1. An important consequence of centrifugal force is that the earth is,
a) Bulged at poles and flat at the equator
b) Flat at poles and bulged at the equator
c) High tides and low tides
d) Rising and setting of sun

2. A car sometimes overturns while taking a turn. When it overturns, it is
a) The inner wheel which leaves the ground first
b) The outer wheel which leaves the ground first
c) Both the wheels which leave the ground simultaneously
d) Either wheel leaves the ground first

3. If the length of the second's hand in a stop clock is 3 cm, the angular velocity and linear velocity of the tip is
a) 0.2047 rad/s, 0.0314 m/s
b) 0.2547 rad/s, 0.314 m/s
c) 0.1472 rad/s, 0.06314 m/s
d) 0.1047 rad/s, 0.00314 m/s

4. Satellite revolving around the earth loses some energy due to collision. What would be the effect on its velocity and distance from the centre of the earth?
a) Velocity increases and distance decreases
b) Both velocity and distance increases
c) Both velocity and distance decreases
d) Velocity decreases and distance increases

5. Time period of second pendulum on a planet, whose mass and diameter are twice that of earth, is
a) $2\sqrt{2}$s b) 2 s c) $\sqrt{2}$s d) $\frac{1}{\sqrt{2}}$s

6. The gravitational force exerted by the earth on a body is called
a) Weight of the body
b) Acceleration of that body
c) Mass of the body
d) Gravitational constant

7. If a constant couple of 500 N-m turns a wheel of moment of inertia 100 kg $m^2$ about an axis through its centre, the angular velocity gained in 2 seconds is
a) 10 rad/s b) 50 rad/s
c) 200 rad/s d) 100 rad/s

8. The dimensions of torque are
a) $[M^1L^2T^{-2}]$ b) $[M^1L^2T^{-1}]$
c) $[M^1L^1T^{-1}]$ d) $[M^1L^2T^2]$

9. Tow disc having same mass rotate about the same axes. If $\rho_1$ and $\rho_2$ be the densities of two bodies ($\rho_1 > \rho_2$), then what is the relation between $I_1$ and $I_2$?
a) $I_1 < I_2$ b) $I_1 = I_2$ c) $I_1 > I_2$ d) $I_1 = 2I_2$

10. A particle executing simple harmonic motion has an amplitude of 6 cm. Its acceleration at a distance of 2 cm from the mean position is 8 cm/$s^2$. The maximum speed of the particle is
a) 8 cm/s b) 12 cm/s c) 16 cm/s d) 24 cm/s

11. When a particle performs S.H.M., its kinetic energy varies periodically. If the frequency of the particle is 10, then the kinetic energy of the particle will vary with frequency equal to
a) 10 b) 20 c) 5 d) 30

12. If length of a simple pendulum is increased by 44%, then what is the gain in the time period of pendulum?
a) 40% b) 20% c) 10% d) 21%

13. Solids which break or rupture before the elastic limits are called
a) Brittle b) Ductile
c) Malleable d) Elastic

14. The following four wires are made of the same material. Which of these will have the largest extension when the same tension is applied?
a) Length = 50 cm, diameter = 0.5 mm
b) Length = 100 cm, diameter = 1 mm
c) Length = 200 cm, diameter = 2 mm
d) Length = 300 cm, diameter = 3 mm

15. If two soap bubbles of unequal radii are in communication with each other, then
a) Air flows from the larger bubble into smaller bubble until they have the same size
b) The size of the bubbles remains the same
c) Air flows from smaller bubble into larger bubble and the larger bubble grows in size and the size of the smaller bubble decreases

d) Air may flow from the smaller bubble into the larger bubble or from the larger bubble into the smaller bubble depending upon the concentration of the soap solution

16. If the cohesive force is greater than the adhesive force, the liquid surface will be
a) Plane b) Convex
c) Concave d) Horizontal

17. A thin metal disc of radius r floats on water surface and bends the surface downwards along the perimeter making an angle θ with vertical edge of the disc. If the disc displaces a weight of water W and surface tension of water is T, then the weight of metal disc is
a) $2\pi rT + W$ b) $2\pi rT\cos\theta - W$
c) $2\pi rT\cos\theta - W$ d) $W - 2\pi rT\cos\theta$

18. A progressive wave of frequency 500 Hz is travelling with a speed of 350 m/s. A compressional maximum appears at a given instant. The minimum time interval after which a rarefactional maximum occurs at the same point is
a) 1/250 s b) 1/500 s c) 1/1000 s d) 1/350 s

19. Two tuning forks of frequencies 256 Hz and 258 Hz are sounded together. The time interval between two consecutive maxima heard by an observer is
a) 0.5 s b) 2 s c) 250 s d) 252 s

20. Two identical plain wires have a fundamental frequency of 600 cycle per second when kept under the same tension. What fractional increase in the tension of one wire will lead to the occurrence of 6 beats per second when both wires vibrate simultaneously?
a) 0.01 b) 0.02 c) 0.03 d) 0.04

21. Two identical wires have the same fundamental frequency of 400 Hz when kept under the same tension. If the tension in one wire is increased by 2%, the number of beats produced will be
a) 4 b) 2 c) 8 d) 1

22. A length of wire has frequency of 256 Hz when stretched by a force of 16 kg. By what factor must the force be changed so that it emits a note of frequency 320 Hz?
a) 25 kg-wt b) 9 kg-wt c) 3 kg-wt d) 5 kg-wt

23. Air in a cylinder is suddenly compressed by a piston, which is then maintained at the same position. With the passage of time
a) The pressure decreases
b) The pressure increases
c) The pressure remains the same
d) The pressure may increase or decrease depending upon the nature of the gas

24. A body initially at 80 °C cools to 64 °C in 5 minutes and to 52 °C in 10 minutes. The temperature of the body after 15 minutes will be
a) 42.7 °C b) 35 °C c) 47 °C d) 40 °C

25. The ratio of energy of radiation emitted by a body at 27°C to the radiation of a black body at 927°C is
a) 1 : 4 b) 1 : 16 c) 1 : 64 d) 1 : 256

26. Rays diverging from a point source form a ________ wavefront
a) Cylindrical b) Spherical
c) Plane d) Cubical

27. During the reflection of light from plane mirror, the incident ray, normal and reflected ray lie
a) Parallel to each other
b) Perpendicular to each other
c) In same plane
d) In different plane

28. The diameter of the pupil of human eye is 2.5 mm. Assuming the wavelength of light used is 5000 Å. What must be the minimum distance between two point like objects to be seen clearly if they are a distance of 5 m from the eye?
a) $1.34 \times 10^{-3}$m b) $1.22 \times 10^{-3}$m
c) $1.5 \times 10^{-3}$m d) $1.6 \times 10^{-3}$m

29. In a double slit experiment, instead of taking slits of equal widths, one slit is made twice as wide as the other. Then in the interference pattern,
a) The intensities of both the maxima and the minima increase
b) The intensity of maxima increases and the minima has zero intensity
c) The intensity of maxima decreases and that of the minima increases
d) The intensity of maxima decreases and the minima has zero intensity

30. In a biprism experiment, $5^{th}$ dark fringe is obtained at a point. If a thin transparent film is placed in the path of one of waves, then $7^{th}$ bright fringe is obtained at the same point.

The thickness of the film in terms of wavelength $\lambda$ and refractive index $\mu$ will be

a) $\frac{1.5\lambda}{(\mu-1)}$ b) $1.5(\mu-1)\lambda$

c) $2.5(\mu-1)\lambda$ d) $\frac{2.5\lambda}{(\mu-1)}$

31. Two spheres of different capacitances charged to different potentials when joined by a wire. The total energy will

a) Increase b) Becomes zero

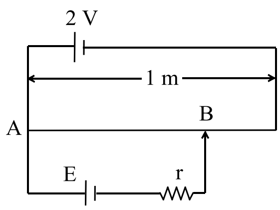
c) Remains same d) Decrease

32. A parallel plate condenser is made by stacking n equally spaced plates connected together alternatively. If the capacitance between any two consecutive unconnected plates is C, then the combined capacitance is

a) C b) n C

c) $(n+1)C$ d) $(n-1)C$

33. In the given figure, battery E is balanced on 55 cm length of potentiometer wire but when a resistance of 10 Ω is connected in parallel with the battery, then it balances on 50 cm length of the potentiometer wire. The internal resistance r of the battery is




a) 1 Ω b) 3 Ω c) 10 Ω d) 5 Ω

34. Slide wire bridge does not operate on the same principle as the

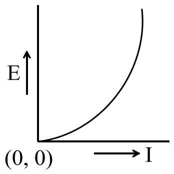
a) Wheatstone bridge b) Potentiometer

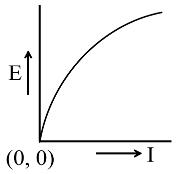
c) Post office box d) Metrebridge

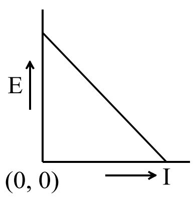
35. At which point will the null point be obtained on a metrebidge if the ratio of the resistances in the two gaps is 2:3?

