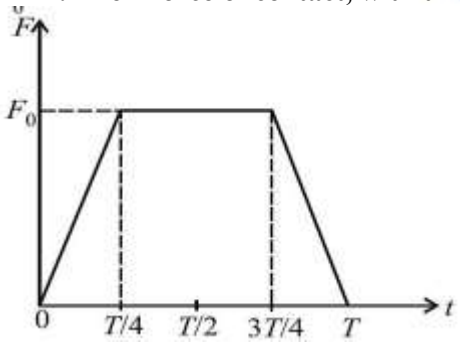
Physics

1. **An electric generator is based on**
   (a) Faraday's laws of electromagnetic induction
   (b) Motion of charged particles in an electromagnetic field
   (c) Fission of uranium by slow neutrons
   (d) Newton's laws of motion
2. **Which of the following decreases, in motion on a straight line, with constant retardation?**
   (a) Speed (b) Acceleration
   (c) Displacement (d) Distance
3. **When a ball is thrown with a velocity of $50\ ms^{-1}$ at an angle 30° with the horizontal, it remains in the air for ..... s. (Take, $g = 10\ ms^{-2}$)**
   (a) 5 (b) 2.5
   (c) 1.25 (d) 0.625
4. **One of the rectangular components of a force of 40 N is $20\sqrt{3}$ N. What is the other rectangular component?**
   (a) 10 N (b) 20 N
   (c) 30 N (d) 25 N
5. **An object dropped in a stationary lift takes time t_1 to reach the floor. It takes time t_2 when lift is moving up with constant acceleration. Then,**
   (a) $t_2 > t_1$ (b) $t_1 > t_2$
   (c) $t_1 \approx t_2$ (d) $t_1 = t_2$
6. **When a body is placed on a rough plane (coefficient of friction $= \mu$) inclined at an angle θ to the horizontal, its acceleration is (acceleration due to gravity $= g$)**
   (a) $g(\sin\theta - \mu\cos\theta)$
   (b) $g(\sin\theta - \cos\theta)$
   (c) $g\mu(\sin\theta - \cos\theta)$
   (d) $g(\mu\sin\theta - \cos\theta)$
7. **A metal ball of mass 2 kg moving with a velocity of 36 km/h has a head on collision with a stationary ball of mass 3 kg. After the collision, if both balls move together, then the loss in kinetic energy due to collision is**
   (a) 40 J (b) 60 J
   (c) 100 J (d) 140 J
8. **A body of mass 8 kg, under the action of a force, is displaced according to the equation, $s = \frac{t^2}{4}$ m, where t is the time. Find the work done by the force in the first 4 s.**
   (a) 9 J (b) 16 J (c) 6 J (d) 3 J
9. **A particle of mass m, moving with a velocity v makes an elastic collision in one dimension with a stationary particle of mass m. During the collision, they remain in contact with each other for an extremely small time T. Their force of contact, with time is shown in the figure. Then, F_0**



(a) $\frac{2mv}{T}$ (b) $\frac{4mv}{3T}$
(c) $\frac{mv}{T}$ (d) $\frac{3mv}{4T}$

10. **Which of the following type of wheels of same mass and radius will have largest moment of inertia?**
    (a) Ring (b) Angular disc
    (c) Solid disc (d) Cylindrical disc

11. The sum of moments of all the particles in a system about its centre of mass is always
(a) minimum (b) zero
(c) maximum (d) infinite

12. Assertion: Two identical trains move in opposite senses in equatorial plane with same speeds relative to the Earth's surface. They have equal magnitude of normal reaction.
Reason : The trains have different centripetal accelerations due to different speeds.
(a) Both A and R are true and R is a correct explanation for A .
(b) Both A and R are true but R is not a correct explanation for A .
(c) A is true, R is false.
(d) A is false, R is true.

13. A spring is stretched by 0.40 m when a mass of 0.6 kg is suspended from it. The period of oscillations of the spring loaded by 255 g and put to oscillations is close to ($g = 10\ ms^{-2}$)
(a) 11 s (b) 48.6 s
(c) 0.82 s (d) 4.86 s

14. A heavy brass sphere is hung from a spring and it executes vertical vibrations with period T. The sphere is now immersed in a non-viscous liquid with a density $(1/10)$ th that of brass. When set into vertical vibrations with the sphere remaining inside liquid all the time, the time period will be
(a) $\left(\sqrt{\frac{9}{10}}\right)T$ (b) $\left(\sqrt{\frac{10}{9}}\right)T$
(c) $\left(\frac{9}{10}\right)T$ (d) Unchanged

15. A particle is kept on the surface of a uniform sphere of mass 1000 kg and radius 1 m. The work done per unit mass against the gravitational force between them is $\left[G = 6.67 \times 10^{-11} Nm^2\ kg^{-2}\right]$
(a) $3.35 \times 10^{-10} Jkg^{-1}$
(b) $-3.35 \times 10^{-10} Jkg^{-1}$
(c) $6.67 \times 10^{-8} Jkg^{-1}$
(d) $-3.35 \times 10^{-8} Jkg^{-1}$

16. The acceleration due ot gravity at a height $(1/20)$ th of the radius of Earth above the Earth's surface is $9\ ms^{-2}$. Its value at an equal depth below the surface of earth is
(a) $9\ ms^{-2}$ (b) $9.25\ ms^{-2}$
(c) $9.5\ ms^{-2}$ (d) $9.8\ ms^{-2}$

17. The Young's modulus of a rubber string of length 12 cm and density $1.5 kgm^{-3}$ is $5 \times 10^8 Nm^{-2}$. When this string is suspended vertically, the increase in its length due to its own weight is (Take, $g = 10\ ms^{-2}$)
(a) 2.16×10^{-10} m (b) 9.6×10^{-11} m
(c) 9.6×10^{-3} m (d) 2.16×10^{-3} m

18. The lower end of a capillary tube is dipped into water and it is observed that the water in capillary tube rises by 7.5 cm. Find the radius of the capillary tube used, if surface tension of water is $7.5 \times 10^{-2} Nm^{-1}$. Angle of contact between water and glass is $0°$ and acceleration due to gravity is $10\ ms^{-2}$.
(a) 0.2 cm (b) 0.1 cm
(c) 0.4 mm (d) 0.2 mm

19. An ideal liquid flows through a horizontal tube of variable diameter. The pressure is lowest where the
(a) velocity is highest
(b) velocity is lowest
(c) diameter is largest
(d) velocity is intermediate

