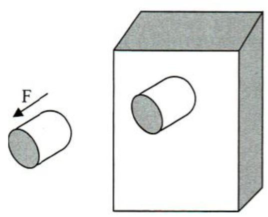
1. Select the WRONG statement
   a) In U.C.M. linear speed is constant
   b) In U.C.M. linear velocity is constant
   c) In U.C.M. magnitude of angular momentum is constant
   d) In U.C.M. angular velocity is constant
2. Banking of roads is independent of
   a) Radius of the path
   b) Mass of the vehicle
   c) Acceleration due to gravity
   d) Maximum velocity of the vehicle around the curved path
3. Which of the following statement is false for a particle moving in a circle with a constant angular speed?
   a) The velocity vector is tangent to the circle
   b) The acceleration vector is tangent to the circle
   c) The acceleration vector points to the centre of the circle
   d) The velocity and acceleration vectors are perpendicular to each other
4. A body is projected vertically upwards from the surface of a planet of radius R with a velocity equal to half the escape velocity for that planet. The maximum height attained by the body is
   a) R/3 b) R/2 c) R/4 d) R/5
5. The dimensional formula for universal gravitational constant G is
   a) $[M^{-1}L^3T^{-2}]$ b) $[M^3L^{-1}T^{-2}]$
   c) $[M^1L^{-3}T^{-2}]$ d) $[M^{-1}L^{-3}T^2]$
6. For a satellite that orbits as close to the earth's surface as possible, which of the following statements is INCORRECT?
   a) Its speed is maximum
   b) Time period of its rotation is minimum
   c) The total energy of the 'earth plus satellite' system is minimum
   d) The total energy of the 'earth plus satellite' system is maximum
7. Five particles of mass 2 kg each are attached to the rim of a circular disc of radius 0.1 m and negligible mass. Moment of inertia of the system about the axis passing throught the centre of the disc and perpendicular to its plane is
   a) 1 kg-m^2 b) 0.1 kg-m^2
   c) 2 kg-m^2 d) 0.2 kg-m^2
8. Direction of angular momentum of rotating body in vertical plane is
   a) Vertical b) Tangential
   c) Horizontal d) Radial
9. A bob of mass m attached to an inextensible string of length l is suspended from a vertical support. The bob rotates in a horizontal circle with an angular speed ω rad/s about the vertical. About the point of suspension
   a) Angular momentum is conserved
   b) Angular momentum changes in magnitude but not in direction
   c) Angular momentum changes in direction but not in magnitude
   d) Angular momentum changes both in direction and magnitude
10. A pendulum has time period T. If it is taken on to another planet having acceleration due to gravity half and mass 9 times that of the earth, then its time period on the other planet will be
    a) $\sqrt{T}$ b) T c) $T^{1/3}$ d) $\sqrt{2}\,T$
11. If the length of a pendulum is made 9 times and mass of the bob is made 4 times, then the value of time period (T) becomes
    a) 3T b) 3/2T c) 4T d) 2T
12. Select the WRONG statement. A body is said to be in S.H.M. if
    a) The motion is periodic
    b) Its acceleration is directed towards a fixed point in its path
    c) The magnitude of acceleration is directly proportional to displacement
    d) The acceleration is directed in the direction of displacement
13. Calculate the force F needed to punch a 1.46 cm diameter hole in a steel plate 1.27 cm thick. The ultimate shear strength of steel is 345 MN/m^2



    a) 100 kN b) 200 kN c) 300 kN d) 400 kN
14. The stress in a wire of diameter 2 mm, if a load of 100 gm is applied to a wire, is

a) $3.1 \times 10^5 N/m^2$ b) $6.2 \times 10^5 N/m^2$
c) $1.5 \times 10^5 N/m^2$ d) $12.4 \times 10^5 N/m^2$

15. Two drops of equal radius r coalesce to form a single drop under isothermal conditions. The radius of such a drop would be
a) r b) 1.4 r c) 1.5 r d) 2 r

16. Surface area of a soap bubble is 1.3×10^{-4} m^2. The work done to double the surface area will be (Surface tension for soap solution $= 3 \times 10^{-3} N/m$)
a) 5.85×10^{-7} joule b) 7.8×10^{-7} joule
c) 1.95×10^{-7} joule d) 3.9×10^{-7} joule

17. A and B are two soap bubbles. The bubble A is larger than B. If these are now joined by a tube, then
a) The bubble A becomes more large
b) The bubble B becomes more large
c) Both the bubbles acquire the same size
d) Both the bubbles will get burst

18. When a longitudinal wave is incident on a rigid will,
a) Compression is reflected as rarefaction with phase change of 0°
b) Compression is reflected as rarefaction with phase change of 180°
c) Compression is reflected as compression with no phase change
d) Compression is reflected as compression with phase change of 180°

19. An object producing a pitch of 600 Hz approaches a stationary person in a straight line with a velocity of 200 m/s. Velocity of sound is 300 m/s. The person will note a change in frequency, as the object files past him, equal to
a) 1440 Hz b) 240 Hz c) 1200 Hz d) 960 Hz

20. In a closed organ pipe, the frequency of the fundamental note is 50 Hz. The note of which of the following frequencies will not be emitted by it?
a) 50 Hz b) 100 Hz c) 150 Hz d) 250 Hz

21. When the length of the vibrating segment of a sonometer wire is increased by 1%, the percentage change in its frequency is
a) $\frac{100}{101}$ b) $\frac{99}{100}$ c) 1 d) 2

22. An organ pipe closed at one end has fundamental frequency of 1500 Hz. The maximum number of overtones generated by this pipe which a normal person can hear is :
a) 14 b) 13 c) 6 d) 9

23. The coefficient of absorption of the thermal radiation of body is
a) Dependent on temperature
b) Dependent on wavelength
c) Independent of wavelength
d) Independent of the nature of the surface

24. In a gas 5 molecules have speed 150 m/s, 160 m/s, 170 m/s, 180 m/s, 190 m/s. Ratio of $v_{r.m.s.}$ to v_{mean} is nearly
a) 1 b) 3 c) 0.5 d) 2

25. When an ideal monoatomic gas is heated at constant pressure, fraction of heat energy supplied which increases the internal energy of gas, is
a) $\frac{2}{5}$ b) $\frac{3}{5}$ c) $\frac{3}{7}$ d) $\frac{3}{4}$

26. When wavefront strikes a reflecting surface,
a) It comes to rest
b) It penetrates the reflecting surface
c) The surface bends
d) The points on the surface become source of secondary wavelets

27. The wavelength of light is 5000 Å. Find the wave number
a) 5×10^6 b) 2×10^6 c) 3×10^6 d) 1×10^6

28. In a biprism experiment, red light of wavelength 6500 Å was used. It was then replaced by green light of wavelength 5200 Å. The value of n for which $(n+1)^{th}$ green bright band would coincide with the n^{th} red bright band for the same setting is
a) $n = 6$ b) $n = 4$ c) $n = 2$ d) $n = 5$

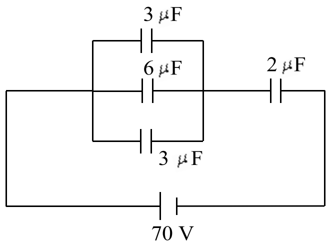
29. A thin mica sheet of thickness 2×10^{-6} m and refractive index ($\mu = 1.5$) is introduced in the path of the first wave. The wavelength of the wave used is 5000 Å. The central bright maximum will shift
a) 2 fringes upward b) 2 fringes downward
c) 10 fringes upward d) None of these

30. A microscope will have maximum resolving power if it is used to illuminate the specimen with
a) Red light b) Yellow light
c) Green light d) Ultraviolet light

31. An air capacitor of capacity $C = 10\ \mu F$ is connected to a constant voltage battery of 12 V. Now the space between the plates is filled with a liquid of dielectric constant 5. The charge that flows now from battery to the capacitor is

a) 120 μC b) 699 μC c) 480 μC d) 24 μC

32. In the given circuit, the potential difference across the 2 μF capacitor is



a) 10 V b) 25 V c) 45 V d) 60 V

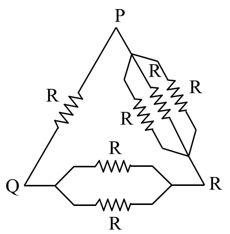
33. A potentiometer wire of length 1 m and resistance 10 Ω is connected in series with a cell of e.m.f. 2 V with internal resistance 1 Ω and a resistance box including a resistance R. If potential difference between the ends of the wire is 1 mV, the value of R is

a) 20000 Ω b) 19989 Ω c) 10000 Ω d) 9989 Ω

34. The material of wire of potentiometer is

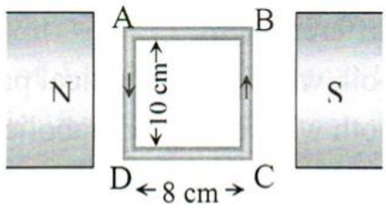
a) Copper b) Steel
c) Manganin d) Aluminium

35. Six equal resistances are connected between points P, Q and R as shown in the figure. Then the net resistance will be maximum between



a) P and Q b) Q and R
c) P and R d) Any time points

36. A 100 turns coil shown in figure carries a current of 2 ampere in a magnetic field B = 0.2 Wb/m^2. The torque acting on the coil



a) 0.32 Nm tending to rotate the side AD out of the page
b) 0.32 Nm tending to rotate the side AD into the page
c) 0.0032 Nm tending to rotate the side AD out of the page
d) 0.0032 Nm tending to rotate the side AD into the page

