia are
(a) Mo, V_2O_5 (b) V_2O_5, Fe
(c) Fe, Mo (d) Mo, Fe

68. Which one of the following statements is not correct?
(a) The pH of 1.0×10^{-8}M HCl is less than 7
(b) The ionic product of water at 25°C is 1.0×10^{-14} mol^2 L^{-2}
(c) $Cl^-$is a Lewis acid
(d) Bronsted Lowry theory cannot explain the acidic character of $AlCl_3$

69. Molar heat capacity (C_p) of water at constant pressure is $75JK^{-1}$ mol^{-1}. The increase in temperature (in K) of 100 g of water when 1 kJ of heat is supplied to it is
(a) 2.4 (b) 0.24
(c) 1.3 (d) 0.13

70. Gelly is a colloidal solution of
(a) solid in liquid (b) liquid in solid
(c) liquid in liquid (d) solid in solid

71. The product(s) formed when H_2O_2 reacts with disodium hydrogen phosphate is
(a) $P_2O_5 \cdot Na_3PO_4$ (b) $Na_2HPO_4 \cdot H_2O_2$
(c) NaH_2PO_4, H_2O (d) $Na_2HPO_4 \cdot H_2O$

72. Which of the following is not correct?
(a) LiOH is a weaker base than NaOH
(b) Salts of Be undergo hydrolysis
(c) $Ca(HCO_3)_2$ is soluble in water
(d) Hydrolysis of beryllium carbide gives acetylene

73. What is Z in the following reactions ?

$$BCl_3 + H_2 \xrightarrow[450^0C]{Cu-Al} X + HCl$$

$$X \xrightarrow{\text{methylation}} Z$$

(a) $(CH_3)BH_2$ (b) $(CH_3)_4\ B_2H_2$
(c) $(CH_3)_3\ B_2H_3$ (d) $(CH_3)_6\ B_2$

74. Which one of the following elements reduces NaOH to Na ?
(a) Si (b) Pb (c) C (d) Sn

75. Which one of the following is used in the preparation of cellulose nitrate ?
(a) KNO_3 (b) HNO_3
(c) KNO_2 (d) HNO_2

76. The oxoacid of sulphur which contains two sulphur atoms in different oxidation states is
(a) pyrosulphurous acid
(b) hyposulphurous acid
(c) pyrosulphuric acid
(d) persulphuric acid

77. Bond energy of Cl_2, Br_2 and I_2 follow the order
(a) $Cl_2 > Br_2 > I_2$ (b) $Br_2 > Cl_2 > I_2$
(c) $I_2 > Br_2 > Cl_2$ (d) $I_2 > Cl_2 > Br_2$

78. Assertion (A) The boiling points of noble gases increases from He to Xe.
Reason (R) The interatomic van der Waals' attractive forces increases from He to Xe.

The correct answer is

(a) Both (A) and (R) are true, and (R) is the correct explanation of (A)

(b) Both (A) and (R) are true, and (R) is not the correct explanation of (A)

(c) (A) is true but (R) is not true

(d) (A) is not true but (R) is true

79. A coordinate complex contains Co^{3+}, Cl^- and NH_3. When dissolved in water, one mole of this complex gave a total of 3 moles of ions. The complex is

(a) $[Co(NH_3)_6]Cl_3$ (b) $[Co(NH_3)_5Cl]Cl_2$

(c) $[Co(NH_3)_4Cl_2]Cl$ (d) $[Co(NH_3)_3Cl_3]$

80. Ni anode is used in the electrolytic extraction of

(a) Al

(b) Mg

(c) Na by Down's process

(d) Na by Castner's process

Mathematics

81. The equation of a straight line passing through the point $(1, 2)$ and inclined at 45° to the line $y = 2x + 1$ is

(a) $5x + y = 7$ (b) $3x + y = 5$

(c) $x + y = 3$ (d) $x - y + 1 = 0$

82. A point moves in the xy-plane such that the sum of its distance from two mutually perpendicular lines is always equal to 5 units. The area (in sq units) enclosed by the locus of the point, is