20. In a steady state, the temperature at the end A and end B of a 20 cm long rodAB are $100°C$ and $0°C$. The temperature of a point 9 cm from A is
(a) $55°C$ (b) $45°C$
(c) $65°C$ (d) $50°C$

21. If two rods of length L and 2L, having coefficients of linear expansion α and 2α respectively are connected end-to-end, then find the average coefficient of linear expansion of the composite rod.
(a) $\frac{3\alpha}{2}$ (b) $\frac{5\alpha}{2}$ (c) $\frac{5\alpha}{4}$ (d) $\frac{5\alpha}{3}$

22. A system is taken from state-A to state-B along two different paths. The heat absorbed and work done by the system along these two paths are Q_1, Q_2 and W_1, W_2 respectively, then
(a) $Q_1 = Q_2$

(b) $W_1 = W_2$
(c) $Q_1 - W_1 = Q_2 - W_2$
(d) $Q_1 + W_1 = Q_2 + W_2$

23. A gas $(\gamma = 1.5)$ is suddenly compressed to $(1/4)$ th its initial volume. Then, find the ratio of its final to initial pressure.
(a) 1:16 (b) 1:8
(c) 1:4 (d) 8:1

24. A cylinder has a piston at temperature of $30^\circ C$. There is all round clearance of 0.08 mm between the piston and cylinder wall if internal diameter of the cylinder is 15 cm. What is the temperature at which piston will fit into the cylinder exactly?
$(\alpha_p = 1.6 \times 10^{-5}/^\circ C$ and $\alpha_c = 1.2 \times 10^{-5}/^\circ C)$
(a) 298°C (b) 273°C
(c) 305°C (d) 268°C

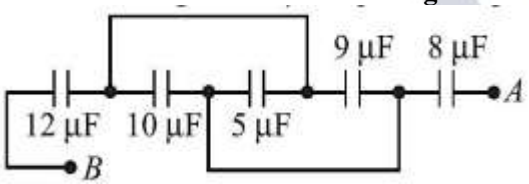
25. A balloon contains $1500\ m^3$ of He at $27^\circ C$ and 4 atmospheric pressure, the volume of He at $-3^\circ C$ temperature and 2 atmospheric pressure will be
(a) 1500 m^3 (b) 1700 m^3
(c) 1900 m^3 (d) 2700 m^3

26. The sources of sound A and B produce a wave of 350 Hz in same phase. A particle P is vibrating under an influence of these two waves. If the amplitudes at P produced by the two waves is 0.3 mm and 0.4 mm , the resultant amplitude of the point P will be, when $AP - BP = 25$ cm and the velocity of sound is $350\ ms^{-1}$
(a) 0.7 mm (b) 0.1 mm
(c) 0.2 mm (d) 0.5 mm

27. In a diffraction pattern due to a single slit of width a, the first minimum is observed at an angle 30° when light of wavelength 500 nm is incident on the slit. The first secondary maximum is observed at an angle of
(a) $\sin^{-1}\left(\frac{1}{2}\right)$ (b) $\sin^{-1}\left(\frac{3}{4}\right)$
(c) $\sin^{-1}\left(\frac{1}{4}\right)$ (d) $\sin^{-1}\left(\frac{2}{3}\right)$

28. Which statement(s) among the following are incorrect?
(i) A negative test charge experiences a force opposite to the direction of the field.
(ii) The tangent drawn to a line of force represents the direction of electric field.
(iii) The electric field lines never intersect.
(iv) The electric field lines form a closed loop.
(a) Only (i) (b) Both (ii) and (iii)
(c) Only (iii) (d) Only (iv)

29. In the given circuit, if the potential difference between A and B is 80 V, then the equivalent capacitance between A and B and the charge on 10μ F capacitor respectively, are

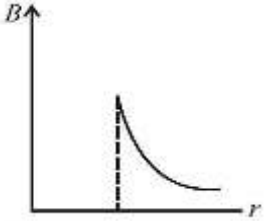


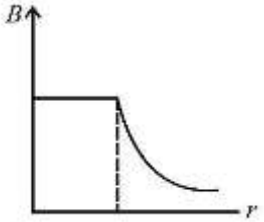
(a) 4μ F and 133μC
(b) 164μ F and 150μC
(c) 15μ F and 200μC
(d) 4μ F and 50μC

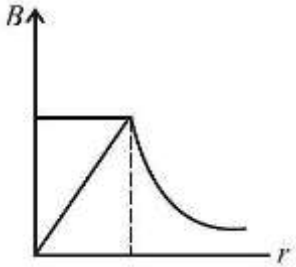
30. A cell of emf 1.8 V gives a current of 17 A when directly connected to an ammeter of resistance 0.06Ω. Internal resistance of the cell is
(a) 0.046Ω (b) 0.066Ω
(c) 0.10Ω (d) 10Ω

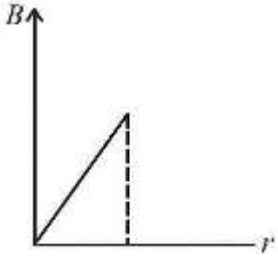
31. In which of the following case no force exerted by a magnetic field on a charge?
(a) Moving with constant velocity
(b) Moving in a circle
(c) At rest
(d) Moving along a curved path

32. A long thin hollow metallic cylinder of radius R has a current i ampere. The magnetic induction B away from the axis at a distance r from the axis varies as shown is

(i) 

(ii) 

(iii) 

(iv) 

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

33. The plane of a dip circle is set in the geographic meridian and the apparent dip is δ_1. It is then set in a vertical plane perpendicular to the geographic meridian. The apparent dip angle is δ_2. The declination θ at the place is

(a) $\tan^{-1}(\tan\delta_1\tan\delta_2)$
(b) $\tan^{-1}(\tan\delta_1+\tan\delta_2)$
(c) $\tan^{-1}\left(\frac{\tan\delta_1}{\tan\delta_2}\right)$
(d) $\tan^{-1}(\tan\delta_1-\tan\delta_2)$

34. Assertion : It is more difficult to move a magnet into a coil with more loops.
Reason : This is because emf induced in each current loop resists the motion of the magnet.

(a) Both A and R are true and R is a correct explanation for A .
(b) Both A and R are true but R is not a correct explanation for A .
(c) A is true and R is false.
(d) A is false, R is true.

35. Two inductors A and B when connected in parallel are equivalent to a single inductor of inductance 1.5 H and when connected in series are equivalent to a single inductor of inductance 8 H. Find the difference in the inductances of A and B.