37. Two identical long conducting wires AOB and COD are placed at right angles to each other, with one above other such that O is their common point for the two. The wires carry I_1 and I_2 currents, respectively. Point P is lying at distance d from O along a direction perpendicular to the plane containing the wires. The magnetic field at the point P will be

a) $\frac{\mu_0}{2\pi d}\left(\frac{I_1}{I_2}\right)$ b) $\frac{\mu_0}{2\pi d}(I_1 + I_2)$
c) $\frac{\mu_0}{2\pi d}(I_1^2 - I_2^2)$ d) $\frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{1/2}$

38. Two long parallel wires P and Q are both perpendicular to the plane of the paper with distance 5 m between them. If P and Q carry current of 2.5 A and 5 A respectively in the same direction, then the magnetic field at a point half way between the wires is

a) $\frac{\sqrt{3}\mu_0}{2\pi}$ b) $\frac{\mu_0}{\pi}$ c) $\frac{3\mu_0}{2\pi}$ d) $\frac{\mu_0}{2\pi}$

39. If a magnetic substance is kept in a magnetic field, then which of the following is thrown out?

a) Paramagnetic b) Ferromagnetic
c) Diamagnetic d) Antiferromagnetic

40. When a ferromagnetic material is placed in a strong external magnetic field, its domain size

a) Increases
b) Decreases
c) Remain same
d) Does not depend upon the strength of field

41. In a step-up transformer, if the voltage in the secondary is increased, then the current in the primary

a) Increases b) Decreases
c) Does not change d) Becomes zero

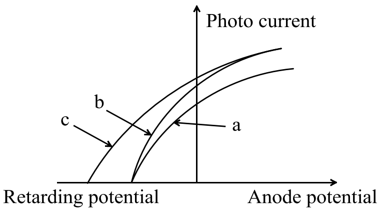
42. A magnetic field of 2×10^{-2} T acts at right angles to a coil of area 100 cm^2 with 50 turns. The average e. m. f. induced in the coil is 0.1 V, when it is removed from the field in time t. The value of t is

a) 0.1 s b) 0.01 s c) 1 s d) 20 s

43. The photoelectric effect is described as the ejection of electron from the surface of a metal, when

a) It is heated to a high temperature
b) Electrons of suitable velocity are incident on it
c) Light of suitable wavelength falls on it
d) It is placed in a strong magnetic field

44. The figure shows a plot of photo current versus anode potential for a photo sensitive surface for three different radiations. Which one of the following is a correct statement



a) Curves (a) and (b) represent incident radiations of different frequencies and different intensities
b) Curves (a) and (b) represent incident radiations of same frequency but of different intensities
c) Curves (b) and (c) represent incident radiations of different frequencies and different intensities
d) Curves (b) and (c) represent incident radiations of same frequency having same intensity

45. Quantum condition is expressed as
a) $mvr = n\frac{h}{2\pi}$ b) $E_1 - E_r = hv$
c) $F = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2}$ d) $F = \frac{mv^2}{r}$

46. The radius of nucleus having 10 nucleons is 3×10^{15}m. The nuclear radius of a nucleus with nucleon number 80 is
a) 3×10^{-15} m b) 1.5×10^{-15} m
c) 6×10^{-15} m d) 4.5×10^{-15} m

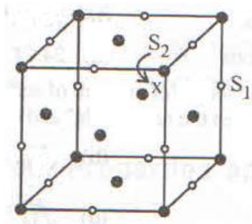
47. A solar cell can be made from
a) A thin wafer of Si doped with As
b) A thin wafer of germanium
c) A thin wafer of pure gallium arsenide
d) A thin wafer of copper

48. When NPN transistor is used as an amplifier,
a) Electrons move from base to collector
b) Holes move from emitter to base
c) Electrons move from collector to base
d) Holes move from base to emitter

49. Magnetic effect of current was discovered by
a) Faraday b) Oersted
c) Ampere d) Joule

50. The strong magnet is made with a material having hysteresis loss of material _____.
a) Small b) Large c) Infinite d) Depends on use

51. In the structure given below ,the sites $S_1$and S_2represent



a) Both octahedral voids
b) Both tetrahedral voids
c) S_1-octahedral void , S_2-tetrahedral void
d) S_1-tetrahedral void , S_2-octahedral void

52. A solid AB has the NaCI structure. If the radius of the cation is 100 pm then the radius of the anion B is
a) 100 pm b) 173.5 pm c) 241.5 pm d) 483 pm

53. Which of the following has no rotation of symmetry?
a) Hexagonal b) Orthorhombic
c) Cubic d) Triclinic

54. The constituent particles of solid can only __________ about their mean position.
a) Rotate b) Oscillate
c) Remain fixed d) Move

55. The weight of $H_2C_2O_4$ $2H_2O$required to prepare 500ml of 0.2 N solution is
a) 126 g b) 12.6 g c) 63 g d) 6.3 g

56. When the concentration is expressed as the number of moles of solute per kg of solvent it is known as
a) Normality b) Molarity
c) Molality d) Mass percentage

57. At 24^0C the solution of sucrose has O.P.2.5 atm. The strength of solution in gm mol/litre is :
a) 10.25 b) 1.05 c) 1025 d) 0.1025

58. A solution of glycol containing 1.82 g/litre has an osmotic pressure of 51.8 cm of mercury at 10^0. What is the, molecular weight of glycol ?
a) 62.04 b) 70 c) 80 d) 100

59. In which of the following reaction ΔH is greater than ΔU?
a) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$
b) $PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$
c) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$
d) $HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(aq)}$

60. The external pressure needed to compress an ideal gas from22 dm^3 to 8 dm^3 if work done is of 4.545 kJ is
a) 3.03×10^5 Nm^{-2} b) 2.03×10^5 Nm^{-2}
c) 1×10^5 Nm^{-2} d) -3.4×10^5 Nm^{-2}

61. The bond energy of O – H bond is “Y” J mol^{-1}.

When one mole of water is formed, which of the following takes place?

a) Y J is released　b) 2Y J is released
c) Y J is absorbed　d) 2Y J is absorbed

62. The heat changes for the reaction :
$C_{(s)} + 2S_{(s)} \rightarrow CS_{2(l)}$ is known as
a) Heat of vaporization　b) Heat of reaction
c) Heat of formation　d) Heat of combustion

63. Lead accumulator is a secondary storage cell because
a) It is an irreversible cell
b) Electrical energy is previously stored in it from an external source
c) Electrolysis occurs in it
d) It involves H_2SO_4 solution

64. In $H_2 - O_2$ fuel cell, at cathode the reduction takes place of the specie, which is
a) O^-　b) O_2^-　c) H_2O　d) O_2

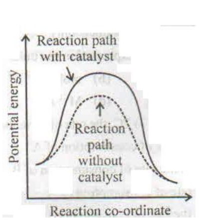
65. The units of equivalent conductance are
a) $ohm^{-1} cm\ equiv^{-1}$　b) $ohm cm^2\ equiv^{-1}$
c) $ohm^{-1} cm^2\ equiv^{-1}$　d) ohmcmequiv

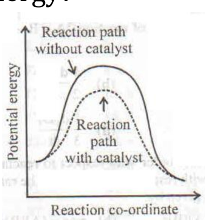
66. The time required to coat a metal surface of 80^0 cm^2 with 5×10^{-3} cm thick layer of silver [density 1.05 gm / cm^3] with passage of 3 A current through silver nitrate solution is
a) 115 sec.　b) 125 sec.　c) 135 sec.　d) 145 sec

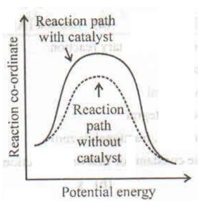
67. A first order reaction is 50% completed in 30 minutes. The rate constant of the reaction is
a) $2.31\ min^{-1}$　b) $2.31 \times 10^{2} min^{-1}$
c) $2.31 \times 10^{-2} min^{-1}$　d) $2.31 \times 10^{-1} min^{-1}$

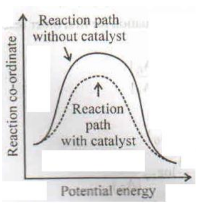
68. The rate constant of a first order reaction whose half-life is 480 S is :
a) $1.44 \times 10^{-3}\ S^{-1}$　b) $1.44\ S^{-1}$
c) $0.72 \times 10^{-3}\ S^{-1}$　d) $2.88 \times 10^{-3}\ S^{-1}$

69. Which of the following is correct plot for effect of catalyst on activation energy?

a) 

b) 

c) 

d) 

70. Thermite is a mixture of ________
a) Oxide of manganese and aluminum
b) Aluminiumpowder and oxide of chromium
c) Oxide of manganese and chromium
d) Aluminium and manganese powder

71. Froth flotation method may be used to increase the concentration of mineral in
a) Chalcopyrites　b) Bauxite
c) Haematite　d) Calamine

72. Formula of Magnetite is ________.
a) Fe_2O_5　b) FeO　c) Fe_3O_4　d) Fe_2O_3

73. The hydrolysis of NCl_3 by H_2O produces
a) NH_2OH and HOCl　b) NH_2NH_2 and HCl
c) NH_4OH and HOCl　d) NH_2Cl and HOCl

74. Atom is a P_4 molecule of white phosphorus are arranged regularly in the following way
a) At the corners of a cube
b) At the corners of an octahedron
c) At the corners of tetrahedron
d) At the center and corners of tetrahedron

75. Hybridization involved in H_2O is
a) sp　b) sp^3　c) sp^3d^2　d) sp^2

76. The correct order of the ionic radii of the ions is
a) $La^{+3} < Eu^{+3} < Lu^{+3} < Yb^{+3}$
b) $La^{+3} < Eu^{+3} < Yb^{+3} < Lu^{+3}$
c) $Yb^{+3} < La^{+3} < Eu^{+3} < Lu^{+3}$
d) $Yb^{+3} < Lu^{+3} < Eu^{+3} < La^{+3}$