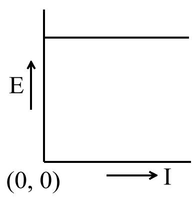
a) 25 cm b) 30 cm c) 40 cm d) 60 cm

36. A long solenoid carries current I. Curve between energy density (at mid-point of solenoid) E and I is given by

a)



b)



c)



d)



37. A rectangular coil has 100 turns each of area $50\ cm^2$. It is capable of rotation about an axis joining the mid points of two opposite sides. When a current of 5 A is passed through it while its plane at right angles to a uniform magnetic field, it experiences a torque of 5 Nm. The magnetic field will be

a) T b) 2 T c) 0.5 T d) 1.5 T

38. Current sensitivity of a galvanometer is x div/mm and voltage sensitivity is y div/m. If resistance of galvanometer is G then relation between x and y is

a) $G=\frac{y}{x}$ b) $G=\frac{x}{y}$

c) $G=\frac{x}{y}\times 10^3$ d) $y=G\,x\times 10^3$

39. Susceptibility of ferromagnetic substance is

a) $>1$ b) $<1$ c) 0 d) 1

40. A domain in a ferromagnetic substance is in the form of a cube of side length 1 μm. If it contains $8\times 10^{10}$ atoms and each atomic dipole has a dipole moment of $9\times 10^{-24}\ A\,m^2$, then magnetization of the domain is

a) $7.2\times 10^5\ A\,m^{-1}$ b) $7.2\times 10^3\ A\,m^{-1}$

c) $7.2\times 10^9\ A\,m^{-1}$ d) $7.3\times 10^{12}\ A\,m^{-1}$

41. Core of a dynamo is laminated because

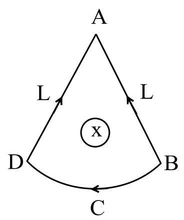
a) Magnetic field increases

b) Efficiency decreases

c) Residual magnetism in core decreases

d) Loss of energy in core due to eddy currents decreases

42. A current carrying loop ABCD is shown where AB = BC = CA = L; BDC is a semicircle. A concentric conducting circular loop of radius r is coplanar and concentric with the semicircular part. Current I in the loop ABCD varies as $I=I_0e^{\alpha t}$, where $I_0$ and $\alpha$ are constants; $r \ll L$. The e. m. f. induced in circular small loop is




a) 0

b) $\frac{\mu_0 I_0 \alpha \pi^2}{L}$

c) $\frac{\mu_0 I_0 \alpha \pi r^2}{L}\left(\frac{3+\sqrt{3}}{3}+\frac{1}{2}\right)e^{\alpha t}$

d) $\left(\frac{\mu_0 I_0 \pi r^2}{L}\right)\left(\frac{3+\sqrt{3}}{3}\right) e^{\alpha t} w$

43. In a photoelectric experiment for 4000 Å incident radiation, the potential difference to stop the ejection is 2 V. If the incident light is changed to 3000 Å, then the potential required to stop the ejection of electrons will be
a) 2 V b) Less than 2 V
c) Zero d) Greater than 2 V
44. When light is incident on a surface, photoelectrons are emitted. For photoelectron,
a) The value of kinetic energy is same
b) Kinetic energy does not depend on the wavelength of incident light
c) The value of kinetic energy is more than a certain minimum energy
d) None of the above
45. An α-particle moving with a constant energy is scattered by the nucleus. The scattering angle will be maximum when the α-particle
a) Approaches the nucleus head on
b) Just passes the nucleus
c) Passes at large distance from the nucleus
d) Is attracted by the nucleus
46. For Balmer series, wavelength of first line is '1 λ' and for Brackett series, wavelength of first line is '2λ' then is
a) 0.081 b) 0.162 c) 0.198 d) 0.238
47. In germanium crystal, a hole is provided by a ________ impurity
a) Covalent b) Trivalent
c) Monovalent d) Tetravalent
48. If the band gap between valence band and conduction band in a material is 5.0 eV, then the material is
a) Semiconductor b) Good conductor
c) Superconductor d) Insulator
49. Which of the following units is not a base unit?
a) metre b) candela
c) ampere d) Pascal
50. Two quantities of 5 and 12 unit when added gives a quantity 13 unit. This quantity is
a) Time
b) Mass
c) Linear momentum
d) Speed
51. A single substance that exists in two or more forms is called.
a) Polymorphous b) Amorphous
c) Isomorphous d) Mono-mono-phous
52. A regular arrangement of the constituent particles of a crystal in a three dimensional space is called ______.
a) Lattice point b) Space point
c) Space lattice d) Unit lattice
53. The crystal with metal deficiency defect is
a) NaCl b) FeO c) KCl d) ZnO
54. Which of the following is expected to be paramagnetic?
a) $TiO_2$ b) TiO c) NaCL d) $C_6H_6$
55. The value of gas constant and solution constant
a) Are different
b) Almost identical
c) Gas constant is greater than solution constant
d) Gas constant is smaller than solution constant
56. When partial pressure of solvent in solution of non-volatile solute is plotted against its mole fraction, nature of graph is
a) A straight line passing through origin
b) A straight line parallel to mole fraction of solvent
c) A straight line parallel to vapour pressure of solvent
d) A straight line intersecting vapour pressure axis
57. The plant cell will shrink when placed in
a) Water b) A hypotonic solution
c) A hypertonic solution d) An isotonic solution
58. The vapour pressure of a solvent decreased by 10 mm of mercury when a non-volatile solute was added to the solvent. The mol fraction of the solute in the solution is 0.2. What should be the mole fraction of the solvent, if the decrease in the vapour pressure is to be 20 mm of mercury?
a) 0.8 b) 0.6 c) 0.4 d) 0.2
59. Calculate the energy change for the following reaction at 300 K

$2CuO_{(s)} \rightarrow Cu_2O_{(s)} + \frac{1}{2} O_{2(g)}$

Given : $\Delta H = 145.6$ kJ mol$^{-1}$

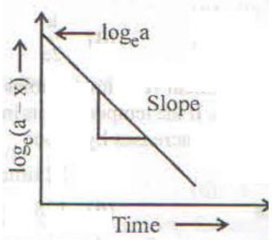
and $\Delta S = 116\ JK^{-1}\ mol^{-1}$

a) 110.8 kJ $mol^{-1}$ b) 221.5 kJ $mol^{-1}$

c) 55.4 kJ $mol^{-1}$ d) 145.6 kJ $mol^{-1}$

60. An isolated system is that system in which
    a) There is no exchange of energy with the surroundings
    b) There is no exchange of mass with the surroundings
    c) There is exchange of mass and energy with the surroundings
    d) Both a and b
61. Hess's law is based on
    a) Enthalpy is a state function
    b) Law of conservation of energy
    c) Law of conservation of mass
    d) Internal energy is a state function
62. The work done on the system when one mole of an ideal gas at 500 K is compressed isothermally and reversibly to one-tenth of its original volume is
    (R = 2 cal)
    a) +2.303 kcal b) -23.03 kcal
    c) -2.303 kcal d) +230.3 kcal
63. The e.m.f of the following three galvanic cells
    1. Zn | $Zn^{2+}$(1m) || $Cu^{2+}$(1m) | Cu
    2. Zn | $Zn^{2+}$(0.1m) || $Cu^{2+}$(1m) | Cu
    3. Zn | $Zn^{2+}$(1m) || $Cu^{2+}$(0.1m) | Cu

    Are represented by $E_1$, $E_2$ and $E_3$. Which of the following statement is true?
    a) $E_2 > E_1 > E_3$ b) $E_3 > E_2 > E_1$
    c) $E_1 > E_2 > E_3$ d) $E_3 > E_1 > E_2$
64. At 298 K the electrolytic conductivity of a 0.2 m KClsolution is $2.50 \times 10^{-2}\ ohm^{-1}\ cm^{-1}$. Compare its molar conductivity.
    a) 62.5$ohm^{-1}\ cm^2 mol^{-1}$ b) 125$ohm^{-1}\ cm^2 mol^{-1}$
    c) 12.5$ohm^{-1}\ cm^2 mol^{-1}$ d) 175$ohm^{-1}\ cm^2 mol^{-1}$
65. Rusting of iron is catalysed by which one of the following?
    a) Fe b) $O_2$ c) Zn d) $H^+$
66. The following four colourless salt solutions are placed in separate test tubes and a strip of Cu is placed in each. Which solution finally turns blur?
    a) $Zn(NO_3)_2$ b) $AgNO_3$
    c) $Cd(NO_3)_2$ d) $Pb(NO_3)_2$
67. Which of the following represents the expression for 3/4th of concentration remaining of a first order reaction?
    a) $\frac{2.303}{k}\log\frac{4}{3}$ b) $\frac{2.303}{k}\log\frac{3}{4}$
    c) $\frac{2.303}{k}\log 4$ d) $\frac{2.303}{k}\log 3$
68. In the following plot, for a first order reaction, slop is equal to