(a) $\frac{25}{4}$ (b) 25 (c) 50 (d) 100

83. The distance between the parallel lines given by $(x + 7y)^2 + 4\sqrt{2}(x + 7y) - 42 = 0$ is

(a) $\frac{4}{5}$ (b) $4\sqrt{2}$

(c) 2 (d) $10\sqrt{2}$

84. If the area of the triangle formed by the pair of lines $8x^2 - 6xy + y^2 = 0$ and the line $2x + 3y = a$ is 7 , then a is equal to

(a) 14 (b) $14\sqrt{2}$

(c) $28\sqrt{2}$ (d) 28

85. If the pair of lines given by $(x^2 + y^2)\cos^2\theta = (x\cos\theta + y\sin\theta)^2$ are perpendicular to each other, then θ is equal to

(a) 0 (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{3}$ (d) $\frac{3\pi}{4}$

86. Given the circle C with the equation $x^2 + y^2 - 2x + 10y - 38 = 0$. Match the List I with the List II given below concerning C

	List I		List II
(A)	The equation of the polar of (4,3) with respect to C	(I)	$y + 5 = 0$
(B)	The equation of the tangent at (9,-5) on C	(II)	$x = 1$
(C)	The equation of The normal at The (-7,-5) on C	(III)	$3x + 8y = 27$
(D)	The equation of the diameter of C passing through (1,3)	(IV)	$x + y = 3$

		(V)	X = 9

The correct answer is

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

87. Consider the circle $x^2 + y^2 - 4x - 2y + c = 0$ whose centre is $A(2, 1)$. If the point $P(10, 7)$ is such that the line segment PA meets the circle in Q with $PQ = 5$, then c is equal to
(a) -15 (b) 20 (c) 30 (d) -20

88. If the line $x + 3y = 0$ is the tangent at $(0, 0)$ to the circle of radius 1 , then the centre of one such circle is
(a) (3,0) (b) $\frac{-1}{\sqrt{10}}, \frac{3}{\sqrt{10}}$
(c) $\frac{3}{\sqrt{10}}, \frac{-3}{\sqrt{10}}$ (d) $\frac{1}{\sqrt{10}}, \frac{3}{\sqrt{10}}$

89. A circle passes through the point $(3, 4)$ and cuts the circle $x^2 + y^2 = a^2$ orthogonally; the locus of its centre is a straight line. If the distance of this straight line from the origin is 25 , then a^2 is equal to
(a) 250 (b) 225
(c) 100 (d) 25

90. The equation to the line joining the centres of the circles belonging to the coaxial system of circles $4x^2 + 4y^2 - 12x + 6y - 3 + \lambda(x + 2y - 6) = 0$ is
(a) $8x - 4y - 15 = 0$
(b) $8x - 4y + 15 = 0$
(c) $3x - 4y - 5 = 0$
(d) $3x - 4y + 5 = 0$

91. Let $x + y = k$ be a normal to the parabola $y^2 = 12x$. If p is length of the perpendicular from the focus of the parabola onto this normal, then $4k - 2p^2$ is equal to
(a) 1 (b) 0 (c) -1 (d) 2

92. If the line $2x + 5y = 12$ intersects the ellipse $4x^2 + 5y^2 = 20$ in two distinct points A and B, then mid-point of AB is
(a) (0,1) (b) (1,2)
(c) (1,0) (d) (2,1)

93. Equation of one of the tangents passing through $(2, 8)$ to the hyperbola $5x^2 - y^2 = 5$ is
(a) $3x + y - 14 = 0$
(b) $3x - y + 2 = 0$
(c) $x + y + 3 = 0$
(d) $x - y + 6 = 0$

94. The area (in sq units) of the equilateral triangle formed by the tangent at $(\sqrt{3}, 0)$ to the hyperbola $x^2 - 3y^2 = 3$ with the pair of asymptotes of the hyperbola is
(a) $\sqrt{2}$ (b) $\sqrt{3}$
(c) $\frac{1}{\sqrt{3}}$ (d) $2\sqrt{3}$

95. The radius of the circle $r = 12\cos\theta + 5\sin\theta$ is
(a) $\frac{5}{12}$ (b) $\frac{17}{2}$ (c) $\frac{15}{2}$ (d) $\frac{13}{2}$

96. If x-coordinate of a point P on the line joining the points $Q(2, 2, 1)$ and $R(5, 1, -2)$ is 4 , then the z-coordinate of P is
(a) -2 (b) -1 (c) 1 (d) 2