(a) 3 H (b) 7.5 H
(c) 2 H (d) 4 H

36. A resonant frequency of a current is f. If the capacitance is made four times the initial value, then the resonant frequency will become

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

37. The law which states that a variation in an electric field causes magnetic field, is

(a) Faraday's law
(b) Bio-Savart law
(c) Modified Ampere's law
(d) Lenz's law

38. Radiation of wavelength 300 nm and intensity $100\ W-m^{-2}$ falls on the surface of a photosensitive material. If 2% of the incident photons produced photoelectron, the number of photoelectrons emitted from an area of $2\ cm^2$ of the surface is nearly

(a) 15×10^{11} (b) 6.04×10^{14}
(c) 1.5×10^{12} (d) 60.4×10^{15}

39. Potential energy between a proton and an electron is given by $U=\frac{ke^2}{3R^3}$, then radius of Bohr's orbit can be given by

(a) $\frac{Ke^2m}{h^2}$ (b) $\frac{6\pi^3Ke^2m}{n^3h^2}$
(c) $\frac{2\pi}{n}\frac{Ke^2m}{h^2}$ (d) $\frac{4\pi^2Ke^2m}{n^2h^2}$

40. A transistor is connected in common emitter configuration. The collector supply is 8 V and the voltage drop across a resistance of 800Ω in the collector circuit is 0.5 V. If the current gain factor α is 0.96 , then the base current is

(a) 2.6×10^{-5} A (b) 3.6×10^{-5} A
(c) 5.6×10^{-5} A (d) 6.6×10^{-5} A

Chemistry

41. If two particles A and B are moving with the same velocity, but wavelength of A is found to be double than that of B. Which of the following statement is correct?

(a) Both A and B have same mass.
(b) Mass of A is half that of B.
(c) Mass of B is half that of A.
(d) Mass of B is one-fourth that of A.

42. The spectrum of helium is expected to be similar to that of

(a) Li^+ (b) H (c) Na (d) He^+

43. On the basis of Bohr's model, the radius of the 3rd orbit is

(a) equal to the radius of 1 st orbit
(b) 3 times the radius of 1 st orbit
(c) 5 times the radius of 1st orbit
(d) 9 times the radius of 1st orbit

44. To which group of the periodic table does an element having electronic configuration $[Ar]3d^5 4s^2$ belong?

(a) Second (b) Fourth
(c) Seventh (d) Third

45. Given that ionisation potential and electron gain enthalpy of chlorine are 13 eV and 4 eV respectively. The electronegativity of chlorine on Mulliken scale, approximately equals to

(a) 8.5 eV (b) 6.0 eV
(c) 3.0 eV (d) 1.5 eV

46. Which of the following represents the correct order of increasing electron gain enthalpy with negative sign for the elements?

(1) Nitrogen (N) (2) Phosphorus (P)
(3) Chlorine (Cl) (4) Fluorine (F)

(a) P < N < F < Cl (b) N < P < F < Cl
(c) Cl < F < P < N (d) F < Cl < N < P

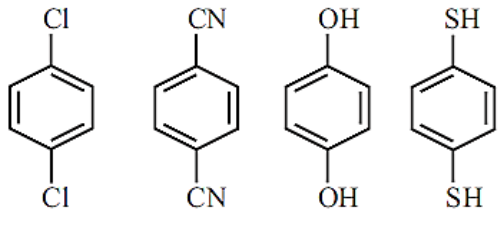
47. Which of the following will have maximum dipole moment?

(a) NF_3 (b) NCl_3
(c) NBr_3 (d) NH_3

48. In which of the following molecules/ions, the central atom is sp^2 hybridised?
BF_3, NO_2^-, NH_2^- and H_2O

(a) NH_2^- and H_2O (b) NO_2^- and H_2O
(c) BF_3 and NO_2^- (d) NO_2^- and NH_2^-

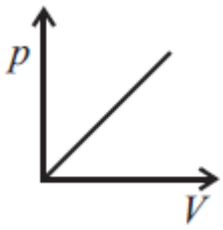
49. For which molecules among the following, the resultant dipole moment (μ) ≠ 0 ?



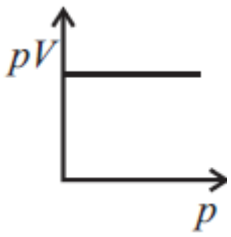
(i) (ii) (iii) (iv)

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

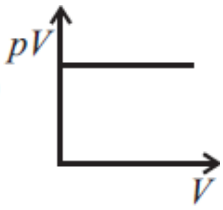
50. Which of the following graphs correctly represents Boyle's Law?



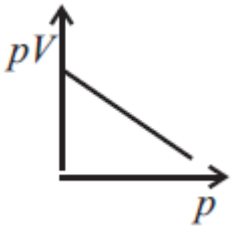
(i)



(ii)



(iii)



(iv)

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

51. The density of an ideal gas can be given by……. where p, V, M, T and R respectively denote pressure, volum molar-mass, temperature and universal gas constant.
(a) $\frac{pM}{RT}$ (b) $\frac{pV}{RT}$ (c) $\frac{RT}{pM}$ (d) $\frac{RT}{pV}$

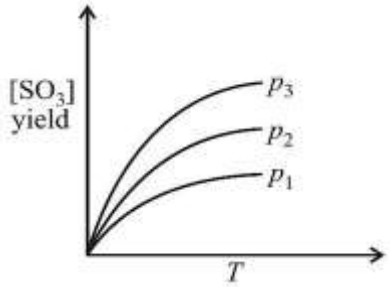
52. When 20 g of $CaCO_3$ is treated with 20 g of HCl, the mass of CO_2 formed would be
(a) 10 g (b) 8.8 g
(c) 22.2 g (d) 20 g

53. Which among the following species acts as a self-indicator?
(a) H_2O_2 (b) I^-
(c) $Cr_2O_7^{2-}$ (d) MnO_4^-

54. If a chemical reaction is known to be non-spontaneous at 298 K but spontaneous at 350 K , then which among the following conditions is true for the reaction?
(a) $\Delta G = -ve, \Delta H = -ve, \Delta S = +ve$
(b) $\Delta G = +ve, \Delta H = +ve, \Delta S = +ve$
(c) $\Delta G = -ve, \Delta H = +ve, \Delta S = +ve$
(d) $\Delta G = +ve, \Delta H = +ve, \Delta S = -ve$

55. Standard entropies of X_2, Y_2 and XY_3 are 60,40 and $50 JK^{-1}$ mol^{-1} respectively. At what temperature, the following reaction will be at equilibrium?
[given : $\Delta H^\circ = -30$ kJ]
$\frac{1}{2}X_2 \ \frac{3}{2}Y_2 \rightleftharpoons XY_3$
(a) 500 K (b) 750 K
(c) 1000 K (d) 1250 K

56. For the reaction $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$, the percentage yield of product at different pressure is shown in the figure. Then, which among the following is true?