77. The number of d electrons retained in Fe^{2+} (Z of Fe=26) ion is
a) 3　b) 4　c) 5　d) 6

78. The no. of incomplete shell in f–block elements is
a) 2　b) 1　c) 0　d) 3

79. The number of ions formed when cuproammonium sulphate is dissolved in water is
a) 1　b) 2　c) 4　d) Zero

80. Composition of complex formed when the ore argentite is treated with NaCN is
a) $Na_3[Ag(CN)_6]$　b) $Na[Au(CN)_2]$
c) $Na[Ag(CN)_2]$　d) $Na[Au(CN)_6]$

81. Which one of the following in NOT a ligand?
a) PH_3　b) NO^+　c) Br^-　d) BF_3

82. Which one of the following compounds would exhibit co-ordination Isomerism?
a) $[Cr(H_2O)_6]Cl_3$　b) $[Cr(NH_3)_6][Co(CN)_6]$
c) $[Cr(en)_3]NO_2$　d) Noneof the above

83. The compounds$[PtCl_2(NH_3)_4]Br_2$ and $[PtCl_2(NH_3)_4]Cl_2$ constitutes a pair of
a) Linkage isomers
b) Ionization isomers
c) Co-ordination isomers
d) Optical isomers

84. Select the correct statement among the following :
a) SN^1 reactions involve two steps
b) SN^2 reactions involve two steps
c) SN^1 reaction involves transition state intermediate
d) SN^2 reaction involves carbonium ion intermediate

85. Give the IUPAC name of : m-$ClCH_2C_6H_4CH_2C(CH_3)_3$
a) 1-(3-Chloro-3-metylphenyl)-2,2-diethylpropane
b) 2-(3-Chloromethylpropyl)-2,2-dimethylpropane
c) 1-(3-Chloromethylphenyl)-3,3-dimethylpropane
d) 1-Chloromethyl-3-(2,2-dimethylpropyl)benzene

86. Which of the following does not have carbonyl group?
a) Ethanoic acid b) Methanoic acid
c) Aldehyde d) Ether

87. At which of the following reaction condition phenol gives O-phenol sulphonicacid ?
a) Conc. H_2SO_4 at high temperature
b) Dil. H_2SO_4 at low temperature
c) Conc. H_2SO_4 at low temperature
d) Dil. H_2SO_4 at high temperature

88. Glacial acetic acid is the same as :
a) Vinegar
b) Pure anhydrous acetic acid
c) Mixture of acetic acid and acetic anhydrous
d) Mixture of alcohol and acetic acid

89. For carbonation of Grignard reagent, which of the following is used?
a) Solid CO_2 b) Formic acid
c) Dry ice d) Both (a) and (c)

90. When formaldehyde is heated with ammonia the compound is
a) Formaldehyde ammonia
b) Methyl amine
c) Hexamethylene tetramine
d) Formaline

91. A) Diazonium saltss are stable at __________temperature.
a) 5 K b) 10 K c) 278 K d) 25 K

92. $CH_3CH_2NH_2 + (CH_3CO)_2O \longrightarrow CH_3CH_2NHCOCH_3 + Q$ The compound Q is
a) Acetychloride b) Acetone
c) Ethanoic acid d) Acetonitrile

93. Which of the following amines give carbylamines reaction?
a) $C_2H_5NH_2$ b) $(C_2H_5)_2NH$
c) $(C_2H_5)_3N$ d) $CH_3NHC_2H_5$

94. General formula for the carbohydrates is
a) $C_nH_{2n}O_{2n+2}$ b) $C_x(H_2O)_x$
c) $C_x(H_2O)_{2x}$ d) $C_x(H_2O)_y$

95. Which of the following base is not present in RNA ?
a) Thymine b) Adenine
c) Uracil d) Guanine

96. Which of the following is not an example of natural polymer ?
a) Wool b) Silk
c) Leather d) Nylon

97. Which of the following represents terylene (or Dacron)?
a) $(-OCH_2 - CH_2 - O - \overset{\overset{O}{\|}}{C} - C_6 - H_5 - \overset{\overset{O}{\|}}{C} -)_n$
b) $(-CH_2 - CH = CH - CH_2 - CH - CH_2 -)_n$
c) $(-CH_2 - \underset{\underset{Cl}{|}}{C} = CH - CH_2 - \underset{\underset{Cl}{|}}{CH} - CH_2 -)_n$
d) $(-CH_2 - \underset{\underset{C_6H_5}{|}}{CH} - CH_2 - \underset{\underset{C_6H_5}{|}}{CH} -)_n$

98. Plexiglass (PMMA) is a polymer of
a) Acrylic acid b) Methyl acrylate
c) Methylmethacrylate d) None of these

99. Which is the most basic in character?
a) NaOH b) KOH
c) NaBr d) NaF

100. The number of tertiary C-atoms in 2,2,4,4 – tetra methyl pentane is
a) 1 b) 2
c) 3 d) 4

101. Let S be a non-empty subset of R. Consider the following statement:
p : There is a rational number $x \in S$ such that $x > 0$
Which of the following statements is the negation of the statement p?
a) There is a rational number $x \in S$ such that $x \leq 0$
b) There is no rational number $x \in S$ such that $x \leq 0$
c) Every rational number $x \in S$ satisfies $x \leq 0$

d) $x \in$ S and $x \leq 0 \rightarrow x$ is not rational

102. The contrapositive of the statement 'If Chandigarh is capital of Punjab, then Chandigarh is in India', is
a) If Chandigarh is not in India, then Chandigarh is not a capital of Punjab
b) If Chandigarh is in India, then Chandigarh is capital of Punjab
c) If Chandigarh is not capital of Punjab, then Chandigarh is not capital of India
d) If Chandigarh is capital of Punjab, then Chandigarh is not in India

103. Which of the following is logically equivalent to $\sim [p \rightarrow (p \vee \sim q)]$?
a) $p \vee (\sim p \wedge q)$ b) $p \wedge (\sim p \wedge q)$
c) $p \wedge (p \vee \sim q)$ d) $p \vee (p \wedge \sim q)$

104. If $A = \begin{bmatrix} 1 & 2 & 0 \\ -1 & 1 & 2 \\ 2 & -1 & 1 \end{bmatrix}$, then $\det(\text{adj}\,(\text{adj}\,A)) =$
a) 13 b) 13^2 c) 13^3 d) 13^4

105. If $\begin{bmatrix} 1 & 1 & 1 \\ 1 & -2 & -2 \\ 1 & 3 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 3 \\ 4 \end{bmatrix}$, then $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ is equal to
a) $\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ b) $\begin{bmatrix} 1 \\ -2 \\ 3 \end{bmatrix}$ c) $\begin{bmatrix} 1 \\ -2 \\ 1 \end{bmatrix}$ d) $\begin{bmatrix} 1 \\ 2 \\ -3 \end{bmatrix}$

106. The value of a for which the system of equations $ax + y + z = 0; x + ay + z = 0; x + y + z = 0$ possess a non-null solution is
a) 1 b) 2 c) -1 d) -2

107. If $\tan 3x = \cot x$, then x is ($n \in I$)
a) $(2n+1)\frac{\pi}{8}$ b) $(2n+1)\frac{\pi}{6}$
c) $(2n+1)\frac{\pi}{4}$ d) $(2n+1)\frac{\pi}{2}$

108. If a, b, c be positive real numbers and the value of
$\theta = \sqrt{\frac{a(a+b+c)}{bc}} + \tan^{-1}\sqrt{\frac{b(a+b+c)}{ca}} + \tan^{-1}\sqrt{\frac{c(a+b+c)}{ab}}$, then $\tan\theta$ is equal to
a) 0 b) 1
c) $\frac{a+b+c}{abc}$ d) $\frac{ab+bc+ca}{a+b+c}$

109. The number of solutions of the equation $2\cos(e^x) = 5^x + 5^{-x}$, are
a) No solution
b) One solution
c) Two solutions
d) Infinitely many solutions

110. The point of intersection of the lines $2x^2 - 5xy + 3y^2 + 8x - 9y + 6 = 0$ is
a) $(-3, 4)$ b) $(3, -5)$ c) $(3, 4)$ d) $(-3, -5)$

111. If the pair of lines $x^2 - 2nxy - y^2 = 0$ and $x^2 - 2mxy - y^2 = 0$ are such that one of them represents the bisectors of the angles between the other then
a) $\frac{1}{n} + \frac{1}{m} = 0$ b) $\frac{1}{n} - \frac{1}{m} = 0$
c) $mn - 1 = 0$ d) $mn + 1 = 0$

112. The joint equation of pair of lines through origin, each of which makes an angle of 60° with Y-axis, is
a) $x^2 - 3y^2 = 0$ b) $x^2 + 3y^2 = 0$
c) $3x^2 - y^2 = 0$ d) $3x^2 + y^2 = 0$

113. The volume of tetrahedron whose vertices are $A(3,7,4), B(5,-2,3), C(-4,5,6), D(1,2,3)$ is
a) $\frac{43}{6}$ cub. uts. b) 43 cub. uts.
c) $\frac{46}{3}$ cub. uts. d) $\frac{6}{43}$ cub. uts.