97. A straight line is equally inclined to all the three coordinate axes. Then, an angle made by the line with the y-axis is
(a) $\cos^{-1}\frac{1}{3}$ (b) $\cos^{-1}\frac{1}{\sqrt{3}}$
(c) $\cos^{-1}\frac{2}{\sqrt{3}}$ (d) $\frac{\pi}{4}$

98. If the foot of the perpendicular from $(0, 0, 0)$ to a plane is $(1, 2, 3)$, then the equation of the plane is
(a) $2x + y + 3z = 14$

(b) $x + 2y + 3z = 14$
(c) $x + 2y + 3z + 14 = 0$
(d) $x + 2y - 3z = 14$

99. The equation of the sphere through the points $(1,0,0)$, $(0,1,0)$ and $(1,1,1)$ and having the smallest radius
(a) $3(x^2 + y^2 + z^2) - 4x - 4y - 2z + 1 = 0$
(b) $2(x^2 + y^2 + z^2) - 3x - 3y - z + 1 = 0$
(c) $x^2 + y^2 + z^2 - x - y + z + 1 = 0$
(d) $x^2 + y^2 + z^2 - 2x - 2y + 4z + 1 = 0$

100. $\lim_{x\to\infty} \frac{x+6}{x+1}^{x+4}$ is equal to
(a) e^4 (b) e^6 (c) e^5 (d) e

101. Let $f: R \to R$ be defined by

$$f(x) = \begin{cases} \alpha + \frac{\sin[x]}{x}, & \text{if } x > 0 \\ 2, & \text{if } x = 0 \\ \beta + \frac{\sin x - x}{x^3}, & \text{if } x < 0 \end{cases}$$

where, $[x]$ denotes the integral part of x. If f continuous at $x = 0$, then $\beta - \alpha$ is equal to
(a) -1 (b) 1 (c) 0 (d) 2

102. If $f(x) = \log e^x \frac{x-2}{x+2}^{3/4}$, then $f'(0)$ is equal to
(a) $\frac{1}{4}$ (b) 4 (c) $\frac{-3}{4}$ (d) 1

103. If $xy \neq 0, x + y \neq 0$ and $x^m y^n = (x + y)^{m+n}$, where $m, n \notin N$, then $\frac{dy}{dx}$ is equal to
(a) $\frac{y}{x}$ (b) $\frac{x+y}{xy}$ (c) xy (d) $\frac{x}{y}$

104. If $x^2 + y^2 = t + \frac{1}{t}, x^4 + y^4 = t^2 + \frac{1}{t^2}$, then $x^3 y \frac{dy}{dx}$ is equal to
(a) -1 (b) 1 (c) 0 (d) t

105. If $f(x) = (x^2 - 1)^7$, then $f^{(14)}(x)$ is equal to
(a) 0 (b) 2! (c) 7! (d) 14 !

106. The coordinates of the point P on the curve $x = a(\theta + \sin\theta), y = a(1 - \cos\theta)$, where the tangent is inclined at an angle $\frac{\pi}{4}$ to x-axis, are
(a) $a\frac{\pi}{4} - 1, a$ (b) $a(\frac{\pi}{2} + 1,)a$
(c) $(a\frac{\pi}{2}, a)$ (d) (a, a)

107. If Δ is the area of the triangle formed by the positive x-axis and the normal and tangent to the circle $x^2 + y^2 = 4$ at $(1, \sqrt{3})$, then Δ is equal to
(a) $\frac{\sqrt{3}}{2}$ (b) $\sqrt{3}$
(c) $2\sqrt{3}$ (d) 6

108. If the volume of a sphere increases at the rate of 2π cm^3/s, then the rate of increase of its radius (in cm/s), when the volume is 288π cm^3, is
(a) $\frac{1}{36}$ (b) $\frac{1}{72}$ (c) $\frac{1}{18}$ (d) $\frac{1}{9}$

109. If $u = f(r)$, where $r^2 = x^2 + y^2$, then $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}$ is equal to
(a) $f''(r)$
(b) $f''(r) + f'(r)$
(c) $f''(r) + \frac{1}{r}f'(r)$
(d) $f''(r) + rf'(r)$