    a) -k b) $-\frac{k}{2.303}$ c) $-\frac{2.303}{k}$ d) -k ×2.303
69. Which of the following theory is not related to chemical kinetics?
    a) Collision theory
    b) Absolute reaction rate theory
    c) VSEPR theory
    d) Transition state theory
70. The reduction of FeO to Fe by CO occurs around ________
    a) 873 K b) 1031 K c) 1123 K d) 1213 K
71. The major role of fluorspar ($CaF_2$) which is added in small quantities in the electrolytic reduction of alumina dissolved in fusedcryolite ($Na_3AlF_6$) is ________.
    a) As a catalyst
    b) To make the fused conducting mixture
    c) To lower the temperature of the molten mass
    d) To reduce the rate of oxidation of carbon at anode
72. Which one of the following is the sulphide ore?
    a) Zincite b) Chalcocite
    c) Cuprite d) Malachite
73. A monoatomic gas reacts with fluorine to form a fluoride which dissolves in HF to give a conducting solution. The fluoride is
    a) $XeF_2$ b) $XeF_4$ c) $XeF_6$ d) $OF_2$
74. Iodine flakes when rubbed with liquor ammonia give dark brown ppt of
    a) $NI_3$ b) $NH_4I$
    c) $NI_3 \cdot NH_3$ d) $NH_4 \cdot NI_3$
75. Phosphine is not obtained by the reaction, when
    a) Red P is heated with NaOH
    b) $Ca_3P_2$ reacts with water
    c) Phosphorus trioxide is boiled with water

d) White P is heated with NaOH

76. Oxidation state/s exhibited by Ce is/are
a) +2 only b) +3,+4
c) +4 only d) +2, +3, +4

77. f-block elements are called
a) Transition element
b) Rare earth element
c) Representative element
d) Inner transition element

78. The steady decrease along the Lanthanide seriesis called Lanthanide contraction and in all amounts to
a) $0.15^0$ A b) $0.22^0$ A c) $0.09^0$ A d) $0.93^0$ A

79. The number of ions furnished by $K_2.PtCl_6$ in solution are
a) Zero b) 1 c) 2 d) 3

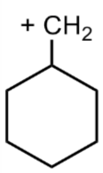
80. The most stable complex among the following is
a) $K_3[Al(C_2O_4)_3]$ b) $[Pt(en)_2]Cl$
c) $K_2[Ni(EDTA)]$ d) $[Ag(NH_3)_2]Cl$

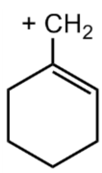
81. Stability constant is more for the complex
a) $[Co(NH_3)_6]^{3+}$ b) $[Ag(NH_3)_2]^+$
c) $[Cu(NH_3)_4]^{2+}$ d) $[Ag(CN)_2]^{-1}$

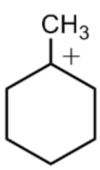
82. Which of the following types of octahedral complexes does not show optical Isomerism?
a) $MA_2X_2Y_2$ b) $[M(AA)_3]^{n+}$
c) $[M(AA)_2X_2]^{n+}$ d) $[Pt(NH)_3)_4]^{2+}$

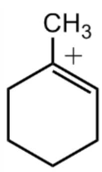
83. Which of the following complex will show geometrical as well as optical Isomerism (en=ethylenediammine)
a) [Pt(NH3)Cl4)] b) $Pt(NH_3)_2Cl_2$
c) $[Pt(en)_3]^{4+}$ d) $[Pt(en)_2Cl_2]$

84. The lowest stability of carbocation among the compounds

a) 


b) 


c) 


d) 


85. Elimination of bromine from 2-Bromobutane results in the formation of
a) Equimolar mixture of But-1-ene and But-2-ene
b) Predominantly But-2-ene
c) Predominantly But-1-ene
d) Predominantly But-2-yne

86. $C_2H_5OH$ is produced when
a) $C_2H_5Br$ reacts with aqueous KOH
b) $C_2H_5Br$ reacts with alcoholic KOH
c) $C_2H_5Br$ reacts with $C_2H_5ONa$
d) $C_2H_5Br$ reacts with AgCN

87. 2-methyl propan-1-ol is obtained from
a) Phenol + conc. $H_2SO_4$
b) Phenol + conc. $HNO_3$
c) Ethanal + $(CH_3)_2CHMgX$
d) Methanol + $(CH_3)_2CHMgX$

88. IUPAC name of acetone is
a) Propanone b) Butanone
c) Dimethyl ketone d) Both (a) and (c)

89. Octyl acetate has
a) Apple flavour b) Banana flavour
c) Pineapple flavour d) Orange flavour

90. Which is most difficult to oxidise?
a) $CH_3CHO$ b) $C_2H_5CHO$
c) $CH_3COCH_3$ d) HCHO

91. Nitrous acid is produce by reacting HCl with
a) $NaNO_3$ b) $NaNO_2$ c) NaCl d) $Na_2CO_3$

92. Which of the following is catalytically reduced to amine?
a) $CH_3CH = N - OH$ b) $CH_3 - CN$
c) $C_2H_5 - NO_2$ d) Both (b) and (c)

93. Methylation of methyl amine gives $1^{st}$ product as
a) $(CH_3)_3N$ b) $(CH_3)_2NH$
c) $(CH_3)_4N^+I^-$ d) Both (a) and (b)

94. ____________vitamin contain $Co^{+3}$ ion
a) $B_{12}$ b) $B_1$ c) $B_2$ d) $B_6$

95. The sequence in which amino acids are linked to one another in protein is its
a) secondary structure
b) tertiary structure
c) primary structure
d) quaternary structure

96. Polythene is a resin obtained by polymerization of
a) Butadiene b) Ethylene
c) Isoprene d) Propylene

97. Which of the following is regenerated fiberss
a) Viscose cellulose b) Acetate rayon
c) Artificial silk d) All of these

98. The turbidity of a polymer solution measures
a) A light absorbed by solution

b) Light transmitted by the solution
c) Light scattered by the solution
d) None of the above

99. The number of significant figures in Avogadro's number is
a) Four
b) Two
c) Three
d) Can be any of these

100. Air at sea level is dense, this is a practical implementation of
a) Boyle's law b) Charles' law
c) Avogadro's law d) Dalton's law

101. The dual of '$(p \wedge t) \vee (c \wedge \sim q)$' where t is a tautology and c is a contradiction, is
a) $(p \vee c) \wedge (t \vee \sim q)$ b) $(\sim p \wedge c) \wedge (t \vee q)$
c) $(\sim p \vee c) \wedge (t \vee q)$ d) $(\sim p \vee t) \wedge (c \vee \sim q)$

102. A compound statement $p \to q$ is false only when
a) p is true and q is false
b) p is false but q is true
c) Atleast one of p or q is false
d) Both p and q are false

103. The inverse of logical statement $p \to q$ is
a) $\sim p \to \sim q$ b) $p \leftrightarrow q$
c) $q \to p$ d) $q \leftrightarrow p$

104. For each real number $x$ such that $-1 < x < 1$, let $A(x)$ be the matrix $(1-x)^{-1}\begin{bmatrix} 1 & -x \\ -x & 1 \end{bmatrix}$ and $z = \frac{x+y}{1+xy}$. Then,
a) $A(z) = A(x) + A(y)$ b) $A(z) = A(x)[A(y)]^{-1}$
c) $A(z) = A(x)A(y)$ d) $A(z) = A(x) - A(y)$

105. The inverse of the matrix $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ is
a) $\frac{1}{24}\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ b) $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$
c) $\frac{1}{24}\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ d) $\begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{4} \end{bmatrix}$

106. If matrix $A = \begin{bmatrix} 1 & 0 & -1 \\ 3 & 4 & 5 \\ 0 & 6 & 7 \end{bmatrix}$ and its inverse is denoted by $A^{-1} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}$, then the value of $a_{23} =$
a) $\frac{21}{20}$ b) $\frac{1}{5}$ c) $-\frac{2}{5}$ d) $\frac{2}{5}$

107. The equation $\sin^4 x + \cos^4 x + \sin 2x + \alpha = 0$ is solvable for
a) $-\frac{1}{2} \le \alpha \le \frac{1}{2}$ b) $-3 \le \alpha \le 1$
c) $-\frac{3}{2} \le \alpha \le \frac{1}{2}$ d) $-1 \le \alpha \le 1$

108. If $\tan^{-1} x + \tan^{-1} y + \tan^{-1} z = \frac{\pi}{2}$, then
a) $x + y + z - xyz = 0$ b) $x + y + z + xyz = 0$
c) $xy + yz + zx + 1 = 0$ d) $xy + yz + zx - 1 = 0$

109. If in a triangle ABC, $a = 6\text{cm}, b = 8\text{cm}, c = 10\text{cm}$, then the value of $\sin 2A$ is
a) $\frac{6}{25}$ b) $\frac{8}{25}$ c) $\frac{10}{25}$ d) $\frac{24}{25}$

110. The angle between the lines represented by the equation $ax^2 + xy + by^2 = 0$ will be 45°, if
a) $a = 1, b = 6$ b) $a = 1, b = -6$
c) $a = 6, b = 1$ d) $a = 1, b = 1$

111. The equation$(x-1)^2 - (y-1)^2 - (x-1) - 5(y-1) + \lambda = 0$ may represents a pair of straight lines if $\lambda$ is
a) $-1$ b) 2 c) $-6$ d) 4