114. In a trapezium, if the vector $\overrightarrow{BC} = \lambda\,\overrightarrow{AD}$, $\bar{p} = \overrightarrow{AC} + \overrightarrow{BD}$ is collinear with $\overrightarrow{AD}$ and $\bar{p} = \mu\,\overrightarrow{AD}$, then
a) $\mu = \lambda + 1$ b) $\lambda = \mu + 1$
c) $\lambda + \mu = 1$ d) $\mu = 2 + \lambda$

115. If the position vectors of the points A, B, C be $\bar{a}, \bar{b}, 3\bar{a} - 2\bar{b}$ respectively, then the points A, B, C are
a) Collinear
b) Non-collinear
c) Forming a right angled triangle
d) None of these

116. The direction cosines of the vector $6\hat{i} - 2\hat{j} - 3\hat{k}$ is
a) $\frac{-3}{7}, \frac{-2}{7}, \frac{6}{7}$ b) $\frac{6}{7}, \frac{-2}{7}, \frac{-3}{7}$
c) $\frac{-2}{7}, \frac{3}{7}, \frac{6}{7}$ d) $\frac{-2}{7}, \frac{3}{7}, \frac{-6}{7}$

117. The direction cosines of a line which lies in the ZOX plane and makes an angle of 30° with positive Z-axis are
a) $\pm\frac{1}{2}, 0, \pm\frac{\sqrt{3}}{2}$ b) $\pm\frac{\sqrt{3}}{2}, 0, \pm\frac{1}{2}$
c) $\pm\frac{1}{2}, 0, \pm\frac{\sqrt{3}}{4}$ d) $\pm\frac{\sqrt{3}}{4}, 0, \pm\frac{1}{2}$

118. If a line makes angle α, β, γ with the axes respectively, then $\cos 2\alpha + \cos 2\beta + \cos 2\gamma =$
a) -2 b) -1 c) 1 d) 2

119. The point of intersection of lines $\bar{r} = (2\hat{j} - 3\hat{k}) + \lambda(\hat{i} + 2\hat{j} + 3\hat{k})$ and $\bar{r} = (2\hat{i} + 6\hat{j} + 3\hat{k}) + \mu(2\hat{i} + 3\hat{j} + 4\hat{k})$ is
a) $(2, 6, 3)$ b) $(0, 2, -3)$
c) $(2, 3, 4)$ d) None of these

120. Lines $\bar{r} = (2\hat{i} - 3\hat{j} + 7\hat{k}) + \lambda(2\hat{i} + p\hat{j} + 5\hat{k})$ and $\bar{r} = (p\hat{i} + 2\hat{j} + 3\hat{k}) + \mu(3\hat{i} - p\hat{j} + p\hat{k})$ are perpendicular for all values of λ and μ if p is equal to
a) $1, -6$ b) $1, 6$ c) $-1, -6$ d) $-1, 6$

121. Equation of a line parallel to line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-1}{3}$ and passing through the point (1, 1, 1) is
a) $\frac{x-1}{1} = \frac{y-2}{1} = \frac{z-3}{1}$
b) $\frac{x-1}{1} = \frac{y-1}{1} = \frac{z-1}{1}$
c) $\frac{x-1}{1} = \frac{y-1}{2} = \frac{z-1}{3}$
d) $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$

122. The reflection of the point $(2, -1, 3)$ in the plane $3x - 2y - z = 9$ is
a) $\left(\frac{26}{7}, \frac{15}{7}, \frac{17}{7}\right)$ b) $\left(\frac{26}{7}, -\frac{15}{7}, \frac{17}{7}\right)$
c) $\left(\frac{15}{7}, \frac{26}{7}, -\frac{17}{7}\right)$ d) $\left(\frac{26}{7}, \frac{17}{7}, \frac{15}{7}\right)$

123. The equation of the line passing through (1, 2, 3) and parallel to the planes $x - y + 2z = 5$ and $3x + y + z = 6$, is
a) $\frac{x-1}{-3} = \frac{y-2}{5} = \frac{z-3}{4}$
b) $\frac{x-1}{-3} = \frac{y-2}{-5} = \frac{z-1}{4}$
c) $\frac{x-1}{-3} = \frac{y-2}{-5} = \frac{z-1}{-4}$
d) $\frac{x-1}{3} = \frac{y-2}{5} = \frac{z-3}{4}$

124. The points which provides the solution to the linear programming problem: Max $P = 2x + 3y$ subject to constraints: $x \geq 0, y \geq 0, 2x + 2y \leq 9, 2x + y \leq 8$, is
a) (3, 2, 5) b) (2, 3, 5) c) (2, 2, 5) d) (1, 3, 5)

125. The minimum value of $z = 6x + 7y$ subject to $5x + 8y \leq 40, 3x + y \leq 6, x \geq 0, y \geq 2$ is
a) 12 b) 14 c) 9 d) 16

126. Let $f(x) = \begin{cases} (1 + |\sin x|)^{\frac{a}{|\sin x|}}, -\frac{\pi}{6} < x < 0 \\ b, \ x = 0 \\ e^{\frac{\tan 2x}{\tan 3x}}, 0 < x < \frac{\pi}{6} \end{cases}$
Then the values of a and b if f is continuous at $x = 0$, are respectively
a) $\frac{2}{3}, \frac{3}{2}$ b) $\frac{2}{3}, e^{\frac{2}{3}}$
c) $\frac{3}{2}, e^{\frac{3}{2}}$ d) None of these

127. If $f(x) = \frac{(2^x - 1)^2}{\tan x . \log(1+x)}$ for $x \neq 0$,
$= \log 4$ for $x = 0$
a) Continuous at $x = 0$
b) Discontinuous at $x = 0$ but is removable
c) Discontinuous at $x = 0$ but it is non removable
d) None of these

128. If $f(x) = \begin{cases} x \sin x \ ; 0 < x \leq \frac{\pi}{2} \\ \frac{\pi}{2} \sin(\pi + x); \frac{\pi}{2} < x < \pi \end{cases}$, then:
a) $f(x)$ is discontinuous at $x = \frac{\pi}{2}$
b) $f(x)$ is continuous at $x = \frac{\pi}{2}$
c) $f(x)$ is continuous at $x = 0$
d) None of these

129. Let $g(x)$ be the inverse of the function $f(x)$ and $f'(x) = \frac{1}{1+x^3}$, then $g'(x)$ is equal to
a) $\frac{1}{1 + [g(x)]^3}$ b) $\frac{1}{1 + [f(x)]^3}$
c) $1 + [g(x)]^3$ d) $1 + [f(x)]^3$

130. If $y = (\sin x)^{\tan x}$, then $\frac{dy}{dx}$ is equal to
a) $(\sin x)^{\tan x} . (1 + \sec^2 x . \log \sin x)$
b) $\tan x . (\sin x)^{\tan x - 1} . \cos x$
c) $(\sin x)^{\tan x} . \sec^2 x . \log \sin x$
d) $\tan x . (\sin x)^{\tan x - 1}$

131. If $y = \frac{a^{\cos^{-1} x}}{1 + a^{\cos^{-1} x}}$ and $z = a^{\cos^{-1} x}$, then $\frac{dy}{dx} =$
a) $\frac{1}{1 + a^{\cos^{-1} x}}$ b) $-\frac{1}{1 + a^{\cos^{-1} x}}$
c) $\frac{1}{\left(1 + a^{\cos^{-1} x}\right)^2}$ d) None of these

132. The function $f(x) = |px - 9| + r|x|, x \in (-\infty, \infty)$ where $p > 0, q > 0, r > 0$ assumes its minimum value only at one point if
a) $p \neq q$ b) $q \neq r$
c) $r \neq p$ d) $p = q = r$

133. The set of all points for which $f(x) = x^2 e^{-x}$ strictly increases is
a) $(0, 2)$ b) $(2, \infty)$ c) $(-\infty, \infty)$ d) $(-2, 0)$

134. The function $f(x) = \tan^{-1}(\sin x + \cos x)$ is an increasing function in the interval
a) $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$ b) $\left(-\frac{\pi}{2}, \frac{\pi}{4}\right)$ c) $\left(0, \frac{\pi}{2}\right)$ d) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

135. If $\int f(x) \sin x \cos x \ dx = \frac{1}{2(b^2 - a^2)} \log[f(x)] + c$, then $f(x) =$
a) $\frac{1}{a^2 \sin^2 x + b^2 \cos^2 x}$ b) $\frac{1}{a^2 \sin^2 x - b^2 \cos^2 x}$
c) $\frac{1}{a^2 \cos^2 x - b^2 \sin^2 x}$ d) $\frac{1}{a^2 \cos^2 x + b^2 \sin^2 x}$

136. $\int x \sin^2 x \ dx =$

a) $\frac{x^2}{4}+\frac{x}{4}\sin 2x+\frac{1}{8}\cos 2x+c$

b) $\frac{x^2}{4}-\frac{x}{4}\sin 2x+\frac{1}{8}\cos 2x+c$

c) $\frac{x^2}{4}+\frac{x}{4}\sin 2x-\frac{1}{8}\cos 2x+c$

d) $\frac{x^2}{4}-\frac{x}{4}\sin 2x-\frac{1}{8}\cos 2x+c$

137. Let $\int \frac{x^2dx}{\sqrt{1-x}}=P(\sqrt{1-x})(3x^2+4x+8)$, then P =

a) $\frac{-2}{15}$ b) $\frac{-1}{15}$ c) $\frac{2}{15}$ d) $\frac{1}{15}$

138. $\int_0^{\pi/2} \frac{\sin^{\frac{3}{2}} x dx}{\cos^{\frac{3}{2}} x+\sin^{\frac{3}{2}} x}=$

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

139. $\int_0^1 \frac{\sin^{-1}\frac{x}{2}}{x}dx=$

a) $\int_0^{\frac{\pi}{6}} \frac{xdx}{\tan x}$ b) $\int_0^{\frac{\pi}{6}} \frac{2x}{\tan x}dx$

c) $\int_0^{\frac{\pi}{2}} \frac{2xdx}{\tan x}$ d) $\int_0^{\frac{\pi}{6}} \frac{xdx}{\sin x}$