110. $\int \frac{dx}{x^2\sqrt{4+x^2}}$ **is equal to**

(a) $\frac{1}{4}\sqrt{4+x^2}+C$ (b) $\frac{-1}{4}\sqrt{4+x^2}+C$

(c) $\frac{-1}{4x}\sqrt{4+x^2}+C$ (d) $\frac{9}{4x}\sqrt{4+x^2}+C$

111. **If** $\int \sec^2 x \operatorname{cosec}^4 x dx = -\frac{1}{3}\cot^3 x + k\tan x - 2\cot x + C$, **then k is equal to**

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

112. $\int \frac{dx}{\sqrt{x-x^2}}$ **is equal to**

(a) $2\sin^{-1}\sqrt{x}+C$ (b) $2\sin^{-1}x+C$

(c) $2x\sin^{-1}x+C$ (d) $\sin^{-1}\sqrt{x}+C$

113. **If** $a>0$, **then** $\int_{-\pi}^{\pi}\frac{\sin^2 x}{1+a^x}dx$ **is equal to**

(a) $\frac{\pi}{2}$ (b) π

(c) $\frac{2\pi}{2}$ (d) $a\pi$

114. **The area (in sq units) bounded by the curves** $y^2=4x$ **and** $x^2=4y$ **is**

(a) $\frac{64}{3}$ (b) $\frac{16}{3}$ (c) $\frac{8}{3}$ (d) $\frac{2}{3}$

115. **The value of the integral** $\int_0^4 \frac{dx}{1+x^2}$ **obtained by using Trapezoidal rule with** $h=1$ **is**

(a) $\frac{63}{85}$ (b) $\tan^{-1}(4)$ (c) $\frac{108}{85}$ (d) $\frac{113}{85}$

116. **If** $\frac{dy}{dx}+2x\tan(x-y)=1$, **then** $\sin(x-y)$ **is equal to**

(a) Ae^{-x^2} (b) Ae^{2x}

(c) Ae^{x^2} (d) Ae^{-2x}

117. **An integrating factor of the differential equation** $(1-x^2)\frac{dy}{dx}+xy=\frac{x^4}{(1+x^5)}\left(\sqrt{1-x^2}\right)^3$ **is**

(a) $\sqrt{1-x^2}$ (b) $\frac{x}{\sqrt{1-x^2}}$

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

118. **If** $f: R\to R^2$ **and** $g: R^+\to R$ **are such that** $g\{f(x)\}=|\sin x|$ **and** $f\{g(x)\}=(\sin\sqrt{x})^2$, **then a possible choice for f and g is**

(a) $f(x)=x^2, g(x)=\sin\sqrt{x}$

(b) $f(x)=\sin x, g(x)=|x|$

(c) $f(x)=\sin^2 x, g(x)=\sqrt{x}$

(d) $f(x)=x^2, g(x)=\sqrt{x}$

119. **If** $f: Z\to Z$ **is defined by** $f(x)=\begin{cases}\frac{x}{2}, & \text{if } x \text{ is even}\\ 0, & \text{if } x \text{ is odd}\end{cases}$, then f is

(a) onto but not one-to-one

(b) one-to-one but not onto

(c) one-to-one and onto

(d) neither one-to-one nor onto

120. **If** $\frac{1}{2\times4}+\frac{1}{4\times6}+\frac{1}{6\times8}+\cdots(n \text{ terms})=\frac{kn}{n\times1}$, **then k is equal to**

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) 1 (d) $\frac{1}{8}$

121. **A regular polygon of n sides has 170 diagonals, then n is equal to**

(a) 12 (b) 17 (c) 20 (d) 25

122. **A committee of 12 members is to be formed from 9 women and 8 men. The number of committees in which the women are in majority is**

(a) 2720 (b) 2702
(c) 2270 (d) 2278

123. **A student has to answer 10 out of 13 questions in an examination choosing at least 5 questions from the first 6 questions. The number of choice available to the student is**
(a) 63 (b) 91
(c) 161 (d) 196

124. $\sum_{k=1}^{\infty}\sum_{r=0}^{k}\frac{1}{3^k}\left({}^{k}C_{r}\right)$ **is equal to**
(a) $\frac{1}{3}$ (b) $\frac{2}{3}$ (c) 1 (d) 2