(a) Pressure has no effect (b) $p_1 < p_2 < p_3$
(c) $p_1 > p_2 > p_3$ (d) $p_1 = p_2 = p_3 \neq 0$

57. Which among the following denotes the correct relationship between K_p and K_c for the reaction, $2A(g) \rightleftharpoons B(g) + C(g)$
(a) $K_p > K_c$ (b) $K_c > K_p$
(c) $K_c = (K_p)^2$ (d) $K_p = K_c$

58. Which metal oxide among the following gives H_2O_2 on treatment with dilute acid?

(a) BaO_2 (b) RbO_2

(c) MnO_2 (d) Al_2O_3

59. Assertion: K, Rb and Cs form superoxides.

Reason: The stability of superoxides increases from K to Cs due to decrease in lattice energy.

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

(b) Both A and R are true but R is not a correct explanation of A .

(c) A is true but R is false.

(d) A is false but R is true.

60. When borax is dissolved in water, it gives an alkaline solution. The alkaline solution consists the following products

(a) NaOH and BH_3

(b) NaOH and H_3BO_3

(c) $NaHCO_3$ and H_3BO_3

(d) Na_2CO_3 and H_3BO_3

61. Identify (P) and (Q) in the following reaction.

$$CH_3Cl + Si \xrightarrow[570K]{Cu-powdert} (P) \xrightarrow{H_2O} (Q)$$

$\longrightarrow$ Straight chain polymer

(a) P: $(CH_3)_3SiCl$, Q: $(CH_3)_3SiOH$

(b) P: $(CH_3)_2SiCl_2$, Q: $(CH_3)_2Si(OH)_2$

(c) P: $(CH_3)_2SiCl_2$, Q: $(CH_3)_2Si(OH)Cl$

(d) P: $(CH_3)_2SiCl_2$, Q: $(CH_3)_2SiO$

62. Green chemistry refers to reactions which

(a) reduce the use and production of hazardous chemicals

(b) study of the extremely show reactions

(c) are related to soil erosion

(d) study of green leaves

63. Assertion : Sodium acetate on Kolbe's electrolysis gives ethane.

Reason : Methyl free radical is formed at cathode.

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

(b) Both A and R are true but R is not a correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

64. When difference in boiling points of two liquids is too small, then the separation is carried out by

(a) steam distillation (b) simple distillation

(c) fractional distillation (d) vacuum distillation

65. In Lassaigne's test for halogens, it is necessary to remove X and Y from the sodium fusion extract, if nitrogen and sulphur are present. This is done by boiling the extract with Z. Identify X, Y and Z.

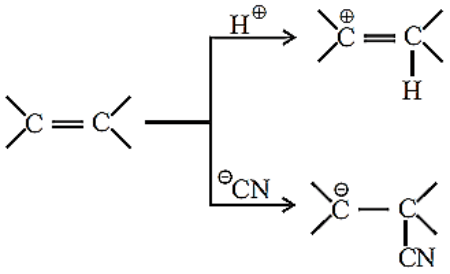
(a) X = $NaNO_3$, Y = Na_2SO_4, Z = conc. HNO_3

(b) X = $NaNH_2$, Y = NaSH, Z = conc. HCl

(c) X = Na_2NO_2, Y = $NaSO_3H$, Z = conc. H_2SO_4

(d) X = NaCN, Y = Na_2 S, Z = conc. HNO_3

66. The following effect is known as



(a) inductive effect (b) electromeric effect
(c) resonance effect (d) hyperconjugation

67. Which of the following will form an ideal solution?

(a) C_2H_5OH and H_2O
(b) HNO_3 and H_2O
(c) $CHCl_3$ and CH_3COCH_3
(d) C_6H_6 and $C_6H_5CH_3$

68. The molal elevation constant is the ratio of elevation in boiling point to

(a) molarity
(b) molality
(c) mole fraction of solute
(d) mole fraction of solvent

69. When a current of 10 A is passes through molten $AlCl_3$ for 1.608 minutes. The mass of Al deposited will be [Atomic mass of Al = 27 g]

(a) 0.09 g (b) 0.81 g
(c) 1.35 g (d) 0.27 g

70. The molar conductivities (λ°_m) at infinite dilution of KBr, HBr and KNH_2 are 120.5, 420.6 and 90.48 S cm^2 mol^{-1} respectively. Find the value of λ°_m for NH_3.

(a) 511.0 S cm^2 mol^{-1}
(b) 390.5 S cm^2 mol^{-1}
(c) 256.2 S cm^2 mol^{-1}
(d) 240.9 S cm^2 mol^{-1}

71. If the rate constant for a first order reaction is 2.303×10^{-3} s^{-1}. Find the time required to reduce 4 g of the reactant to 0.2 g.

(a) 1.30 hours (b) 21.60 hours
(c) 0.36 hours (d) 2.60 hours

72. A plot of log(x/m) versus log(p) for adsorption of a gas on a solid gives a straight line with a slope of

(a) $-\log k$ (b) $\log(1/n)$
(c) $\frac{1}{n}$ (d) $\text{antilog}(1/n)$

73. Match the following compounds with their corresponding physical properties.

A. IBr	**(A) Orange solid**
B. ClF_3	**(B) Yellow-green liquid**
C. BrF_3	**(C) Black solid**
D. lCl_3	**(D) Colourless gas**

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

74. What is coordination number of the metal in $[Co(en)_2Cl_2]^{2+}$?

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

75. A compound A is used in paints instead of salts of lead. Compound A is obtained when a white compound B is strongly heated. Compound B is insoluble in water but dissolves in NaOH solution forming a solution of compound C. The compound A on heating with coke gives a volatile metal D and a gas E which burns with a blue flame. Identify the possible species D and C can be respectively?

(a) $D = Hg, C = Hg(OH)_2$
(b) $D = Cd, C = Na_2(CdO_2)$

(c) $D = Zn, C = Na_2ZnO_2$
(d) $D = Zn, C = Zn(OH)_2$

76. Identify the product of the following reaction.

$(C_6H_{10}O_5)_n + nH_2O \xrightarrow[393\ K,\ 2-3\ atm]{H^+}$?