140. The integral $\int_{-1}^{3}\left(\tan^{-1}\frac{x}{x^2+1}+\tan^{-1}\frac{x^2+1}{x}\right)dx=$

a) π b) 2π

c) 3π d) None of these

141. The area bounded by the curve $x=2-y-y^2$ and the Y-axis is

a) $\frac{5}{2}$ sq. units b) $\frac{7}{2}$ sq. units

c) $\frac{9}{2}$ sq. units d) $\frac{11}{2}$ sq. units

142. The area bounded by the X-axis, the curve $y=f(x)$ and the lines $x=1, x=b$ is equal to $\sqrt{b^2+1}-\sqrt{2}$ for all $b>1$, then $f(x)$ is

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

143. Area bounded by the curve $y=xe^{x^2}$, X-axis and the ordinates $x=0, x=a$, is

a) $\frac{e^{a^2}+1}{2}$ sq. units b) $\frac{e^{a^2}-1}{2}$ sq. units

c) $e^{a^2}+1$ sq. units d) $e^{a^2}-1$ sq. units

144. Solution of $\frac{dy}{dx}+2xy=y$ is

a) $y=ce^{x-x^2}$ b) $y=ce^{x^2-x}$

c) $y=ce^{x}$ d) $y=ce^{-x^2}$

145. The solution of $(\operatorname{cosec} x\log y)dy+(x^2y)dx=0$ is

a) $\frac{\log y}{2}+(2-x^2)\cos x+2\sin x=c$

b) $\left(\frac{\log y}{2}\right)^2+(2-x^2)\cos x+2x\sin x=c$

c) $\frac{(\log y)^2}{2}+(2-x^2)\cos x+2x\sin x=c$

d) None of these

146. The degree of the differential equation $\left(1+\left(\frac{dy}{dx}\right)^2\right)^{3/4}=\left(\frac{d^2y}{dx^2}\right)^{1/3}$ is

a) $\frac{1}{3}$ b) 4 c) 9 d) $\frac{3}{4}$

147. The following table represents a probability distribution for a random variable X:

X	1	2	3	4	5	6
$P(X=x)$	0.1	2k	k	0.2	3k	0.1

Then, the value of k is

a) 0.1 b) 0.2 c) 0.3 d) 0.4

148. If X is a random variable with probability distribution as given below:

X	0	1	2	3
P(X)	k	3k	3k	k

Then the value of k and its variance are

a) $\frac{1}{8},\frac{22}{27}$ b) $\frac{1}{8},\frac{23}{7}$ c) $\frac{1}{8},\frac{24}{27}$ d) $\frac{1}{8},\frac{3}{4}$

149. If A ={2, 4, 5}, B = {7, 8, 9}, then $n(A\times B)$ is equal to

a) 6 b) 9 c) 3 d) 0

150. Let R be a relation on N defined by $x+2y=8$. The domain of R is

a) {2, 4, 8} b) {2, 4, 6, 8}

c) {2, 4, 6} d) {1, 2, 3, 4}

Physics|Chemistry|Maths **Time:03 HRS**
Marks: 200

: ANSWER KEY :

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

: HINTS AND SOLUTIONS :

4 **(a)**

If body is projected with velocity $v(v < v_e)$ then height up to which it will rise, $h = \frac{R}{\left(\frac{v_e^2}{v^2}-1\right)}$

$v = \frac{v_e}{2}$ (Given)

$$\therefore h = \frac{R}{\left(\frac{v_e}{v_e/2}\right)^2 - 1} = \frac{R}{4-1} = \frac{R}{3}$$

5 **(a)**

$$F = \frac{Gm_1m_2}{R^2}$$

$$\therefore G = \frac{FR^2}{m_1m_2} = \frac{[M^1L^1T^{-2}]}{[M^2]} = [M^{-1}L^3T^{-2}]$$

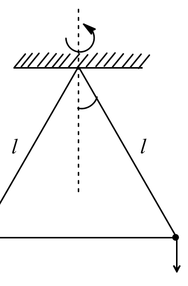
7 **(b)**

As the mass of disc is negligible, only the moment of inertia of five particles will be considered

$$I = \sum mr^2 = 5\,mr^2 = 5 \times 2 \times (0.1)^2 = 0.1\text{ kg} - m^2$$

9 **(c)**

$\tau = mg \times l \sin\theta$. (Direction parallel to plane of rotation of particle) as τ is perpendicular to $\vec{L}$, direction of L changes but magnitude remains same



10 **(d)**

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$\therefore T \propto \frac{1}{\sqrt{g}}$$

$$\frac{T'}{T}=\sqrt{\frac{g}{g'}}=\sqrt{\frac{g}{\left(\frac{g}{2}\right)}}=\sqrt{\frac{2}{1}}$$

$\therefore T'=\sqrt{2}T$

11 **(a)**

$$T=2\pi\sqrt{\frac{l}{g}}$$

$\therefore T\propto\sqrt{l}$, hence if l is made 9 times then T becomes 3 times

14 **(a)**

Longitudinal stress $=\frac{mg}{\pi r^2}$

$$=\frac{100\times10^{-3}\times9.8}{3.14\times(1\times10^{-3})^2}$$

$$=\frac{9.8\times10^{-1}}{3.14\times10^{-6}}=\frac{9.8}{3.14}\times10^5=3.1\times10^5 N/m^2$$

15 **(b)**

Surface energy should remain constant by law of conservation of energy. Hence, total surface area should be conserved, i.e.

$4\pi r_1^2+4\pi r_2^2=4\pi r^2$

Let $r_1=r_2=r\Rightarrow r^2+r^2=R^2$

$\therefore R=\sqrt{2}\,r=1.4\,r$

16 **(d)**

Work done = surface tension × change in surface area

$=T\times(2A-A)$

$=T\times A$

$=3\times10^{-3}\times1.3\times10^{-4}$

$=3.9\times10^{-7}$ J

19 **(a)**

When source is moving towards listener,

$$n_1=\frac{v\times n}{v-v_s}=\frac{300\times600}{300-200}=1800\text{ Hz}$$

When source is moving away from listener,

$$n_2=\frac{v\times n}{v+v_s}=\frac{300\times600}{300+200}=360\text{ Hz}$$

$\therefore$ Change in frequency $=n_1-n_2=1800-360$

$=1440$Hz

20 **(b)**

For closed organ pipe, only odd harmonics are present. Hence note of frequency 100 Hz will not be emitted as $100=2\times50$

21 **(c)**

$$n=\frac{1}{2l}\sqrt{\frac{T}{M}}\Rightarrow n\propto l^{-1}$$

$$\therefore \%\frac{\Delta n}{n}=-\frac{\Delta l}{l}\times100$$

$=-\Delta l=-1\%=1\%$ (In magnitude)

22 **(c)**

Critical hearing frequency for a person is 20,000 Hz

For a closed pipe vibrating in N^{th} mode, frequency of vibration

$$n_1=\frac{(2N-1)v}{41}=(2N-1)n$$

$\therefore 20{,}000=(2N-1)\times1500$

$\therefore N=7.1\approx7$

Also, in closed pipe,

Number of overtones = (Number of mode of vibration) – 1

$=7-1$

$=6$

24 **(a)**

$$v_{mean}=\frac{150+160+170+180+190}{5}$$

$$=\frac{850}{5}=170\text{ m/s}$$

$$v_{r.m.s.}=\sqrt{\frac{150^2+160^2+170^2+180^2+190^2}{5}}$$

$$=\sqrt{\frac{144500}{5}}=\sqrt{29100}=170.59\text{ m/s}$$

$$\therefore\frac{v_{r.m.s.}}{v_{mean}}=\frac{170.59}{170}\approx1$$

25 **(b)**

For a monoatomic gas, $\gamma=\frac{C_p}{C_v}=\frac{5}{3}$

Now, $\Delta Q=\mu C_P\Delta T$ ...(i)

and $\Delta U=\mu C_V\Delta T$ ...(ii)

$\therefore$ Dividing equation (ii) by equation (i),

$$\frac{\Delta U}{\Delta Q}=\frac{C_V}{C_P}=\frac{3}{5}$$

Hence, fraction of heat energy to increases the internal energy be $\frac{3}{5}$

27 **(b)**

$$\bar{v}=\frac{1}{\lambda}=\frac{1}{5000\times10^{-10}}=\frac{10^7}{5}=0.2\times10^7$$

$=2\times10^6$

28 **(b)**

$(n+1)\lambda_g=n\,\lambda_r$

$\therefore (n+1)\times5200=n\times6500$

$\therefore 52n+52=65n\Rightarrow n=4$

29 **(a)**

Fringe shift,

$$X_0=\frac{X}{\lambda}(\mu-1)t$$

$$=\frac{\beta}{(5000\times10^{-10})}(1.5-1)\times2\times10^{-6}$$

$=2\beta$

i.e., The central bright maximum will shift 2 fringes upwards

31 **(c)**

Initial charge on the capacitor $Q = 10 \times 12 = 120\ \mu C$

Final charge on the capacitor $Q' = (5 \times 10) \times 12 = 600\ \mu C$

$\therefore$ Charge supplied by the battery later $= Q' - Q = 480\ \mu C$

32 **(d)**

$V = \frac{Q}{C}$ But $Q = C_{eff} V$ ...(i)

$C_p = 3 + 6 + 3 = 12\ \mu F$

$\therefore C_s = C_{eff} = \frac{12 \times 2}{12 + 2} = \frac{24}{14} = \frac{12}{7}\ \mu F$