125. **If $ab \neq 0$ and the sum of the coefficients of x^7 and x^4 in the expansion of $\left(\frac{x^2}{a}-\frac{b}{x}\right)^{11}$ is 0 , then**
(a) $a = b$ (b) $a + b = 0$
(c) $ab = -1$ (d) $ab = 1$

126.
$\frac{1}{x(x+1)(x+2)\ldots(x+n)} = \frac{A_0}{x} + \frac{A_1}{x+1} + \cdots \frac{A_n}{x+n}, 0 \leq i \leq r \Rightarrow A_r$ **is equal to**
(a) $(-1)^r \frac{r!}{(n-r)!}$ (b) $(-1)^r \frac{1}{r!(n-r)!}$
(c) $\frac{1}{r!(n-r)!}$ (d) $\frac{r!}{(n-r)!}$

127. $1 + \frac{1}{3\cdot 2^2} + \frac{1}{5\cdot 2^4} + \frac{1}{7\cdot 2^6} + \cdots$ **is equal to**
(a) $\log_e 2$ (b) $\log_e 3$
(c) $\log_e 4$ (d) $\log_e 5$

128. **In $\triangle PQR, \angle R = \frac{\pi}{4}, \tan\frac{P}{3}, \tan\frac{Q}{3}$ are the roots of the equation $ax^2 + bx + c = 0$, then**
(a) $a + b = c$ (b) $b + c = 0$
(c) $a + c = 0$ (d) $b = c$

129. **The product of real of the equation $|x|^{6/5} - 26|x|^{3/5} - 27 = 0$**
(a) -3^{10} (b) -3^{12}
(c) $-3^{12/5}$ (d) $-3^{21/5}$

130. **If α, β and γ are the roots of the equation $x^3 + px^2 + qx + r = 0$, then the coefficient of x in the cubic equation whose roots are $\alpha(\beta+\gamma), \beta(\gamma+\alpha)$ and $\gamma(\alpha+\beta)$ is**
(a) 2q (b) $q^2 + pr$
(c) $p^2 - qr$ (d) $r(pq - r)$

131. **Let**
$A = \begin{vmatrix} 2 & e^{i\pi} \\ -1 & i^{2012} \end{vmatrix}, C = \frac{d}{dx}\frac{1}{x}x = 1$
$D = \int_{e^2}^{1}\frac{dx}{x}$. **If the sum of two roots of the equation $Ax^3 + Bx^2 + Cx - D = 0$ is equal to zero, then B is equal to**
(a) -1 (b) 0 (c) 1 (d) 2

132. $A = \begin{bmatrix} i & -i \\ -i & i \end{bmatrix}, B = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \Rightarrow A^8$
(a) 4B (b) 8B
(c) 64B (d) 128B

133. **If $f(x)$**
$\begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & x(x+1) \\ 3x(x-1) & x(x-1)(x-2) & (x-1)x(x+1) \end{vmatrix}$
then $f(2012)$ is equal to
(a) 0 (b) 1
(c) -500 (d) 500

134. Let $A=\begin{bmatrix}-1 & -2 & -3\\ 3 & 4 & 5\\ 4 & 5 & 6\end{bmatrix}$, $B=\begin{bmatrix}1 & -2\\ -1 & 2\end{bmatrix}$ and $C=\begin{bmatrix}2 & 0 & 0\\ 0 & 2 & 0\\ 0 & 0 & 2\end{bmatrix}$, if a, b and c respectively, denote if a, b and c respectively, denote the ranks of A, B and C, then the correct order of these number is

(a) $a<b<c$ (b) $c<b<a$

(c) $b<a<c$ (d) $a<c<b$

135. Given that, $a\alpha^2+2b\alpha+c\neq 0$ and that the system of equations

$(a\alpha+b)x+ay+bz=0$;

$(b\alpha+c)x+by+cz=0$;

$(a\alpha+b)y+(b\alpha+c)z=0$

has a non-trivial solution, then a, b and c lie in

(a) Arithmetic progression

(b) Geometric progression

(c) Harmonic progression

(d) Arithmetico-geometric progression

136. If a, b, c and $d\in R$ such that $a^2+b^2=4$ and $c^2+d^2=2$ and if $(a+ib)^2=(c+id)^2(x+iy)$, then x^2+y^2 is equal to