(a) Fructose (b) Glucose
(c) Lactose (d) Maltose

77. The number of optical isomers possible for 2-bromo-3chloro butane are

(a) 8 (b) 10 (c) 4 (d) 2

78. During the action of enzyme 'zymase' glucose is converted into……. with the liberation of carbon dioxide gas.

(a) phenol (b) ethanol
(c) methanol (d) isopropyl alcohol

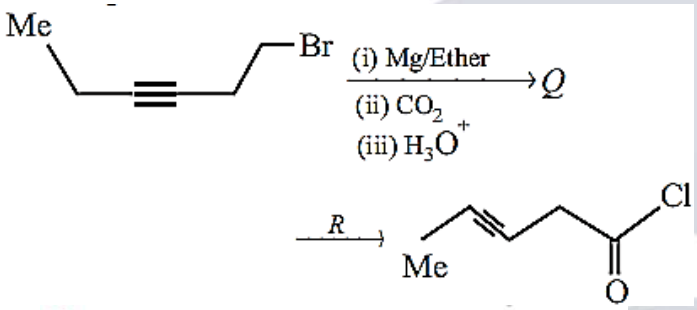
79. The total number of products formed in the following reaction sequence is

$CH_3COCl \xrightarrow{(i)(CH_3)_3Cd} (P)$

$(P) + CH_3CHO \xrightarrow[(ii)NaOH(aq),\Delta]{} ?$

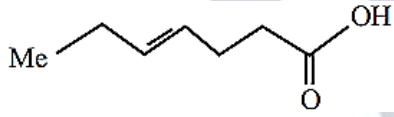
(a) 2 (b) 4 (c) 1 (d) 3

80. In the following reaction sequence, identify product ' Q ' and reagent ' R '.



(a) 

and $SOCl_2$

(b) 

and SO_2Cl_2

(c) 

and $SOCl_2$

(d) 

and $CH_3SO_2Cl_2$

Mathematics

81. Let $f: R \to R$ and $g: R \to R$ be defined by $f(x) = 2x + 1$ and $g(x) = x^2 - 2$ determine $(g \circ f)(x)$ is equal to

(a) $2x^2 - 3$ (b) $4x^2 + 4x - 1$
(c) $4x^2 + 4x + 1$ (d) $2x^2 - 4$

82. Given, the function $f(x) = \frac{a^x + a^{-x}}{2}$ $(a > 2)$, then $f(x + y) + f(x - y)$ is equal to

(a) $f(x) - f(y)$ (b) $f(y)$
(c) $2f(x)f(y)$ (d) $f(x)f(y)$

83. If f is a function defined on $(0, 1)$ by $f(x) = \min\{x - [x], -x - [x]\}$, then (fofofof) (x) is equal to $\longrightarrow$ ($[\cdot]$ greatest integer function)

(a) x (b) $-x$ (c) $4x$ (d) $2x$

84. $n \in N$ then, the statement $8n + 16 \leq 2^n$ is true for

(a) $n = 2$ (b) $n = 3$
(c) $n = 6$ (d) $n = 5$

85. The equation whose roots are the values of the equation $\begin{vmatrix} 1 & -3 & 1 \\ 1 & 6 & 4 \\ 1 & 3x & x^2 \end{vmatrix} = 0$ is

(a) $x^2 + x + 2 = 0$ (b) $x^2 + x - 2 = 0$
(c) $x^2 + 2x + 2 = 0$ (d) $x^2 - x - 2 = 0$

86. Let a and b be non-zero real numbers such that $ab = 5/2$ and given $A = \begin{bmatrix} a & -b \\ b & a \end{bmatrix}$ and $AA^T 20I$ (I is unit matrix), then the equation whose roots are a and b is

(a) $x^2 \mp 10x + 5 = 0$
(b) $2x^2 \pm 10x + 5 = 0$
(c) $x^2 - 5x + \frac{5}{2} = 0$
(d) $x^2 - 25x + \frac{5}{2} = 0$

87. If $A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}, 10B = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$ and $B = A^{-1}$, then the value of α is

(a) 2 (b) 0 (c) 5 (d) 4

88. The rank of the matrix $\begin{bmatrix} 4 & 2 & (1-x) \\ 5 & k & 1 \\ 6 & 3 & (1+x) \end{bmatrix}$ is 1 , then,

(a) $k = \frac{5}{2}, x = \frac{1}{5}$ (b) $k = \frac{5}{2}, x \neq \frac{1}{5}$
(c) $k = \frac{1}{5}, x = \frac{5}{2}$ (d) $k \neq \frac{5}{2}, x = \frac{1}{5}$

89. If $a_1, a_2, \ldots a_9$ are in GP, then $\begin{vmatrix} \log a_1 & \log a_2 & \log a_3 \\ \log a_4 & \log a_5 & \log a_6 \\ \log a_7 & \log a_8 & \log a_9 \end{vmatrix}$ is equal to

(a) $\log(a_1, a_2, \ldots a_n)$ (b) 1
(c) $(\log a_9)^9$ (d) 0

90. $(\sin\theta - i\cos\theta)^3$ is equal to

(a) $i^3(\cos 3\theta + i\sin 3\theta)$
(b) $\cos 3\theta + i\sin 3\theta$
(c) $\sin 3\theta - i\cos 3\theta$
(d) $(-i)^3(\cos 3\theta + i\sin 3\theta)$

91. Real part of $(\cos 4 + i\sin 4 + 1)^{2020}$ is

(a) $2^{2020}\cos^{2020} 2\cos 2020$
(b) $2^{2020}\cos^{2020} 2\cos 4040$
(c) $2^{1020}\cos^{2020} 2\cos 4040$
(d) $2^{2020}\cos^{2020} 1\cos 2020$

92. If $(x^2 + 5x + 5)^{x+5} = 1$, then the number of integers satisfying this equation is

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

93. Let $f(x) = x^3 + ax^2 + bx + c$ be polynomial with integer coefficients. If the roots of $f(x)$ are integer and are in Arithmetic Progression, then a cannot take the value

(a) -642 (b) 1214
(c) 1323 (d) 1626

94. The sum of the roots of the equation $e^{4t} - 10e^{3t} + 29e^{2t} - 22e^t + 4 = 0$ is

(a) $\log_e 10$ (b) $2\log_e 2$
(c) $\log_2 29$ (d) $2\log_{10} 2$

95. If a person has 3 coins of different denominations, the number of different sums can be formed is

(a) 3 (b) 7 (c) 8 (d) 3!