112. If $r(1 - m^2) + m(p - q) = 0$, then a bisector of the angle between the lines represented by the equation $px^2 - 2rxy + qy^2 = 0$ is
a) $y = x$ b) $y = -x$ c) $y = mx$ d) $my = x$

113. If $\bar{a}, \bar{b}, \bar{c}$ are any three coplanar unit vectors, then
a) $\bar{a}.(\bar{b} \times \bar{c}) = 1$ b) $\bar{a}.(\bar{b} \times \bar{c}) = 3$
c) $(\bar{a} \times \bar{b}).\bar{c} = 0$ d) $(\bar{c} \times \bar{a}).\bar{b} = 1$

114. If $3\hat{i} - 2\hat{j} + 5\hat{k}$ and $-2\hat{i} + p\hat{j} - q\hat{k}$ are collinear vectors, then
a) $p = \frac{4}{3}, q = \frac{-10}{3}$ b) $p = \frac{10}{3}, q = \frac{4}{3}$
c) $p = \frac{-4}{3}, q = \frac{10}{3}$ d) $p = \frac{4}{3}, q = \frac{10}{3}$

115. A vector perpendicular to $2\hat{i} + \hat{j} + \hat{k}$ and coplanar with $\hat{i} + 2\hat{j} + \hat{k}$and$\hat{i} + \hat{j} + 2\hat{k}$ is
a) $5(\hat{j} - \hat{k})$ b) $\hat{i} + 7\hat{j} - \hat{k}$
c) $5(\hat{j} + \hat{k})$ d) $2\hat{i} + 7\hat{j} - \hat{k}$

116. The projections of a line on the co-ordinate axes are 4, 6, 12. The direction cosines of the line are
a) $\frac{2}{7}, \frac{3}{7}, \frac{6}{7}$ b) 2,3,6

c) $\frac{2}{11}, \frac{3}{11}, \frac{6}{11}$ d) $\frac{2}{5}, \frac{3}{5}, \frac{6}{5}$

117. Points $(-2,4,7), (3,-6,-8)$ and $(1,-2,-2)$ are
a) Collinear
b) Vertices of an equilateral triangle
c) Vertices of isosceles triangle
d) None of these

118. A line passes through the points $(6,-7,-1)$ and $(2,-3,1)$. If the angle α, which the line makes with the positive direction of X-axis is acute, the direction cosines of the line are
a) $\frac{2}{3}, \frac{-2}{3}, \frac{-1}{3}$ b) $\frac{2}{3}, \frac{2}{3}, \frac{-1}{3}$ c) $\frac{2}{3}, \frac{-2}{3}$, d) $\frac{2}{3}, \frac{-2}{3}, \frac{1}{3}$

119. The distance of the point A(2, 3, 4) from X-axis is
a) 5 b) $\sqrt{13}$ c) $2\sqrt{5}$ d) $5\sqrt{2}$

120. The co-ordinates of the foot of the perpendicular from the point (a, b, c) on Z-axis is
a) (a, 0, 0) b) (0, b, 0) c) (0, 0, c) d) (a, b, 0)

121. The vector equation of the line $3x-2=2y+1=3z-3$ is
a) $\bar{r} = \frac{2}{3}\hat{\imath} - \frac{1}{2}\hat{\jmath} + \hat{k} + \lambda(2\hat{\imath} + 3\hat{\jmath} + 2\hat{k})$
b) $\bar{r} = \hat{\imath} + \hat{\jmath} + \hat{k} + \lambda(2\hat{\imath} + 3\hat{\jmath} + \hat{k})$
c) $\bar{r} = \lambda(2\hat{\imath} + 3\hat{\jmath} + 2\hat{k})$
d) $\bar{r} = \frac{2}{3}\hat{\imath} - \frac{1}{2}\hat{\jmath} + \hat{k} + \lambda(2\hat{\imath} + \hat{\jmath})$

122. If the distance between the plane $Ax - 2y + z = d$ and the plane containing the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ is $\sqrt{6}$, then $|\alpha|$ is
a) 3 b) 4 c) 5 d) 6

123. The equation of the plane containing the line $2x - 5y + z = 3, x + y + 4z = 5$ and parallel to the plane $x + 3y + 6z = 1$, is
a) $2x + 6y + 12z = 13$
b) $x + 3y + 6z = -7$
c) $x + 3y + 6z = 7$
d) $2x + 6y + 12z = -13$

124. The graph of inequations $x \le y$ and $y \le x + 3$ is located in
a) II quadrant b) I, II quadrants
c) I, II, III quadrants d) II, III, IV quadrants

125. A wholesale merchant wants to start the business of cereal with rs. 24000. Wheat is rs. 400 per quintal and rice is rs. 600 per quintal. He has capacity to store 200 quintal of cereal. He earns profit of rs. 25 per quintal on wheat and rs. 40 per quintal on rice. If he stores $x$ quintal rice and $y$ quintal wheat, then for maximum profit the objective function is
a) $25x + 40y$ b) $40x + 25y$
c) $400x + 600y$ d) $\frac{400}{40}x + \frac{600}{25}y$

126. The number of points at which the function $f(x) = \frac{1}{\log|x|}$ is discontinuous are
a) 1 b) 2 c) 3 d) 4

127. If $f(x) = \begin{cases} x + \lambda, x < 3 \\ 4, \ x = 3 \\ 3x - 5, x > 3 \end{cases}$ is continuous at $x = 3$, then $\lambda =$
a) 4 b) 3 c) 2 d) 1

128. Functions $f(x) = \begin{cases} x - 1, x < 2 \\ 2x - 3, x \ge 2 \end{cases}$ is continuous
a) For all real values of $x$
b) Only for $x = 2$
c) For all real values of $x$ when $x \ne 2$
d) Only for integral values of $x$

129. Differential coefficient of $\tan^{-1}\left(\frac{2x}{1-x^2}\right)$ with respect to $\sin^{-1}\left(\frac{2x}{1+x^2}\right)$ is equal to
a) 0 b) $-1$
c) 1 d) None of these

130. If $y = \sin^{-1}(x\sqrt{1-x} + \sqrt{x}\sqrt{1-x^2})$, then $\frac{dy}{dx} =$
a) $\frac{-2x}{\sqrt{1-x^2}} + \frac{1}{2\sqrt{x-x^2}}$ b) $\frac{-1}{\sqrt{1-x^2}} - \frac{1}{2\sqrt{x-x^2}}$
c) $\frac{1}{\sqrt{1-x^2}} + \frac{1}{2\sqrt{x-x^2}}$ d) None of these

131. If $x = a\cos^3\theta, y = a\sin^3\theta$, then $\sqrt{1 + \left(\frac{dy}{dx}\right)^2}$ is equal to
a) $|\sec\theta|$ b) $\sec\theta$ c) $\tan^2\theta$ d) $\sec^2\theta$

132. If the curve $y = ax^2 - 6x + b$ passes through (0, 2) and has its tangent parallel to X-axis at $x = \frac{3}{2}$, then the values of a and b are respectively
a) 2 and 2 b) $-2$ and $-2$
c) $-2$ and 2 d) 2 and $-2$

133. The value of c for which the conclusion of mean value theorem holds for the function $f(x) = \log_e x$ on the interval [1, 3], is

a) $2\log_3 e$ b) $\frac{1}{2}\log_e 3$ c) $\log_3 e$ d) $\log_e 3$

134. It is given that at $x = 1$, the function $x^4 - 62x^2 + ax + 9$ attains its maximum value on the interval [0, 2]. The value of a is