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

137. If z is complex number such that, $\left|z-\frac{4}{z}\right|=2$ then the greatest value of $|z|$ is

(a) $1+\sqrt{2}$ (b) $\sqrt{2}$

(c) $\sqrt{3}+1$ (d) $1+\sqrt{5}$

138. If α is a non-real root of the equation $x^6-1=0$, then $\frac{\alpha^2+\alpha^3+\alpha^4+\alpha^5}{\alpha+1}$ is equal to

(a) α (b) 1 (c) 0 (d) -1

139. The minimum value of $27\tan^2\theta+3\cot^2\theta$ is

(a) 15 (b) 18 (c) 24 (d) 30

140. $\cos 36^\circ-\cos 72^\circ$ is equal to

(a) 1 (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) $\frac{1}{8}$

141. If $\tan x+\tan\left(x+\frac{\pi}{3}\right)+\tan\left(x+\frac{2\pi}{3}\right)=3$, then $\tan 3x$ is equal to

(a) 3 (b) 2 (c) 1 (d) 0

142. If $3\sin x+4\cos x=5$, then $6\tan\frac{x}{2}-9\tan^2\frac{x}{2}$ is equal to

(a) 0 (b) 1 (c) 3 (d) 4

143. If $\frac{1}{2}\le x\le 1$, then

$\cos^{-1}x+\cos^{-1}\frac{x}{2}+\frac{1}{2}\sqrt{3-3x^2}$ is equal to

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) π (d) 0

144. If a, b and c form a geometric progression with common ratio r, then the sum of the ordinates of the points of intersection of the line $ax+by+c=0$ and the curve $x+2y^2=0$ is

(a) $-\frac{r^2}{2}$ (b) $-\frac{r}{2}$

(c) $\frac{r}{2}$ (d) r

145. The point $(3,2)$ undergoes the following three transformations in the order given

(i) Reflection about the line $y=x$.

(ii) Translation by the distance 1 unit in the positive direction of x-axis.

(iii) Rotation by an angle $\frac{\pi}{4}$ about the origin in the anti-clockwise direction.

Then, the final position of the point is

(a) $(-\sqrt{18},\sqrt{18})$ (b) $(-2,3)$

(c) $(0,\sqrt{18})$ (d) $(0,3)$

146. If X is a poisson variate such that $\alpha = P(X = 1) = P(X = 2)$, then $P(X = 4)$ is equal to

(a) 2α (b) $\frac{\alpha}{3}$ (c) αe^{-2} (d) αe^{2}

147. Suppose X follows a binomial distribution with parameters n and p, where $0 < p < 1$. If $\frac{P(X=r)}{P(X=n-r)}$ is independent of n for every r, then p is equal to

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{1}{4}$ (d) $\frac{1}{8}$

148. In an entrance test there are multiple choice questions. There are four possible answers to each question, of which one is correct. The probability that a student know the answer to a question is $9/10$. If he gets the correct answer to a question, then the probability that he was guessing is

(a) $\frac{37}{40}$ (b) $\frac{1}{37}$ (c) $\frac{36}{37}$ (d) $\frac{1}{9}$

149. There are four machines and it is known that exactly two of them are faulty. They are tested one by one, in a random order till both the faulty machines are identified. Then, the probability that only two tests are need is

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

150. A fair coin is tossed 100 times. The probability of getting tails an odd number of times is

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{8}$ (d) $\frac{3}{8}$

151. $\mathbf{a} = \mathbf{i} + \mathbf{j} - 2\mathbf{k} \Rightarrow \sum\{(\mathbf{a} \times \mathbf{i}) \times \mathbf{j}\}^2$ is equal to

(a) $\sqrt{6}$ (b) 6

(c) 36 (d) $6\sqrt{6}$

152. Let $\mathbf{a}, \mathbf{b}$ and $\mathbf{c}$ be three non-coplanar vectors and let $\mathbf{p}, \mathbf{q}$ and $\mathbf{r}$ be the vectors defined by $\mathbf{p} = \frac{\mathbf{b}\times\mathbf{c}}{[\mathbf{abc}]}, \mathbf{q} = \frac{\mathbf{c}\times\mathbf{a}}{[\mathbf{abc}]}, \mathbf{r} = \frac{\mathbf{a}\times\mathbf{b}}{[\mathbf{abc}]}$. Then, $(\mathbf{a}+\mathbf{b})\cdot\mathbf{p} + (\mathbf{b}+\mathbf{c})\cdot\mathbf{q} + (\mathbf{c}+\mathbf{a})\cdot\mathbf{r}$ is equal to