96. There are 7 identical white balls and 3 identical black balls. The number of distinguishable arrangements in a row of all the balls, so that no two black balls are adjacent is

(a) 120 (b) $89 \cdot (8!)$
(c) 56 (d) 42×5^4

97. The number of ways of distributing eight identical rings to three different girls so that every girl gets at least one rings is

(a) 21 (b) 120

(c) ${}^{8}P_{3}$ (d) ${}^{8}P_{3} - 6$

98. If $\frac{x^4}{(x-1)(x-2)} = f(x) + \frac{A}{x-1} + \frac{B}{x-2}$, then

(a) $f(x) = x^2 - 3x + 7$

(b) $f(x) = x^2 + 3x + 7$

(c) $A + B = 17$

(d) $A - B = -18$

99. $\tan 2\alpha \cdot \tan(30^\circ - \alpha) + \tan 2\alpha \cdot \tan(60^\circ - \alpha) + \tan(60^\circ - \alpha) \cdot \tan(30^\circ - \alpha)$ is equal to

(a) $\tan 3\alpha$ (b) $\tan^2 2\alpha - \tan^2 60^\circ$

(c) 1 (d) 0

100. If $\sin\alpha - \cos\alpha = m$ and $\sin 2\alpha = n - m^2$, where $-\sqrt{2} \le m \le \sqrt{2}$, then n is equal to

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

101. The value of x satisfying the equation $3\operatorname{cosec} x = 4\sin x$ are

(a) $\frac{\pi}{6}, \frac{\pi}{3}$ (b) $\pm\frac{\pi}{6}$

(c) $\pm\frac{\pi}{3}$ (d) $\frac{\pi}{3}, \frac{\pi}{4}$

102. If $\tan^{-1}\left[\frac{1}{1+1.2}\right] + \tan^{-1}\left[\frac{1}{1+2.3}\right] + \ldots + \tan^{-1}\left[\frac{1}{1+n(n+1)}\right] = \tan^{-1}[x]$, then x is equal to

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

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

103. If $\sin hu = \tan\theta$, then $\cosh u$ is equal to

(a) $-\sec\theta$ (b) $\sec\theta$

(c) $\sin\theta$ (d) $\cot\theta$

104. In a $\triangle ABC$, if $a = 3, b = 4$ and $\sin A = \frac{3}{4}$, then $\angle CBA$ is equal to

(a) 60° (b) 75° (c) 90° (d) 45°

105. In $\triangle ABC$, $A = 75^\circ$ and $B = 45^\circ$, then the value of $b + c\sqrt{2}$ is equal to

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

106. In $\triangle ABC$, suppose the radius of the circle opposite to an $\angle A$ is denoted by r_1, similarly $r_2 \leftrightarrow \angle B$ and $r_3 \leftrightarrow \angle C$. If r is the radius of inscribed circle, then, what is the value of $\frac{ab - r_1 r_2}{r_3}$ is equal to

(a) $r_1 r_2 r_3$ (b) r

(c) $r_1 r_2 \frac{r_3}{2}$ (d) $\frac{r}{2}$

107. A vector makes equal angles α with X and Y-axis, and 90° with Z-axis. Then, α is equal to

(a) 60° or 120° (b) 30° and 150°

(c) 45° and 135° (d) 90°

108. Angle made by the position vector of the point $(5, -4, -3)$ with the positive direction of X-axis is

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

109. If D, E and F are respectively mid-points of AB, AC and BC in $\triangle ABC$, then $BE + AF$ is equal to

(a) DC (b) $\frac{3}{2}$BF

(c) $\frac{1}{2}$BF (d) $\frac{1}{2}$DC

110. If the volume of the parallelopiped formed by the vectors $\hat{i} + a\hat{j} + \hat{k}, \hat{j} + a\hat{k}$ and $a\hat{i} + \hat{k}$ becomes minimum, then a is equal to

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

111. If $a = \frac{3}{2}\hat{k}$ and $b = \frac{2\hat{i} + 2\hat{j} - \hat{k}}{2}$, then angle between $a + b$ and $a - b$ is

(a) 45° (b) 90°

(c) 30° (d) 60°

112. Let $a = \hat{i} + \hat{j} + \hat{k}, b = \hat{i} + 3\hat{j} + 5\hat{k}$ and $c = 7\hat{i} + 9\hat{j} + 11\hat{k}$, then the area of parallelogram having diagonals $a + b$ and $b + c$ is

(a) $4\sqrt{6}$ sq units (b) $2\sqrt{6}$ sq units
(c) $\sqrt{6}$ sq units (d) $6\sqrt{6}$ sq units

113. **If $\mathbf{a} = 2\hat{i} + \hat{j} + 3\hat{k}, \mathbf{b} = \hat{i} + 3\hat{j} - \hat{k}$ and $\mathbf{c} = 3\hat{i} - \hat{j} - 2\hat{k}$, then the value of $\begin{vmatrix} \mathbf{a}\cdot\mathbf{a} & \mathbf{a}\cdot\mathbf{b} & \mathbf{a}\cdot\mathbf{c} \\ \mathbf{b}\cdot\mathbf{a} & \mathbf{b}\cdot\mathbf{b} & \mathbf{b}\cdot\mathbf{c} \\ \mathbf{c}\cdot\mathbf{a} & \mathbf{c}\cdot\mathbf{b} & \mathbf{c}\cdot\mathbf{c} \end{vmatrix}$ is equal to**

(a) 2020 (b) 2025
(c) 2030 (d) 1849

114. **If a and b are two vectors such that $|\mathbf{a}| = 2, |\mathbf{b}| = 3$ and $\mathbf{a} + t\,\mathbf{b}$ and $\mathbf{a} - t\,\mathbf{b}$ are perpendicular, where t is a positive scalar, then**

(a) $t = \pm\frac{2}{3}$ (b) $t = \frac{4}{9}$
(c) $t = \frac{2}{3}$ (d) $t = \frac{2}{9}$

115. **The variance of the variates 112, 116, 120, 125 and 132 about their AM is**

(a) 58.8 (b) 60
(c) 48.8 (d) 61.8

116. **Which of the following set of data has least standard deviation?**

(a) 10,20,30,40 (b) 2,4,6,8
(c) 3,6,9,12 (d) 1, 2, 3, 4

117. **12 balls are distributed among 3 boxes, then the probability that the first box will contain 3 balls is**