a) 122 b) 100 c) 120 d) 150

135. $\int e^x [\tan x - \log(\cos x)]dx =$

a) $e^x \log(\sec x) + c$ b) $e^x \log(\operatorname{cosec} x) + c$

c) $e^x \log(\cos x) + c$ d) $e^x \log(\sin x) + c$

136. $\int \frac{1}{\sqrt{1 + \sin x}} dx =$

a) $2\sqrt{2} \log\tan\left(\frac{\pi}{8} + \frac{x}{4}\right) + c$

b) $\frac{1}{\sqrt{2}} \log\tan\left(\frac{\pi}{8} + \frac{x}{4}\right) + c$

c) $\sqrt{2} \log\tan\left(\frac{\pi}{8} + \frac{x}{4}\right) + c$

d) $\frac{1}{2\sqrt{2}} \log\tan\left(\frac{\pi}{8} + \frac{x}{4}\right) + c$

137. If $\int x \sin x dx = -x \cos x + A$, then A =

a) $\sin x$ + constant b) $\cos x$ + constant

c) Constant d) None of these

138. The value of integral $\int_{1/\pi}^{2/\pi} \frac{\sin\left(\frac{1}{x}\right)}{x^2} dx =$

a) 2 b) −1 c) 0 d) 1

139. $\int_{-\pi/2}^{\pi/2} \sqrt{\frac{1}{2}(1 - \cos 2x)} dx =$

a) 0 b) 2

c) $\frac{1}{2}$ d) None of these

140. The value of $\int_0^{2\pi} \cos^{99} x \, dx$ is

a) 1 b) −1 c) 99 d) 0

141. Area bounded by the curve $xy - 3x - 2y - 10 = 0$, X-axis and the lines $x = 3, x = 4$ is

a) $16 \log 2 - 13$ sq. units

b) $16 \log 2 - 3$ sq. units

c) $16 \log 2 + 3$ sq. units

d) None of these

142. Area enclosed by the parabola $ay = 3(a^2 - x^2)$ and X-axis is

a) $4a^2$ sq. units b) $12a^2$ sq. units

c) $4a^3$ sq. units d) None of these

143. Area bounded by the curve $f(x) = \cos x$ and the lines $x = 0, x = \pi$ is

a) 4 sq. units b) 1 sq. unit

c) 2 sq. units d) 3 sq. units

144. A solution of the differential equation $\left(\frac{dy}{dx}\right)^2 - x\frac{dy}{dx} + y = 0$ is

a) $y = 2$ b) $y = 2x$

c) $y = 2x - 4$ d) $y = 2x^2 - 4$

145. If $\frac{dy}{dx} + \frac{1}{\sqrt{1-x^2}} = 0$, then

a) $y + \sin^{-1} x = c$

b) $y^2 + 2\sin^{-1} x + c = 0$

c) $x + \sin^{-1} y = 0$

d) $x^2 + 2\sin^{-1} y = 0$

146. The solution of $e^{dy/dx} = (x + 1), y(0) = 3$, is

a) $y = x\log x - x + 2$

b) $y = (x + 1)\log|x + 1| - x + 3$

c) $y = (x + 1)\log|x + 1| + x + 3$

d) $y = x\log x + x + 3$

147. The random variable X has the following probability distribution:

| $x$ | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| $P(X = x)$ | 0.2 | 0.1 | 0.3 | k |

Then the variance of X =

a) 1.29 b) 1.31 c) 1.27 d) 1.23

148. Which of the following distribution of probabilities of a random variable is the probability distribution?

a) X : 0 1 2 3
P(X) : 0.3 0.2 0.4 0.1

b) X : 0 1 2
P(X) : 0.1 0.7 0.4

c) X : 1 2 3 4
P(X) : 0.5 0.5 0.2 0.3

d) X : 2 3 4 5
P(X) : 02 0.2 0.2 0.5

149. If $\sin\theta + \cos\theta = 1$, then $\sin\theta\cos\theta =$

a) 0 b) 1 c) 2 d) $\frac{1}{2}$

150. $\sin 163^o \cos 347^o + \sin 73^o \sin 167^o =$

a) 0 b) $\frac{1}{2}$ c) 1 d) none of these

## : ANSWER KEY :

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1) | b | 2) | a | 3) | d | 4) | a | 5) | a | 6) | a | 7) | a |
| 8) | a | 9) | a | 10) | b | 11) | b | 12) | b | 13) | a | 14) | a |
| 15) | c | 16) | b | 17) | c | 18) | c | 19) | a | 20) | b | 21) | a |
| 22) | b | 23) | a | 24) | a | 25) | d | 26) | b | 27) | c | 28) | b |
| 29) | a | 30) | d | 31) | d | 32) | d | 33) | a | 34) | b | 35) | c |
| 36) | a | 37) | b | 38) | c | 39) | a | 40) | a | 41) | d | 42) | c |
| 43) | d | 44) | c | 45) | a | 46) | b | 47) | b | 48) | d | 49) | d |
| 50) | c | 51) | a | 52) | c | 53) | b | 54) | b | 55) | b | 56) | a |
| 57) | c | 58) | b | 59) | a | 60) | a | 61) | b | 62) | a | 63) | a |
| 64) | b | 65) | d | 66) | b | 67) | a | 68) | a | 69) | c | 70) | c |
| 71) | c | 72) | b | 73) | c | 74) | c | 75) | a | 76) | b | 77) | d |
| 78) | b | 79) | d | 80) | c | 81) | a | 82) | d | 83) | d | 84) | c |
| 85) | b | 86) | a | 87) | d | 88) | a | 89) | d | 90) | c | 91) | b |
| 92) | c | 93) | d | 94) | a | 95) | c | 96) | b | 97) | d | 98) | c |
| 99) | d | 100) | a | 101) | a | 102) | a | 103) | a | 104) | c | 105) | d |
| 106) | d | 107) | c | 108) | d | 109) | b | 110) | b | 111) | c | 112) | c |
| 113) | c | 114) | d | 115) | a | 116) | a | 117) | a | 118) | a | 119) | a |
| 120) | c | 121) | a | 122) | d | 123) | c | 124) | c | 125) | b | 126) | c |
| 127) | d | 128) | a | 129) | c | 130) | c | 131) | a | 132) | a | 133) | a |
| 134) | c | 135) | a | 136) | c | 137) | a | 138) | d | 139) | b | 140) | d |
| 141) | c | 142) | a | 143) | c | 144) | c | 145) | a | 146) | b | 147) | a |
| 148) | a | 149) | a | 150) | b | | | | | | | | |

## : HINTS AND SOLUTIONS :

2 **(a)**

Because the reaction on inner wheel decreases and becomes zero. So it leaves the ground first

3 **(d)**

For seconds hand, $T = 60$ s,

$r = 3 \text{ cm} = 3 \times 10^{-2}$ m

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{60} = 0.1047 \text{ rad/s}$$

and $v = \omega r = 0.1047 \times 3 \times 10^{-2} = 0.00314$ m/s

5 **(a)**

$M_P = 2M_E, D_P = 2D_E \Rightarrow R_P = 2R_E$

$T_E = 2$ s

$$g_E = \frac{GM_E}{R_E}, g_P = \frac{GM_P}{R_P^2}$$

$$\therefore g_P = g_E \times \frac{M_P}{M_E} \times \left(\frac{R_E}{R_P}\right)^2$$

$$= g_E \times 2 \times \left(\frac{1}{2}\right)^2 = \frac{g_E}{2} \Rightarrow \frac{g_E}{g_P} = 2$$

Now, $T \propto \frac{1}{\sqrt{g}}$

$$\therefore T_P = T_E \times \sqrt{\frac{g_E}{g_P}} = T_E\sqrt{2} = 2\sqrt{2}$$

7 **(a)**

$\tau = I\alpha$

$$\therefore \alpha = \frac{\tau}{I} = \frac{500}{100} = 5$$

$$\therefore \alpha = \frac{\omega}{t} \Rightarrow \omega = \alpha . t = 5 \times 2 = 10 \text{ rad/s}$$

8 **(a)**

$\tau = I\,\alpha = \text{kg m}^2\text{s}^{-2} = [M^1L^2T^{-2}]$

10 **(b)**

$a = \omega^2 x$

$$\therefore \omega = \sqrt{A/x} = \sqrt{\frac{8}{2}} = 2 \text{ rad/s}$$

$\therefore v_{max} = A\omega = 6 \times 2 = 12$ cm/s

11 **(b)**

$\text{K.E.} = \frac{1}{2}k(A^2 - x^2)$

As $x = A\sin(\omega t + \alpha)$

$\therefore \text{K.E.} = \frac{1}{2}k[A^2 - A^2\sin^2(\omega t + \alpha)]$

$= \frac{1}{2}kA^2[(1 - \sin^2(\omega t + \alpha)]$

$= \frac{1}{2}kA^2\cos^2(\omega t + \alpha) \quad ...(i)$

As $\cos^2\theta = \frac{1+\cos 2\theta}{2}$

$\cos^2(\omega t + \alpha) = \frac{1 + \cos 2(\omega t + \alpha)}{2}$

$\therefore$ Eq. (i) becomes

$\text{K.E.} = \frac{1}{2}kA^2\left(\frac{1 + \cos 2(\omega t + \alpha)}{2}\right)$

$\therefore$ Kinetic energy of particle vary with frequency two times of frequency of particle

$\therefore$ If frequency of particle is 10 then the kinetic energy of the particle will vary with frequency $2 \times 10 = 20$

12 **(b)**

$l_2 = 44\%$ of $l_1 \Rightarrow l_2 = 1.44l$

$T \propto \sqrt{l} \Rightarrow T_1 \propto \sqrt{l_1}$ and $T_2\sqrt{l_2}$

$\therefore \frac{T_2}{T_1} = \sqrt{\frac{l_2}{l_1}} \Rightarrow \frac{T_2}{T_1} = \sqrt{1.44} = 1.2$

$\therefore$ % change in $\frac{T_2 - T_1}{T_1} \times 100 = \left(\frac{1.2-1}{1}\right) \times 100 = 20\%$

14 **(a)**

Young's Modulus for a wire is given as,

$Y = \frac{MgL}{\Delta L\, A} \Rightarrow \Delta L = \frac{MgL}{YA}$

$\therefore \Delta L \propto \frac{L}{A}$

Now, $\left(\frac{L}{A}\right)$ is maximum for $L = 50$ cm and diameter $= 0.5$ mm