(a) 0 (b) 1 (c) 2 (d) 3

153. Let $\mathbf{a} = \mathbf{i} + 2\mathbf{j} + \mathbf{k}, \mathbf{b} = \mathbf{i} - \mathbf{j} + \mathbf{k}, \mathbf{c} = \mathbf{i} + \mathbf{j} - \mathbf{k}$. A vector in the plane of $\mathbf{a}$ and $\mathbf{b}$ has projection $\frac{1}{\sqrt{3}}$ on $\mathbf{c}$. Then, one such vector is

(a) $4\mathbf{i} + \mathbf{j} - 4\mathbf{k}$ (b) $3\mathbf{i} + \mathbf{j} - 3\mathbf{k}$

(c) $4\mathbf{i} - \mathbf{j} + 4\mathbf{k}$ (d) $2\mathbf{i} + \mathbf{j} + 2\mathbf{k}$

154. The point if intersection of the lines $\mathbf{l_1}: \mathbf{r}(t) = (\mathbf{i} - 6\mathbf{j} + 2\mathbf{k}) + t(\mathbf{i} + 2\mathbf{j} + \mathbf{k})$ $\mathbf{l_2}: \mathbf{R}(u) = (4\mathbf{j} + \mathbf{k}) + u(2\mathbf{i} + \mathbf{j} + 2\mathbf{k})$ is

(a) (4,4,5) (b) (6,4,7)

(c) (8,8,9) (d) (10,12,11)

155. The vectors $\mathbf{AB} = 3\mathbf{i} - 2\mathbf{j} + 2\mathbf{k}$ and $\mathbf{BC} = \mathbf{i} - 2\mathbf{k}$ are the adjacent sides of a parallelogram. The angle between its diagonals is

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$ or $\frac{2\pi}{3}$

(c) $\frac{3\pi}{4}$ or $\frac{\pi}{4}$ (d) None of these

156. If p th, q th, r th terms of a geometric progression are the positive numbers $\mathbf{a}, \mathbf{b}$ and $\mathbf{c}$ respectively, then the angle between the vectors $(\log \mathbf{a}^2)\mathbf{i} + (\log \mathbf{b}^2)\mathbf{j} + (\log \mathbf{c}^2)\mathbf{k}$ and $(q-r)\mathbf{i} + (r-p)\mathbf{j} + (p-q)\mathbf{k}$ is

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{2}$

(c) $\sin^{-1}\frac{1}{\sqrt{a^2+b^2+c^2}}$ (d) $\frac{\pi}{4}$

157. A vertical pole subtends an angle $\tan^{-1}\left(\frac{1}{2}\right)$ at point P on the ground. If the angles substende by the upper half and the lower half of the pol at P are respectively α and β, the $(\tan\alpha, \tan\beta)$ is equal to

(a) $\left(\frac{1}{4}, \frac{1}{5}\right)$ (b) $\left(\frac{1}{5}, \frac{2}{9}\right)$

(c) $\left(\frac{2}{9}, \frac{1}{4}\right)$ (d) $\left(\frac{1}{4}, \frac{2}{9}\right)$

158. **If α, β and γ are length of the altitudes of a $\triangle$ ABC with area $\triangle$, then $\frac{\Delta^2}{R^2}\frac{1}{\alpha^2}+\frac{1}{\beta^2}+\frac{1}{\gamma^2}$ is equal to**

(a) $\sin^2 A+\sin^2 B+\sin^2 C$
(b) $\cos^2 A+\cos^2 B+\cos^2 C$
(c) $\tan^2 A+\tan^2 B+\tan^2 C$
(d) $\cot^2 A+\cot^2 B+\cot^2 C$

159. **In an acute angled triangle, $\cot B\cot C+\cot A\cot C+\cot A\cot B$ is equal to**

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

160. **$x=\log\left(\frac{1}{y}+\sqrt{1+\frac{1}{y^2}}\right) \Rightarrow y$ is equal to**

(a) $\tanh x$ (b) $\coth x$
(c) $\operatorname{sech} x$ (d) $\operatorname{cosech} x$