(a) $\frac{{}^{12}C_3 \times 2^9}{3^{12}}$ (b) $\frac{{}^{12}C_3 \times 2^9}{3^{10}}$
(c) $\frac{{}^{12}C_3}{3^{12}}$ (d) $\frac{{}^{12}C_3}{3^{10}}$

118. **If the letters of the word REGULATIONS be arranged in such a way that relative positions of the letters of the word GULATIONS remain the same, then the probability that there are exactly 4 letters between R and E is**

(a) $\frac{3}{55}$ (b) $\frac{6}{55}$ (c) $\frac{9}{55}$ (d) $\frac{7}{55}$

119. **A random variable X has the probability distribution**

X	P(X)
1	0.15
2	0.23
3	0.12
4	0.10
5	0.20
6	0.08
7	0.07
8	0.05

For the events $E = \{X \text{ is a prime number }\}$ and $F = \{X < 4\}$, then $P(E \cup F)$ is

(a) 0.77 (b) 0.87
(c) 0.35 (d) 0.50

120. **A die is tossed thrice. If event of getting an even number is a success, then the probability of getting at least 2 successes is**

(a) $\frac{7}{8}$ (b) $\frac{1}{4}$ (c) $\frac{2}{3}$ (d) $\frac{1}{2}$

121. **If the axes are rotated through an angle $45°$, the coordinates of the point $(2\sqrt{2}, -3\sqrt{2})$ in the new system are**

(a) $(3\sqrt{3}, -5)$ (b) $(-1, -5)$
(c) $(5\sqrt{3}, -7)$ (d) $(7, -\sqrt{3})$

122. **The sum of the squares of the intercepts made the line $5x - 2y = 10$ on the coordinate axes equals**

(a) 29 (b) 25 (c) 4 (d) 100

123. **For three consecutive odd integers a · b and c, if the variable line $ax + by + c = 0$ always passes through the point (α, β), the value of $\alpha^2 + \beta^2$ equals**

(a) 9 (b) 4 (c) 5 (d) 3

124. The line which is parallel to X-axis and crosses the curve $y = \sqrt{x}$ at an angle of $45°$ is

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

(c) $y = 1$ (d) $y = 4$

125. If $2x + 3y + 4 = 0$ is the perpendicular bisector of the line segment joining the points $A(1, 2)$ and $B(\alpha, \beta)$, then the value of $13\alpha + 13\beta$ equals

(a) -81 (b) -99 (c) 99 (d) 81

126. The equation of the pair of straight lines perpendicular to the pair $2x^2 + 3xy + 2y^2 + 10x + 5y = 0$ and passing though the origin is

(a) $2x^2 + 5xy + 2y^2 = 0$

(b) $2x^2 - 3xy + 2y^2 = 0$

(c) $2x^2 + 3xy + y^2 = 0$

(d) $2x^2 - 5xy + 2y^2 = 0$

127. If the centroid of the triangle formed by the lines $2y^2 + 5xy - 3x^2 = 0$ and $x + y = k$ is $\left(\frac{1}{18}, \frac{11}{18}\right)$, then the value of k equals

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

128. If m_1 and $m_2, (m_1 > m_2)$ are the slopes of the lines represented by $5x^2 - 8xy + 3y^2 = 0$, then $m_1 : m_2$ equals

(a) 5: 1 (b) 2: 1

(c) 5: 3 (d) 3: 2

129. If the slope of one of the lines represented by $ax^2 + 2hxy + by^2 = 0$ is the square of the other then, $\left|\frac{a+b}{h} + \frac{8h^2}{ab}\right|$ is equal to

(a) 3 (b) 2 (c) 6 (d) 4

130. Find the equations of the tangents drawn to the circle $x^2 + y^2 = 50$ at the points where the line $x + 7 = 0$ meets it.

(a) $7x + y + 50 = 0$ and $7x - y + 50 = 0$

(b) $x + y = 0$ and $x - y = 0$

(c) $x + 7y + 5 = 0$ and $y - 7x + 5 = 0$

(d) $x + 7y + 50 = 0$ and $x - 7y + 50 = 0$

131. If the chord of contact of tangents from a point on the circle $x^2 + y^2 = r_1^2$ to the circle $x^2 + y^2 = r_2^2$ touches the circle $x^2 + y^2 = r_3^2$, then r_1, r_2 and r_3 are in

(a) AP (b) HP (c) GP (d) AGP

132. Find the equation of the circle passing through $(1, -2)$ and touching the X-axis at $(3, 0)$.

(a) $x^2 + y^2 + 6x - 4y - 9 = 0$

(b) $x^2 + y^2 - 6x - 4y + 9 = 0$

(c) $x^2 + y^2 - 6x - 4y - 9 = 0$

(d) $x^2 + y^2 - 6x + 4y + 9 = 0$

133. Let L_1 be a straight line passing through the origin and L_2 be the straight line $x + y = 1$. If the intercepts made by the circle $x^2 + y^2 - x + 3y = 0$ on L_1 and L_2 are equal, then which of the following equations represent L_1

(a) $x + y = 0$ and $x + 7y = 0$

(b) $x - y = 0$ and $x + 7y = 0$

(c) $x - 7y = 0$ and $x + y = 0$

(d) $x - 7y = 0$ and $x - y = 0$

134. The radius of the circle whose centre lies at $(1, 2)$ while cutting the circle $x^2 + y^2 + 4x + 16y - 30 = 0$ orthogonally, is ……. units.

(a) $\sqrt{41}$ (b) $\sqrt{31}$ (c) $\sqrt{21}$ (d) $\sqrt{11}$

135. The point which has the same power with respect to each of the circles $x^2+y^2-8x+40=0, x^2+y^2-5x+16=0$ and $x^2+y^2-8x+16y+160=0$ is

(a) $\left(-8,\frac{-15}{2}\right)$ (b) $\left(8,\frac{-15}{2}\right)$

(c) $\left(8,\frac{15}{2}\right)$ (d) $\left(-8,\frac{15}{2}\right)$

136. If one end of focal chord of the parabola $y^2=8x$ is $\left(\frac{1}{2},2\right)$, then the length of the focal chord is ..... units.