Hence, option (A) is correct

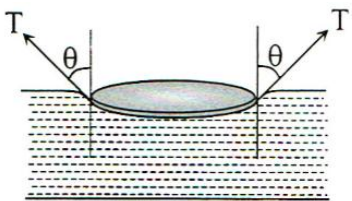
15 **(c)**

Excess pressure inside soap bubble,

$P = \frac{4T}{r}$

Smaller bubble has more excess pressure

17 **(c)**



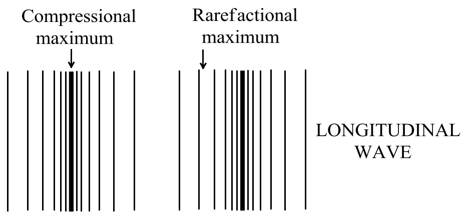

Here, Weight of metal disc = total upward force

= upthrust force + force due to surface tension

= weight of displaced water + $T\cos\theta\ (2\pi r)$

$= W + 2\pi rT\cos\theta$

18 **(c)**




$T = 0.2\text{ sec} \Rightarrow n = \frac{1}{T} = 5\text{Hz}$

Time interval between two consecutive compressional maxima, $T = \frac{1}{n} = \frac{1}{500}$ s

Time interval between compressional maxima and rarefactional maxima, $\frac{T}{2} = \frac{1}{2n} = \frac{1}{1000}$ s

19 **(a)**

Beat frequency $= 258 - 256 = 2$ Hz

$\therefore$ Time interval between two maxima

$= \frac{1}{\text{beat frequency}} = \frac{1}{2} = 0.5\text{s}$

20 **(b)**

$n_1 \sim n_2 = 6$

$\therefore \frac{1}{2l}\sqrt{\frac{T'}{m}} - \frac{1}{2l}\sqrt{\frac{T}{m}} = 6$

$\therefore \frac{1}{2l}\sqrt{\frac{T'}{m}} - 600 = 6$

$\therefore \frac{1}{2l}\sqrt{\frac{T'}{m}} = 606 \quad ...(i)$

$\therefore \frac{1}{2l}\sqrt{\frac{T}{m}} = 600 \quad ...(ii)$

Dividing Equation (i) by Equation (ii), we get

$\left(\frac{\frac{1}{2l}\sqrt{\frac{T'}{m}}}{\frac{1}{2l}\sqrt{\frac{T}{m}}}\right) = \frac{606}{600}$

$\therefore \sqrt{\frac{T'}{T}} = (1.01) \Rightarrow \frac{T'}{T} = (1.02)$

$\therefore T' = T(1.02)$

Increase in tension,

$\Delta T' = T \times 1.02 - T = (0.02T)$

$\therefore$ Fractional increase in the tension, $\frac{\Delta T'}{T} = 0.02$

21 **(a)**

$n \propto \sqrt{T}$

$\therefore \frac{\Delta n}{n} = \frac{1}{2}\frac{\Delta T}{T}$

$\therefore$ Beat frequency, $\Delta n = \left(\frac{1}{2}\frac{\Delta T}{T}\right)n$

$= \frac{1}{2} \times \frac{2}{100} \times 400$

$= 4$

22 **(b)**

$n \propto \sqrt{T}$

$\therefore \frac{T_2}{T_1} = \frac{n_2^2}{n_1^2}$

$\therefore T_2 = \frac{n_2^2}{n_1^2} \times T_1 = \left(\frac{320}{256}\right)^2 \times 16 = 25\ \text{kg} - \text{wt}$

$\therefore \Delta T = T_2 - T_1 = 25 - 16 = 9$ kg-wt

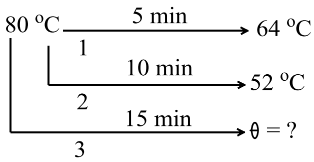
23 **(a)**

Due to compression the temperature of the system increases to a very high value. This causes the flow of heat from system to the surroundings, thus decreasing the temperature. The decrease in temperature results in decrease in pressure

24 **(a)**

According to Newton law of cooling,

$\frac{\theta_1 - \theta_2}{t} = K\left[\frac{\theta_1 + \theta_2}{2} - \theta_0\right]$




For first process: $\frac{(80-64)}{5}$

$= K\left[\frac{80+64}{2} - \theta_0\right]$ ...(i)

For second process: $\frac{(80-52)}{10}$

$= K\left[\frac{80+52}{2} - \theta_0\right]$ ...(ii)

For third process: $\frac{(80-\theta)}{15}$

$= K\left[\frac{80+\theta}{2} - \theta_0\right]$ ...(iii)

On solving equation (i) and (ii) we get $K = \frac{1}{15}$and $\theta_0 = 24$ °C. Substituting these values in equation (iii) we get $\theta = 42.7$ °C

25 **(d)**

$\frac{Q_1}{Q_2} = \left(\frac{T_1}{T_2}\right)^4 = \left(\frac{273 + 27}{273 + 927}\right)^4$

$= \left(\frac{300}{1200}\right)^4 = \left(\frac{1}{4}\right)^4 = \frac{1}{256}$

28 **(b)**

$d\theta = \frac{1.22\lambda f}{D}$

$= \frac{1.22 \times 5000 \times 10^{-10} \times 5}{2.5 \times 10^{-3}}$

$= 1.22 \times 10^{-3}$m

29 **(a)**

In interference between waves of equal amplitudes 'a', the minimum intensity is zero and the maximum intensity is proportional to $4a^2$. For waves of unequal amplitudes 'a' and $A(A > a)$, the minimum intensity is non-zero and the maximum intensity is proportional to $(a + A)^2$, which is greater than $4a^2$

30 **(d)**

For 5$^{th}$ dark fringe,

$x_1 = (2n - 1)\frac{\lambda D}{2d} = \frac{9\lambda D}{2d}$

For 7$^{th}$ bright fringe, $x_2 = n\lambda\frac{D}{d} = \frac{7\lambda D}{d}$

$\therefore x_2 - x_1 = (\mu - 1)t\frac{D}{d}$

$\therefore \frac{\lambda D}{d}\frac{\lambda_2 D}{d} = (\mu - 1)t\frac{D}{d}$

$\therefore t = \frac{2.5\lambda}{(\mu - 1)}$

32 **(d)**

n plates will form $(n - 1)$ number of parallel capacitors

$\therefore$ Total capacity will be $(n - 1)C$

33 **(a)**

$r = \left(\frac{l_1 - l_2}{l_2}\right) \times R'$

$\therefore r = \left(\frac{55 - 50}{50}\right) \times 10 = 1\ \Omega$

35 **(c)**

$\frac{X}{100 - X} = \frac{2}{3}$

$\therefore 3X = 200 - 2X$

$\therefore 5X = 200 \Rightarrow X = 40$ cm

37 **(b)**

$B = \frac{\tau}{InA} = \frac{5}{5 \times 100 \times 50 \times 10^{-4}} = 2$ T

38 **(c)**

$S_i = x\ \text{div/mm} = \frac{x\ \text{div}}{10^{-3}\text{m}} = x \times 10^3 \text{div/m}$

$S_v = y$ div/m

Now,$S_v = \frac{S_i}{G} \Rightarrow G = \frac{S_i}{S_v}$

$\therefore G = \frac{x}{y} \times 10^3$

40 **(a)**

The volume of the cubic domain is

$V = (10^{-6}\text{m}) = 10^{-18}\text{m}^3$

Net dipole moment

$m_{net} = 8 \times 10^{10} \times 9 \times 10^{-24}\text{A m}^2$

$= 72 \times 10^{-14}$ A m$^2$

$\therefore$ Magnetization, $M = \frac{m_{net}}{\text{Domain volume}}$

$= \frac{72 \times 10^{-14}\ \text{A m}^2}{10^{-18}\text{m}^3}$

$= 72 \times 10^4\ \text{A m}^{-1} = 7.2 \times 10^5\ \text{A m}^{-1}$

43 **(d)**

According to Einstein's photoelectric equation

$E = W_0 + K_{max}$

$\therefore V_0 = \frac{hc}{e}\left[\frac{1}{\lambda} - \frac{1}{\lambda_0}\right]$

$\therefore$ As $\lambda$ decreases, $V_0$ increases

46 **(b)**

$\frac{1}{\lambda_B} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] \frac{1}{\lambda_{Br}} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right]$

$= R\left[\frac{5}{36}\right] \quad = R\left[\frac{9}{400}\right]$

$\therefore \lambda_B = \frac{36}{5R} \quad \therefore \lambda_{Br} = \frac{400}{9R}$

$\therefore \frac{\lambda_B}{\lambda_{Br}} = \frac{36}{5R} \times \frac{9R}{400} = 0.162$

59 **(a)**

$\Delta G = \Delta H - T\Delta S = 145.6 - 300 \times \frac{116}{1000}$

$= 110.8 \text{ kJ mol}^{-1}$

73 **(c)**

Solution of $XeF_6$ dissolves in HF is conducting due to the formation of ions.