$\therefore Q = \frac{12}{7} \times 70 = 120\ \mu C$ ...[From (i)]

$\therefore V = \frac{120}{2} = 60\ V$

33 **(b)**

$V = I.R = \frac{e}{(R + R_h + r)} R$

$\therefore 10^{-3} = \frac{2}{(10 + R + 1)} \times 10$

$\therefore R = 19{,}989\ \Omega$

34 **(c)**

Manganin or constantan are used for making the potentiometer wire

35 **(a)**

Resistance between P and Q,

$$R_{PQ} = R || \left(\frac{R}{3} + \frac{R}{2}\right) = \frac{R \times \frac{5}{6}R}{\left(R + \frac{5}{6}R\right)} = \frac{5}{11}R$$

Resistance between Q and R,

$$R_{QR} = \frac{R}{2} || \left(R + \frac{R}{3}\right) = \frac{\frac{R}{2} \times \frac{4R}{3}}{\left(\frac{R}{2} + \frac{4R}{3}\right)} = \frac{4}{11}R$$

Resistance between P and R,

$$R_{PR} = \frac{R}{3} || \left(\frac{R}{2} + R\right) = \frac{\frac{R}{3} \times \frac{3R}{2}}{\left(\frac{R}{3} + \frac{3R}{2}\right)} = \frac{3}{11}R$$

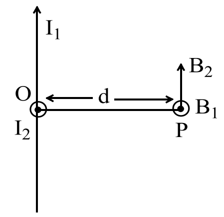
Hence it is clear that R_{PQ} is maximum

36 **(a)**

$\tau = NBIA = 100 \times 0.2 \times 2 \times (0.08 \times 0.1)$
$= 0.32 N\ m$

Direction is given by Fleming's left hand rule

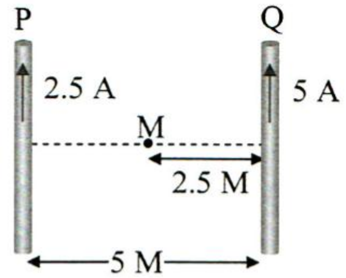
37 **(d)**



$B = \sqrt{B_1^2 + B_2^2} = \frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{1/2}$

38 **(d)**

In the figure, magnetic field at mid point M is given by,



$B_{net} = B_Q - B_P$

$= \frac{\mu_0}{4\pi} . \frac{2}{r}(I_Q - I_P)$

$= \frac{\mu_0}{4\pi} \times \frac{2}{2.5}(5 - 2.5) = \frac{\mu_0}{2\pi}$

39 **(c)**

Diamagnetic substances are repelled by magnetic field

42 **(a)**

$e = -\frac{n(B_2 - B_1)A\cos\theta}{t}$

$\therefore t$

$= \frac{-50 \times (0 - 2 \times 10^{-2}) \times 100 \times 10^{-4} \times \cos 0°}{0.1}$

$\therefore t = 0.1\ s$

44 **(b)**

Stopping potential is same for (a) and (b). Hence, their frequencies are same. Also maximum current values are different for (a) and (b). Hence, they will have different intensities

46 **(c)**

$R \propto (1)^{1/3}$

$\therefore R_{80} \propto (80)^{1/3}$ and $R_{10} \propto (10)^{1/3}$

$\therefore \frac{R_{80}}{R_{10}} = \left(\frac{80}{10}\right)^{1/3} = (8)^{1/3} = 2$

$\therefore R_{80} = 2 \times R_{10}$

$= 2 \times 3 \times 10^{-15} = 6 \times 10^{-15}\ m$

48 **(a)**

When NPN transistor is used as an amplifier, majority charge carrier electrons of N-type emitter move from emitter to base and then base to collector

51 **(c)**

In the fcc arrangement octahedral voids are present on the edge centres and tetrahedral voids are present on the body diagonals .hence $S_1$is octahedral void and S_2 is tetrahedral void.

52 **(c)**

In NaCI type solids, $\frac{r_c}{r_a} = 0.414$

$r_a = \frac{r_c}{0.414} = \frac{100}{0.414} = 241.5$ pm

55 **(d)**

Molecular wt. of $H_2C_2O_4 . 2H_2O$=126

$H_2C_2O_4 . 2H_2O$ is dibasic acid.gm. equivalent wt. is half of molecular wt.

58 **(a)**

$\pi = \frac{51.8}{76}$

$M = \frac{WRT}{\pi . V}$

59 **(b)**

$\Delta H = \Delta U + \Delta nRT$

In the reaction $PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$

$\Delta n = (1 + 1) - 1 = 1$

$\therefore \Delta H = \Delta U + RT \quad \therefore \Delta H > \Delta U$

60 **(a)**

Work done W = 4.545 kJ = 4545 J

$\Delta V = 22 - 8 = 14\ dm^3$

$= 14 \times 10^{-3}\ m^3$

$W = P\Delta V$

$= \frac{W}{\Delta V} = \frac{4545}{14 \times 10^{-3}}$

$P = 3.03 \times 10^5\ Nm^{-2}$

61 **(b)**

In water (H – O – H), there are two O – H bonds. Therefore energy released when one mole of water is formed = 2y J.

67 **(c)**

$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{30} = 2.31 \times 10^{-2} min^{-1}$

68 **(a)**

$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{480} = 1.44 \times 10^{-3} S^{-1}$

82 **(b)**

When the both cation and the anion are complex ion, co-ordination Isomerism arises due to interchange of Ligands within the co-ordination sphere.

86 **(d)**

Ethers are represented as R-O-R'

90 **(c)**

$6CH_2O + 4NH_3 \rightarrow (CH_2)_6N_4 + 6H_2O$

Urotropine/
Hexamethylene tetraamine

92 **(c)**

$CH_3CH_2NH_2 + (CH_3CO)_2O$
$\rightarrow CH_3CH_2NHCOCH_3 + CH_3COOH$

101 **(c)**

For every rational number $x \in S$ satisfies $x \leq 0$

102 **(a)**

Contrapositive of $p \rightarrow q$ is $\sim q \rightarrow \sim p$

103 **(b)**

$\sim [p \rightarrow (p \vee (\sim q))]$

$\equiv \sim [\sim p \vee (p \vee (\sim q))]$

$\equiv p \wedge \sim [p \vee (\sim q)]$

$\equiv p \wedge (\sim p \wedge q)$

105 **(d)**

We have, $\begin{bmatrix} 1 & 1 & 1 \\ 1 & -2 & -2 \\ 1 & 3 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 3 \\ 4 \end{bmatrix}$

$x + y + z = 0$

$x - 2y - 2z = 3$

$x + 3y + z = 4$

On solving, $x = 1, y = 2, z = -3$ i.e., $\begin{bmatrix} 1 \\ 2 \\ -3 \end{bmatrix}$

106 **(a)**

$\begin{bmatrix} a & 1 & 1 \\ 1 & a & 1 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

Applying $R_1 \rightarrow R_1 - R_3$,

$\begin{bmatrix} a-1 & 0 & 0 \\ 1 & a & 1 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

$\therefore (a - 1)x + 0 + 0 = 0$

$\therefore a - 1 = 0 \Rightarrow a = 1$

107 **(a)**

$\tan 3x = \cot x \Rightarrow \tan 3x = \tan\left(\frac{\pi}{2} - x\right)$

$\therefore 3x = n\pi + \frac{\pi}{2} - x \Rightarrow 4x = n\pi + \frac{\pi}{2}$

$\therefore x = \frac{n\pi}{4} + \frac{\pi}{8} = (2n + 1)\frac{\pi}{8}$

108 **(a)**

$$\theta = \tan \sqrt{\frac{a(a+b+c)}{bc}} + \tan^{-1} \sqrt{\frac{b(a+b+c)}{ca}} + \tan^{-1} \sqrt{\frac{c(a+b+c)}{ab}}$$

let $s^2 = \frac{a+b+c}{abc}$

hence,

$\theta = \tan^{-1}\sqrt{a^2s^2} + \tan^{-1}\sqrt{b^2s^2} + \tan^{-1}\sqrt{c^2s^2}$

$= \tan^{-1}(as) + \tan^{-1}(bs) + \tan^{-1}(cs)$

$= \tan^{-1}\left[\frac{as + bs + cs - abcs^3}{1 - abs^2 - acs^2 - bcs^2}\right]$

Hence, $\tan\theta = \left[\frac{s[(a+b+c)-abcs^2]}{1-(ab+bc+ca)s^2}\right]$

$= \left[\frac{s(a+b+c)-(a+b+c)}{1-s^2(ab+bc+ca)}\right]$

$= 0,$

[Since $s^2(abc) = (a+b+c)$]

Trick: Since it is an identity, so it will be true for any value of a, b, c. Let $a = b = c = 1$, then $\theta = \tan^{-1}\sqrt{3} + \tan^{-1}\sqrt{3} + \tan^{-1}\sqrt{3} = \pi \Rightarrow \tan\theta = 0$

109 **(a)**

We know $\frac{5^x+5^{-x}}{2} \geq 1$, (using A.M. ≥ G.M.)