(a) $\frac{625}{4}$ (b) $\frac{5}{\sqrt{2}}$ (c) $\frac{25}{2}$ (d) 25

137. If a point $P(x,y)$ moves along the ellipse $\frac{x^2}{25}+\frac{y^2}{16}=1$ and if C is the centre of the ellipse, then the sum of maximum and minimum values of CP is

(a) 25 (b) 9 (c) 4 (d) 5

138. The asymptotes of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$, with any tangent to the hyperbola form a triangle whose area is $a^2\tan(\alpha)$. Then, its eccentricity equals

(a) $\sec(\alpha)$ (b) $\operatorname{cosec}(\alpha)$

(c) $\sec^2(\alpha)$ (d) $\operatorname{cosec}^2(\alpha)$

139. The ratio in which the YZ-plane divides the line joining $(2,4,5)$ and $(3,5,-4)$ is

(a) 2: 3 internally (b) 3: 2 internally

(c) 3: 2 externally (d) 2: 3 externally

140. The direction cosines of a line which makes equal angles with the coordinate axes are

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

(c) $\left(\frac{\pm1}{\sqrt{3}},\frac{\pm1}{\sqrt{3}},\frac{\pm1}{\sqrt{3}}\right)$ (d) $\left(\frac{12}{15},\frac{5}{13},0\right)$

141. Let O be the origin and P be a point which is at a distance of 3 units from the origin. If the direction ratios of $\overline{OP}$ are $(1,-2,-2)$, then the coordinates of P are

(a) $(1,-2,-2)$ (b) $(3,-6,-6)$

(c) $\left(\frac{1}{3},\frac{-2}{3},\frac{-2}{3}\right)$ (d) $\left(\frac{1}{9},\frac{-2}{9},\frac{-2}{9}\right)$

142. $\lim_{z\to1}\frac{z^{(1/3)}-1}{z^{(1/6)}-1}$ is equal to

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

143. $f(x)=\begin{cases}\frac{72^x-9^x-8^x+1}{\sqrt{2}-\sqrt{1+\cos x}}, & x\neq0\\ k\log2\log3, & x=0\end{cases}$

Find the value of k for which the function f is continuous.

(a) $\sqrt{2}$ (b) 24

(c) $18\sqrt{3}$ (d) $24\sqrt{2}$

144. If the function $f(x)$, defined below is continuous in the interval $[0,\pi]$, then

$$f(x)=\begin{cases}x+a\sqrt{2}(\sin x) & ,0\le x<\frac{\pi}{4}\\ 2x(\cot x)+b & ,\frac{\pi}{4}\le x\le\frac{\pi}{2}\\ a(\cos 2x)-b(\sin x) & ,\frac{\pi}{2}<x\le\pi\end{cases}$$

(a) $a=\frac{\pi}{6}, b=\frac{\pi}{12}$ (b) $a=\frac{-\pi}{6}, b=\frac{\pi}{12}$

(c) $a=\frac{-\pi}{6}, b=\frac{-\pi}{12}$ (d) $a=\frac{\pi}{6}, b=\frac{-\pi}{12}$

145. If $y=x+\frac{1}{x}$, then which among the following holds?

(a) $x^2y'+xy=0$

(b) $x^2y'+xy+2=0$

(c) $x^2y' - xy + 2 = 0$
(d) $x^2y' + xy - 2 = 0$

146. **If $y = \tan^{-1}\left(\frac{\sqrt{1+x^2}+\sqrt{1-x^2}}{\sqrt{1+x^2}-\sqrt{1-x^2}}\right)$, where $x^2 \leq 1$. Then, find $\frac{dy}{dx}$ is equal to**

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

147. **If $3\sin xy + 4\cos xy = 5$, then $\frac{dy}{dx}$ is equal to**

(a) $\frac{3\sin xy+4\cos xy}{3\cos xy-4\sin xy}$ (b) $\frac{3\cos xy+4\sin xy}{4\cos xy-3\sin xy}$
(c) $\frac{-y}{x}$ (d) $\frac{x}{y}$

148. **$f(x)^x = \sqrt{x^2+1}: g(x) = \frac{x+1}{x^2+1}: h(x) = 2x - 3$, then the value of $f'[h'(g'(x))]$ is equal to**

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

149. **If the error committed in measuring the radius of a circle is 0.05%, then the corresponding error in calculating its area would be**

(a) 0.05% (b) 0.0025%
(c) 0.25% (d) 0.1%

150. **The stationary points of the curve $y = 8x^2 - x^4 - 4$ are**

(a) $(0,-4), (2,12), (-2,12)$
(b) $(0,4), (-2,12), (1,2)$
(c) $(0,-4), (-1,2), (2,12)$
(d) $(0,4), (-1,2), (1,2)$

151. **Which statement among the following is true?**

(i) the function $f(x) = x|x|$ is strictly increasing on $R - \{0\}$.
(ii) the function $f(x) = \log_{(1/4)} x$ is strictly increasing on $(0, \infty)$.
(iii) a one-one function is always an increasing function.
(iv) $f(x) = x^{1/3}$ is strictly decreasing on R

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

152. **For which value (s) of $af(x) = -x^3 + 4ax^2 + 2x - 5$ is decreasing for every x ?**

(a) (1,2) (b) (3,4)
(c) R (d) no value of a

153. **The distance between the origin and the normal to the curve $y = e^{2x} + x^2$ drawn at $x = 0$ is ….. units**

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

154. **If $\int \frac{dx}{x\left(\sqrt{x^4-1}\right)} = \frac{1}{k}\sec^{-1}\left(x^k\right)$, then the value of k is equal to**

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

155. $\int \frac{e^x(x+3)}{(x+5)^3} dx$ **is equal to**

(a) $\frac{e^x}{(x+5)^2} + C$ (b) $e^x(x+5)^2 + C$
(c) $e^x(x+3)^2 + C$ (d) $\frac{e^x}{(x+3)^2} + C$

156. **If $\int \frac{(x-1)^2}{(x^2+1)^2} dx = \tan^{-1}(x) + g(x) + k$, then $g(x)$ is equal to**

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

157. If $\int \frac{1-(\cot x)^{2021}}{\tan x+(\cot x)^{2022}}dx =$ $\frac{1}{A}\log\left|(\sin x)^{2023}+(\cos x)^{2023}\right|+c$, then A is equal to

(a) 2020 (b) 2021

(c) 2022 (d) 2023

158. $\int_2^4\{|x-2|+|x-3|\}dx$ is equal to

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

159. $\int_{-1/2}^{1/2}\left\{[x]+\log\left(\frac{1+x}{1-x}\right)\right\}dx$ is equal to

(a) $2\log(1/2)$ (b) 0

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

160. The solution of the differential equation $\frac{d^2y}{dx^2}+y=0$ is

(a) $y=3\sin x+4\cos x$ (b) $y=x^2$

(c) $y=x+2$ (d) $y=\log x$