$HF + XeF_6 \rightarrow XeF_5^{+1} + HF_2^{-1} +$

74 **(c)**

$2NH_3 + 3I_2 \rightarrow NI_3 \cdot NH_3 + 3HI$

86 **(a)**

$R - Br + \underset{(aq.)}{KOH} \rightarrow R - OH + KBr$

101 **(a)**

Dual of '∨' is '∧' and of 't' is 'c'

105 **(d)**

If $A = \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}, A^{-1} = \begin{bmatrix} \frac{1}{a} & 0 & 0 \\ 0 & \frac{1}{b} & 0 \\ 0 & 0 & \frac{1}{c} \end{bmatrix}$

$\therefore$ option (D) is the correct answer

106 **(d)**

$|A| = -20$

$\therefore a_{23} = \frac{\text{Co} - \text{factor of } a_{32}}{-20} = \frac{-8}{-20} = \frac{2}{5}$

107 **(c)**

$\sin^4 x + \cos^4 x + \sin 2x + \alpha = 0$

$\Rightarrow (\sin^2 x + \cos^2 x)^2 - 2\sin^2 x \cos^2 x + \sin 2x + \alpha = 0$

$\Rightarrow \sin^2 2x - 2\sin 2x - 2 - 2\alpha = 0$

Let $\sin 2x = y$. Then the given equation

Becomes $y^2 - 2y^2 - 2(1 + \alpha) = 0$

Where $-1 \geq y \geq 1$, $(\because -1 \leq \sin 2x \leq 1)$

For real, discriminant $\geq 0 \Rightarrow 3 + 2\alpha \geq 0$

$\Rightarrow \alpha \geq -\frac{3}{2}$

Also, $-1 \leq y \leq 1 \Rightarrow -1 \leq 1 - \sqrt{3 + 2\alpha} \leq 1$

$\Rightarrow 3 + 2\alpha \leq 4 \Rightarrow \alpha \leq \frac{1}{2}$. Thus, $-\frac{3}{2} \leq \alpha \leq \frac{1}{2}$

108 **(d)**

Given that

$\tan^{-1} x + \tan^{-1} y + \tan^{-1} z = \frac{\pi}{2}$

$\Rightarrow \tan^{-1}\left[\frac{x + y + z - xyz}{1 - xy - yz - xz}\right] = \frac{\pi}{2}$

$\Rightarrow \left[\frac{x + y + z - xyz}{1 - xy - yz - xz}\right] = \tan\frac{\pi}{2} = \frac{1}{0}$

Hence, $xy + yz + zx - 1 = 0$

**Trick**: $x = y = z = \frac{1}{\sqrt{3}}$, so that

$\tan^{-1}\frac{1}{\sqrt{3}} + \tan^{-1}\frac{1}{\sqrt{3}} + \tan^{-1}\frac{1}{\sqrt{3}} = \frac{\pi}{2}$

(D) holds for these values of $x, y, z$

109 **(b)**

Let $B = 90°$

$\Rightarrow \sin^2 B = 1$

Now, $\cos^2 A + \cos^2 C = \cos^2 A + \cos^2\left(\frac{\pi}{2} - A\right)$

$= \cos^2 A + \sin^2 A = 1$

$\therefore$ It is a right angled triangle

110 **(b)**

$\tan 45° = \frac{2\sqrt{\frac{1}{4} - ab}}{a + b}$

$\therefore (a + b)^2 = (1 - 4ab)$

$\therefore a^2 + b^2 + 6ab - 1 = 0$

Which is satisfied by

$a = 1$ and $b = -6$

111 **(c)**

$(x - 1)^2 - (y - 1)^2 - (x - 1) - 5(y - 1) + \lambda = 0$

$\therefore x'^2 - y'^2 - x' - 5y' + \lambda = 0$

$\begin{vmatrix} 1 & 0 & \frac{-1}{2} \\ 0 & -1 & \frac{-5}{2} \\ \frac{-1}{2} & \frac{-5}{2} & \lambda \end{vmatrix} = 0$

$\therefore 1\left(-\lambda - \frac{25}{4}\right) - \frac{1}{2}\left(\frac{-1}{2}\right) = 0$

Solving, we get $\lambda = -6$

113 **(c)**

$\bar{a}.(\bar{b} \times \bar{c}) = 0$ or $(\bar{a} \times \bar{b}).\bar{c} = 0$

114 **(d)**

$\bar{a} = \lambda\bar{b}$

$\therefore 3 = -2\lambda$

$\lambda = \frac{-3}{2}$

Now $-2 = p\lambda \Rightarrow p = \frac{4}{3}$

And $5 = -q\lambda \Rightarrow q = \frac{10}{3}$

115 **(a)**

Let the vector be $a\hat{i}+b\hat{j}+c\hat{k}$

It is perpendicular to $2\hat{i}+\hat{j}+\hat{k}$

$\therefore 2a+b+c=0$ ...(i)

It is coplanar with $\hat{i}+2\hat{j}+\hat{k}$ and $\hat{i}+\hat{j}+2\hat{k}$

$\therefore \begin{vmatrix} a & b & c \\ 1 & 2 & 1 \\ 1 & 1 & 2 \end{vmatrix}=0$

$\therefore 3a-b-c=0$ ...(ii)

On solving (i) and (ii), $a=0, b=5, c=-5$

$\therefore$ Required vector is $5(\hat{j}-\hat{k})$

116 **(a)**

Direction cosines $=\left(\frac{4}{\sqrt{196}},\frac{6}{\sqrt{196}},\frac{12}{\sqrt{196}}\right)$

i.e., $\left(\frac{2}{7},\frac{3}{7},\frac{6}{7}\right)$

117 **(a)**

Here, $\frac{3-(-2)}{1-3}=\frac{-6-4}{-2-(-6)}=\frac{-8-7}{-2-(-8)}$

$\Rightarrow -\frac{5}{2}=-\frac{5}{2}=-\frac{5}{2}$

$\therefore$ the given points are collinear

118 **(a)**

The d.c.s of the given lines are proportional to $2-6,-3+7,1+1$ i.e., $-2,2,1$

$\because$ angle $\alpha$ is acute, $\cos\alpha>0 \Rightarrow \cos\alpha=\frac{2}{3}$

Thus, required d.c.s are $\frac{2}{3},\frac{-2}{3},\frac{-1}{3}$

119 **(a)**

Distance $=\sqrt{y^2+z^2}=\sqrt{9+16}=5$

120 **(c)**

Any point on Z-axis is $(0,0,\lambda)$

The foot of perpendicular from the point (a, b, c) on Z-axis is (0, 0, c)

121 **(a)**

The Cartesian equation of the line is

$3x-2=2y+1=3z-3$

$\Rightarrow 3\left(x-\frac{2}{3}\right)=2\left(y+\frac{1}{2}\right)=3(z-1)$

$\Rightarrow \frac{x-\frac{2}{3}}{2}=\frac{y+\frac{1}{2}}{3}=\frac{z-1}{2}$

This shows that the given line passes through $\left(\frac{2}{3},\frac{-1}{2},1\right)$

and has direction ratio proportional to 2, 3, 2

Therefore, its vector equation is

$\bar{r}=\left(\frac{2}{3}\hat{i}-\frac{1}{2}\hat{j}+\hat{k}\right)+\lambda(2\hat{i}+3\hat{j}+2\hat{k})$

123 **(c)**

The equation of the required plane is

$(2x-5y+z-3)+\lambda(x+y+4z-5)=0$ ...(i)

$\therefore (2+\lambda)x+(-5+\lambda)y+(1+4\lambda)z+(-3-5\lambda)=0$

Since, this plane is parallel to $x+3y+6z=1$

$\therefore \frac{2+\lambda}{1}=\frac{-5+\lambda}{3}=\frac{1+4\lambda}{6}$

By solving, we get

$\lambda=-\frac{11}{2}$

Putting $\lambda=-\frac{11}{2}$ in (i), we get

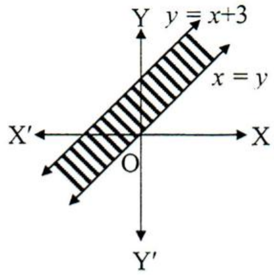
$(2x-5y+z-3)-\frac{11}{2}(x+y+4z-5)=0$

$\Rightarrow -7x-21y-42z+49=0$

$\Rightarrow x+3y+6z-7=0$

124 **(c)**

The shaded area is the required area given in graph as below




125 **(b)**

For maximum profit, $z=40x+25y$

126 **(c)**

Since, $f(x)$ is not defined at $x=0,1,-1$ and at all other points $f(x)$ is continuous

The given function is discontinuous as 3 points

127 **(d)**

By definition of continuity, we know that

$\lim_{x\to3^+}f(x)=f(3)=\lim_{x\to3^-}f(x)$

$\Rightarrow \lim_{x\to3^-}f(x)=4$ or $\lim_{h\to0}(3-h+\lambda)=4$

$\Rightarrow 3+\lambda=4 \Rightarrow \lambda=1$

128 **(a)**

$\lim_{x\to2^-}f(x)=\lim_{x\to2}(x-1)=1$

$\lim_{x\to2^+}f(x)=\lim_{x\to2}(2x-3)=1$

129 **(c)**

Let $y=\tan^{-1}\left(\frac{2x}{1-x^2}\right)$ and $z=\sin^{-1}\left(\frac{2x}{1+x^2}\right)$