Since, $\cos(e^x) \leq 1$

So, there does not exist any solution4

110 **(c)**

$a = 2; h = \frac{-5}{2}; b = 3; g = 4, f = -\frac{9}{2}, c = 6$

The point of intersection is given by

$\left(\frac{hf-bg}{ab-h^2}, \frac{gh-af}{ab-h^2}\right) \equiv (3,4)$

111 **(d)**

$x^2 - 2nxy - y^2 = 0$ ...(i)

$x^2 - 2mxy - y^2 = 0$ ...(i)

Equation of bisectors of angle between pair of straight lines (i) is $\frac{x^2-y^2}{1+1} = \frac{xy}{-n}$

$\therefore nx^2 - ny^2 = -2xy$ ...(iii)

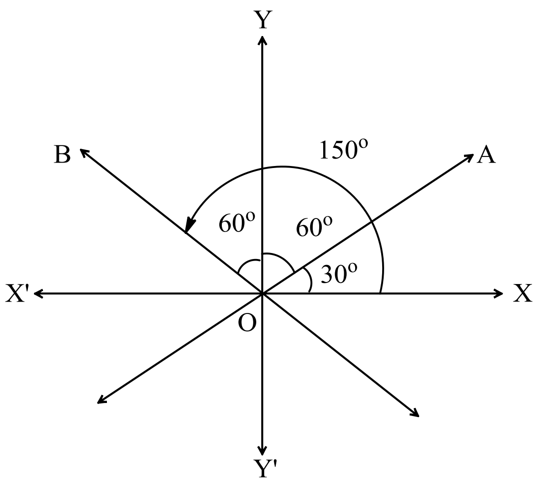
Since, equation (ii) and (iii) represents same pair of straight lines

$\therefore \frac{1}{n} = \frac{-2m}{2} = \frac{1}{n}$

$\therefore \frac{1}{n} = \frac{m}{-1}$

$\therefore mn + 1 = 0$

112 **(a)**



Let OA and OB be the required lines

∴ angles made by OA and OB with X-axis are 30° and 150° respectively

∴ their equations are $y = \frac{1}{\sqrt{3}}x$ and $y = -\frac{1}{\sqrt{3}}x$

i.e., $x - \sqrt{3}y = 0$ and $x + \sqrt{3}y = 0$

∴ the joint equations of the lines is

$(x - \sqrt{3}y)(x + \sqrt{3}y) = 0$

$\Rightarrow x^2 - 3y^2 = 0$

113 **(c)**

Volume of tetrahedron is $\frac{1}{6}[\overrightarrow{AB} \cdot \overrightarrow{AC} \times \overrightarrow{AD}]$

Now $\overrightarrow{AB} = 2\hat{i} - 9\hat{j} - \hat{k}, \overrightarrow{AC} = -7\hat{i} - 2\hat{j} + 2\hat{k},$

$\overrightarrow{AD} = -2\hat{i} - 5\hat{j} - \hat{k}$

$\therefore \overrightarrow{AB}.\overrightarrow{AC} \times \overrightarrow{AD} = \begin{vmatrix} 2 & -9 & -1 \\ -7 & -2 & 2 \\ -2 & -5 & -1 \end{vmatrix}$

$= 2(2+10) + 9(7+4) - 1(35-4) = 92$

∴ Volume of tetrahedron $= \frac{1}{6}(92)$

$= \frac{46}{3}$ cubic units

114 **(a)**

We have, $\bar{p} = \overrightarrow{AC} + \overrightarrow{BD}$

$= \overrightarrow{AC} + \overrightarrow{BC} + \overrightarrow{CD}$

$= \overrightarrow{AC} + \lambda\overrightarrow{AD} + \overrightarrow{CD}$

$= \lambda\overrightarrow{AD} + (\overrightarrow{AC} + \overrightarrow{AD})$

$= \lambda\overrightarrow{AD} + \overrightarrow{AD}$

$= (\lambda + 1)\overrightarrow{AD}$

Therefore $\bar{p} = \mu\overrightarrow{AD} \Rightarrow \mu = \lambda + 1$

115 **(a)**

Here $\overrightarrow{AB} = \bar{b} - \bar{a}$ and

$\overrightarrow{AC} = (3\bar{a} - 2\bar{b}) - (\bar{a}) = -2(\bar{b} - \bar{a})$

Therefore, it is of the form $\overrightarrow{AB} = m\overrightarrow{AC}$

Hence A, B, C are collinear

116 **(b)**

Let $\bar{r} = 6\hat{i} - 2\hat{j} - 3\hat{k}$

$|\bar{r}| = \sqrt{6^2 + (-2)^2 + (-3)^2} = \sqrt{49} = 7$

∴ direction cosines are $\frac{x}{r}, \frac{y}{r}, \frac{z}{r}$

i.e., $\frac{6}{7}, \frac{-2}{7}, \frac{-3}{7}$

117 **(a)**

Let l, m, n be the direction cosines of the required line. Since the line lies in ZOX plane, the required line makes an angle 90° with Y-axis. Since it makes 30° with positive Z-axis, it makes 60° with X-axis

$\therefore \cos 60° = \pm\frac{1}{2}, \cos 90° = 0, \cos 30° = \pm\frac{\sqrt{3}}{2}$

The direction cosines of the required line are

$\pm\frac{1}{2}, 0, \pm\frac{\sqrt{3}}{2}$

118 **(b)**

$\cos 2\alpha + \cos 2\beta + \cos 2\gamma$

$= 2\cos^2\alpha - 1 + 2\cos^2\beta - 1 + 2\cos^2\gamma - 1$

$= 2(\cos^2\alpha + \cos^2\beta + \cos^2\gamma) - 3$

$= 2(1) - 3 = -1$

119 **(a)**

Line $L_1: \bar{r} = (2\hat{j} - 3\hat{k}) + \lambda(\hat{i} + 2\hat{j} + 3\hat{k})$

Line $L_2: \bar{r} = (2\hat{i} + 6\hat{j} + 3\hat{k}) + \mu(2\hat{i} + 3\hat{j} + 4\hat{k})$

L_1 and L_2 can be written in Cartesian from as

$L_1: \frac{x}{1} = \frac{y-2}{2} = \frac{z+3}{3} = \lambda$ and

$L_2: \frac{x-2}{2} = \frac{y-6}{3} = \frac{z-3}{4} = \mu$

$\therefore$ any point on L_1 is $(\lambda, 2 + 2\lambda, -3 + 3\lambda)$

any point on L_2 is $(2 + 2\mu, 6 + 3\mu, 3 + 4\mu)$

At the point of intersection,

$\lambda = 2 + 2\mu \Rightarrow \lambda - 2\mu = 2$ ....(i)

$2 + 2\lambda = 6 + 3\mu \Rightarrow 2\lambda - 3\mu = 4$ ....(ii)

and $-3 + 3\lambda = 3 + 4\mu$

$\Rightarrow 3\lambda - 4\mu = 6$ ....(iii)

Solving (i) and (ii), we get

$\mu = 0, \lambda = 2$. This holds true for equation (iii)

$\therefore$ The point of intersection is (2, 6, 3)

120 **(d)**

The given lines are perpendicular,

$\therefore 2.3 + p.(-p) + 5 \cdot p = 0$

$\Rightarrow 6 - p^2 + 5p = 0$

$\Rightarrow p^2 - 5p - 6 = 0$

$\Rightarrow (p-6)(p+1) = 0$

$\Rightarrow p = 6$ or $p = -1$

121 **(c)**

The required line is parallel to line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-1}{3}$

Hence the direction ratios of the required line are 1, 2, 3

$\therefore$ the equation of required line which passes through (1, 1, 1) is

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

123 **(a)**

$$\bar{n} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 2 \\ 3 & 1 & 1 \end{vmatrix} = -3\hat{i} + 5\hat{j} + 4\hat{k}$$

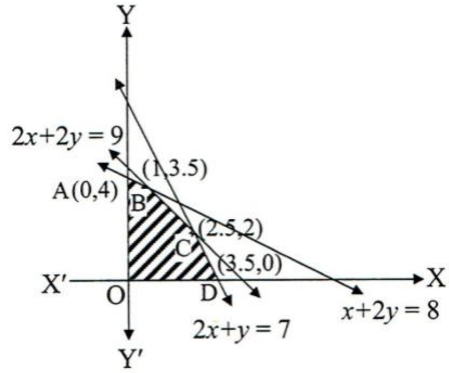
$\therefore$ D.r.s of line are $-3, 5, 4$

$\therefore$ The equation of a line passing through (1, 2, 3) and having drs $-3, 5, 4$ is

$$\frac{x-1}{-3} = \frac{y-2}{5} = \frac{z-3}{4}$$

124 **(d)**

Given, $P = 2x + 3y$ Graph has been shown by given constraints and maximum value of P can be on A or B or C or D



$P_A = P_{(0,4)} = 2(0) + 3(4) = 12$

$P_B = P_{(1,3.5)} = 2 \times 1 + 3 \times 3.5 = 12.5$

$P_C = P_{(2.5,2)} = 2 \times 2.5 + 3 \times 2 = 11$

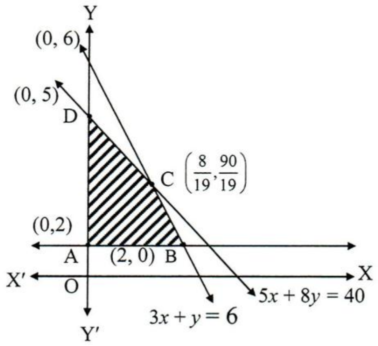
$P_D = P_{(3.5,0)} = 2 \times 3.5 + 3 \times 0 = 7$

$\therefore$ At B (1,3.5), $P_{max} = 12.5$

125 **(b)**

$A(0,2), B\left(\frac{4}{3}, 2\right), C\left(\frac{8}{19}, \frac{10}{19}\right), D(0,5)$