Put $x=\tan\theta$

$\therefore y=2\theta, z=2\theta$

$\therefore \frac{dy}{d\theta}=2,\frac{dz}{d\theta}=2$

$\therefore \frac{dy}{dz}=1$

130 **(c)**

Putting $x=\sin A$ and $\sqrt{x}=\sin B$

$y=\sin^{-1}(\sin A\sqrt{1-\sin^2 B}+\sin B\sqrt{1-\sin^2 A})$

$=\sin^{-1}[\sin(A+B)]=A+B=\sin^{-1}x+\sin^{-1}\sqrt{x}$

$\Rightarrow \frac{dy}{dx}=\frac{1}{\sqrt{1-x^2}}+\frac{1}{2\sqrt{x-x^2}}$

131 **(a)**

$x = a\cos^3\theta$

$\therefore \dfrac{dx}{d\theta} = -3a\cos^2\theta.\sin\theta$

$y = a\sin^3\theta$

$\therefore \dfrac{dy}{d\theta} = 3a\sin^2\theta.\cos\theta$

$\therefore \dfrac{dy}{dx} = -\tan\theta \therefore \sqrt{1+\left(\dfrac{dy}{dx}\right)^2} + \sqrt{1+\tan^2\theta}$

$= \sqrt{\sec^2\theta} = |\sec\theta|$

132 **(a)**

$y = ax^2 - 6x + b$

$\therefore \dfrac{dy}{dx} = 2ax - 6$

$\therefore \left(\dfrac{dy}{dx}\right)_{\left(x=\frac{3}{2}\right)} = 3a - 6$

Since, the tangent is parallel to X-axis at $x = \frac{3}{2}$

$\therefore \left(\dfrac{dy}{dx}\right)_{\left(x=\frac{3}{2}\right)} = 0$

$\Rightarrow 3a - 6 = 0$

$\Rightarrow a = 2$

Now, the given curve passes through (0, 2)

$\therefore 2 = 0 - 0 + b$

$\Rightarrow b = 2$

133 **(a)**

Applying mean value theorem, we have

$f'(c) = \dfrac{f(3) - f(1)}{3 - 1}$

$\Rightarrow \dfrac{1}{c} = \dfrac{\log 3 - \log 1}{2}$

$\Rightarrow c = \dfrac{2}{\log 3}$

$\Rightarrow c = 2\log_3 e$

134 **(c)**

$f(x) = x^4 - 62x^2 + ax + 9 \quad ...(i)$

$\therefore f'(x) = 4x^3 - 124x + a$

For maximum or minimum, $f'(x) = 0$

$\therefore 4x^3 - 124x + a = 0$

$\because x = 1$ is a root of (i)

$\therefore f'(1) = 4 - 124 + a = 0 \quad \therefore a = 120$

135 **(a)**

$\int e^x [\tan x - \log(\cos x)]dx$

$= \int e^x [\tan x + \log(\sec x)] + dx$

$= e^x \log(\sec x) + c$

$.....\left[\because \int e^x [f(x) + f'(x)]dx = e^x f(x) + c\right]$

136 **(c)**

$\int \dfrac{1}{\sqrt{1+\sin x}}dx$

$= \int \dfrac{1}{\sin\frac{x}{2} + \cos\frac{x}{2}}dx$

$= \int \dfrac{1}{\sqrt{2}\sin\left(\frac{\pi}{4} + \frac{x}{2}\right)}dx$

$= \dfrac{1}{\sqrt{2}}\int \text{cosec}\left(\dfrac{x}{2} + \dfrac{\pi}{4}\right)dx$

$= \sqrt{2}\log\tan\left(\dfrac{\pi}{8} + \dfrac{x}{4}\right) + c$

137 **(a)**

$\int x\sin x\, dx = -x\cos x + \int \cos x\, dx$

$= -x\cos x + \sin x + \text{constant}$

$\therefore A = \sin x + \text{constant}$

138 **(d)**

Put $t = \frac{1}{x} \Rightarrow dt = -\frac{1}{x^2}dx$as $t = \frac{\pi}{2}$ and $\pi$

$\therefore \int_{1/\pi}^{2/\pi} \dfrac{\sin\left(\frac{1}{x}\right)}{x^2}dx = -\int_{\pi}^{\pi/2} \sin t\, dt = [\cos t]_{\pi}^{\pi/2}$

$= \left[\cos\dfrac{\pi}{2} - \cos(\pi)\right] = 1$

139 **(b)**

$\int_{-\pi/2}^{\pi/2} \sqrt{\dfrac{1}{2}(1 - \cos 2x)}dx = 2\int_0^{\pi/2} |\sin x|dx$

$= 2[-\cos x]_0^{\pi/2} = 2\left[-\cos\left(\dfrac{\pi}{2}\right) + \cos 0\right] = 2$

140 **(d)**

Let $I = \int_0^{2\pi} \cos^{99} x\, dx$

$\therefore I = 2\int_0^{\pi} \cos^{99} x\, dx \quad ...[\because \cos^{99}(2\pi - x)$

$= \cos^{99} x]$

Now, $\int_0^{\pi} \cos^{99} x\, dx = 0 \quad ...[\because \cos^{99}(\pi - x) = -\cos^{99} x]$

$\therefore I = 2 \times 0 = 0$

141 **(c)**

Given curve is $xy - 3x - 2y - 10 = 0$

$\Rightarrow y(x - 2) = 3x + 10$

$\Rightarrow y = \dfrac{3x + 10}{x - 2}$

$\therefore$ Required area $= \int_0^4 y\, dx = \int_3^4 \frac{3x+10}{x-2}dx$

$= [3x + 16\log(x - 2)]_3^4$

$= 3 + 16\log 2$ sq. units

142 **(a)**

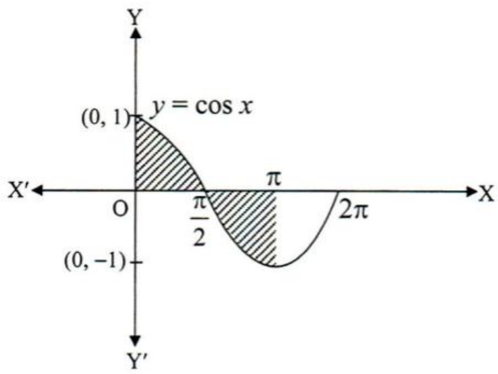
The parabola meets X-axis at the points, where $\frac{3}{a}(a^2 - x^2) = 0 \Rightarrow x = \pm a$

$\therefore$ Required area $= \int_{-a}^{a} \frac{3}{a}(a^2 - x^2)dx$

$= \frac{6}{a}\int_0^a (a^2 - x^2)\,dx$

$= 4a^2$ sq. units

143 **(c)**




Required area $= 2\int_0^{\pi/2} \cos x\,dx = 2[\sin x]_0^{\pi/2}$

$= 2$ sq. units

144 **(c)**

Consider option (C),

$y = 2x - 4$ ....(i)

$\therefore \frac{dy}{dx} = 2$

From (i), we get

$y = 2x - (2)^2$

$\Rightarrow y = x\frac{dy}{dx} - \left(\frac{dy}{dx}\right)^2$

$\Rightarrow \left(\frac{dy}{dx}\right)^2 - \frac{xdy}{dx} + y = 0$

145 **(a)**

$\frac{dy}{dx} = -\frac{1}{\sqrt{1-x^2}}$

$\Rightarrow dy = -\frac{1}{\sqrt{1-x^2}}dx$

On integrating both sides, we get

$\Rightarrow y + \sin^{-1} x = c$

146 **(b)**

$e^{dy/dx} = (x+1)$

$\Rightarrow \frac{dy}{dx} = \log(x+1)$

On integrating both sides, we get

$\int dy = \int \log(x+1)\,dx + c$

$\Rightarrow y = x\log|x+1| - \int \frac{x}{x+1}dx + c$

$= x\log|x+1| - \int \frac{x+1-1}{x+1}dx + c$

$= x\log|x+1| - \int \left(1 - \frac{1}{x+1}\right)dx + c$

$\therefore y = x\log|x+1| - x + \log|x+1| + c$ .....(i)

Since, $y(0) = 3$ i.e., $y = 3$, when $x = 0$

$\therefore 3 = 0 + c \Rightarrow c = 3$

$\therefore y = x\log|x+1| + \log|x+1| - x + 3$

.....[From (i)]

$\therefore y = (x+1)\log|x+1| - x + 3$

147 **(a)**

Since, $\sum P(X = x) = 1$

$\therefore 0.2 + 0.1 + 0.3 + k = 1$

$\therefore k = 1 - 0.6 = 0.4$

$E(X) = \sum x_i \cdot P(x_i)$

$= 1(0.2) + 2(0.1) + 3(0.3) + 4(0.4)$

$= 0.2 + 0.2 + 0.9 + 1.6 = 2.9$

Variance $= \sum x_i^2 . P(x_i) - [E(X)]^2$

$= (1)^2(0.2) + (2)^2(0.1) + (3)^2(0.3) + (4)^2(0.4) - (2.9)^2$

$= 0.2 + 0.4 + 2.7 + 6.4 - 8.41$

$= 9.7 - 8.41$

$= 1.29$

148 **(a)**

The sum of all the probabilities in a probability distribution is always unity

In option (A), we have $0.3 + 0.2 + 0.4 + 0.1 = 1$