Are the corner points of the feasible region



$z(0,2) = 14$

$z\left(\frac{4}{3}, 2\right) = 22$

$z\left(\frac{8}{19}, \frac{10}{19}\right) = \frac{678}{19}$

$z(0,5) = 35$

$\therefore$ Min $z = 14$ at $A(0,2)$

127 **(b)**

$$\lim_{x \to 0} \frac{(2^x - 1)^2}{x^2} \times \frac{1}{\frac{\tan x}{x}} \times \frac{1}{\frac{\log(1+x)}{x}}$$

$$= (\log 2)^2 \times 1 \times \frac{1}{\log e} = (\log 2)^2$$

But $f(0) = \log 4$, If we redefine $f(0) = (\log 2)^2$ then this discontinuity is removable

128 **(a)**

$$\lim_{x \to \frac{\pi}{2}^-} f(x) = \lim_{x \to \frac{\pi}{2}} x \sin x = \frac{\pi}{2}$$

$$\lim_{x \to \frac{\pi}{2}^+} f(x) = \lim_{x \to \frac{\pi}{2}} \frac{\pi}{2} \sin(\pi + x) = \frac{-\pi}{2}$$

129 **(c)**

since, $g(x)$ is the inverse of $f(x)$

$\therefore fog(x) = x \forall x$

$\Rightarrow \frac{d}{dx}[fog(x)] = \frac{d}{dx}(x) \forall x$

$\Rightarrow f'[g(x)].g'(x) = 1 \forall x$

$\Rightarrow \frac{1}{1+[g(x)]^3}.g'(x) = 1 \forall x$

$\Rightarrow g'(x) = 1 + [g(x)]^3 \forall x$

130 **(a)**

$y = (\sin x)^{\tan x}$

Taking logarithm on both sides, we get

$\log y = \tan x . \log \sin x$

Differentiating w.r.t. x, we get

$\frac{1}{y}.\frac{dy}{dx} = \tan x . \cot x + \log \sin x . \sec^2 x$

$\Rightarrow \frac{dy}{dx} = (\sin x)^{\tan x}[1 + \sec^2 x \log \sin x]$

131 **(c)**

$y = \frac{a^{\cos^{-1}x}}{1+a^{\cos^{-1}x}}$ and $z = a^{\cos^{-1}x} \Rightarrow y = \frac{z}{1+z}$

$\Rightarrow \frac{dy}{dx} = \frac{(1+z)1 - z(1)}{(1+z)^2} = \frac{1}{(1+z)^2}$

$= \frac{1}{\left(1+a^{\cos^{-1}x}\right)^2}$

132 **(d)**

$f(x) = |px - 9| + r|x|, x \in (-\infty, \infty)$

Where $p > 0, q > 0$ and $r > 0$ can assume its minimum value only at one point, if $p = q = r$

133 **(a)**

$f'(x) = 2xe^{-x} - x^2 e^{-x} = xe^{-x}(2 - x)$

Since, f is increasing, $f'(x) > 0$

$\Rightarrow xe^{-x}(2 - x) > 0 \Rightarrow x(2 - x) > 0$

$\Rightarrow x > 0, 2 - x > 0$ or $x < 0, 2 - x < 0$

$\Rightarrow x > 0, 2 > x$ or $x < 0, 2 < x$

$\Rightarrow 0 < x < 2$ or $2 < x < 0$ (Not possible)

$\Rightarrow 0 < x < 2 \Rightarrow x \in (0, 2)$

136 **(d)**

$\int x \sin^2 x \, dx = \int x\left(\frac{1-\cos 2x}{2}\right)dx$

$= \frac{1}{2}\left[\int x \, dx - \int x . \cos 2x \, dx\right]$

$= \frac{1}{2}\left[\frac{x^2}{2} - \frac{x \sin 2x}{2} + \int \frac{\sin 2x}{2}dx\right]$

$= \frac{x^2}{4} - \frac{x}{4}\sin 2x - \frac{1}{8}\cos 2x + c$

137 **(a)**

Let $I = \int \frac{x^2 dx}{\sqrt{1-x}}$

Put $1 - x = t^2 \Rightarrow dx = -2tdt$

$\therefore I = -2\int \frac{(1-t^2)^2 \, tdt}{t} = -2\int (1-t^2)^2 \, dt$

$= -2\int (1 + t^4 - 2t^2) \, dt$

$= -2\left[t + \frac{t^5}{5} - \frac{2t^3}{3}\right]$

$= -2t\left[\frac{15 + 3t^4 - 10t^2}{15}\right]$

$= \frac{-2}{15}\sqrt{1-x}[15 + 3(1-x)^2 - 10(1-x)]$

$= \frac{-2}{15}\sqrt{1-x}(3x^2 + 4x + 8)$

$\therefore P = \frac{-2}{15}$

138 **(d)**

Let $I = \int_0^{\pi/2} \frac{\sin^{\frac{3}{2}} x dx}{\cos^{\frac{3}{2}} x + \sin^{\frac{3}{2}} x}$ ...(i)

$= \int_0^{\pi/2} \frac{\sin^{\frac{3}{2}}\left(\frac{\pi}{2} - x\right)}{\cos^{\frac{3}{2}}\left(\frac{\pi}{2} - x\right) + \sin^{\frac{3}{2}}\left(\frac{\pi}{2} - x\right)}dx$

$= \int_0^{\pi/2} \frac{\cos^{\frac{3}{2}} x dx}{\sin^{\frac{3}{2}} x + \cos^{\frac{3}{2}} x}$ ...(ii)

Adding (i) and (ii), we get

$I = \frac{1}{2}\int_0^{\pi/2} dx = \frac{1}{2}[x]_0^{\pi/2} = \frac{\pi}{4}$

139 **(a)**

Let $I = \int_0^1 \frac{\sin^{-1}\left(\frac{x}{2}\right)}{x}dx$

Put $\sin^{-1}\left(\frac{x}{2}\right) = t \Rightarrow x = 2\sin t \Rightarrow dx = 2\cos t dt$

$\therefore I = \int_0^{\frac{\pi}{6}} \frac{t}{(2\sin t)}(2\cos t \, dt)$

$= \int_0^{\frac{\pi}{6}} \frac{t}{\tan t}dt = \int_0^{\frac{\pi}{6}} \frac{x}{\tan x}dx$

140 **(b)**

$\int_{-1}^{3}\left\{\tan^{-1}\left(\frac{x}{x^2+1}\right) + \tan^{-1}\left(\frac{x^2+1}{x}\right)\right\}dx$

$= \int_{-1}^{3}\left\{\tan^{-1}\left(\frac{x}{x^2+1}\right) + \cot^{-1}\left(\frac{x}{x^2+1}\right)\right\}dx$

$= \int_{-1}^{3} \frac{\pi}{2}dx = 2\pi$

142 **(d)**

$\int_1^b f(x) \, dx = \sqrt{b^2+1} - \sqrt{2}$

$= \sqrt{b^2+1} - \sqrt{1+1}$

$= \left[\sqrt{x^2+1}\right]_1^b$

$\therefore f(x) = \frac{d}{dx}\sqrt{x^2+1} = \frac{2x}{2\sqrt{x^2+1}} = \frac{x}{\sqrt{x^2+1}}$

143 **(b)**

Required area is $= \int_0^a y\, dx = \int_0^a x e^{x^2}\, dx$

Put $x^2 = t \Rightarrow x\, dx = \frac{dt}{2}$

As $x = 0 \Rightarrow t = 0$ and $x = a \Rightarrow t = a^2$

$\therefore$ required area $= \frac{1}{2}\int_0^{a^2} e^t\, dt$

$= \frac{1}{2}[e^t]_0^{a^2}$

$= \frac{e^{a^2}-1}{2}$ sq. units

144 **(a)**

$\frac{dy}{dx} + 2xy = y \Rightarrow \frac{dy}{dx} = y(1-2x)$

Integrating on both sides, we get

$\int \frac{dy}{y} = \int (1-2x)\, dx + c_1$

$\Rightarrow \log y = x - x^2 + c_1$

$\Rightarrow y = e^{x-x^2}.e^{c_1}$

$\Rightarrow y = c.e^{x-x^2}$, where $c = e^{c_1}$

145 **(c)**

$(\operatorname{cosec} x \log y)dy + (x^2 y)dx = 0$

$\Rightarrow \frac{1}{y}\log y dy = -x^2 \sin x dx$

On integrating both sides, we get

$\frac{(\log y)^2}{2} + \left[x^2(-\cos x) + \int 2x \cos x dx\right] = c$

$\Rightarrow \frac{(\log y)^2}{2} - x^2\cos x + 2(x\sin x + \cos x) = c$

$\Rightarrow \frac{(\log y)^2}{2} + (2-x^2)\cos x + 2x\sin x = c$

146 **(b)**

$\left[1\left(\frac{dy}{dx}\right)^2\right]^{3/4} = \left(\frac{d^2y}{dx^2}\right)^{1/3}$

$\Rightarrow \left[1+\left(\frac{dy}{dx}\right)^2\right]^9 = \left(\frac{d^2y}{dx^2}\right)^4$

Clearly, degree is 4

147 **(a)**

We have,

$0.1 + 2k + k + 0.2 + 3k + 0.1 = 1$

$\therefore 6k = 1 - 0.4 = 0.6$

$\therefore k = \frac{0.6}{6} = 0.1$

148 **(d)**

The sum of all the probability distribution is unity

$\therefore k + 3k + 3k + k = 1$

$\Rightarrow 8k = 1$

$\Rightarrow k = \frac{1}{8}$

x_i	p_i	$x_i p_i$	$x_i^2\, p_i$
0	$\frac{1}{8}$	0	0
1	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$
2	$\frac{3}{8}$	$\frac{6}{8}$	$\frac{12}{8}$
3	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{9}{8}$
		1.5	3

Variance $= E(X^2) - [E(X)]^2 = 3 - (1.5)^2 - \frac{3}{4}$