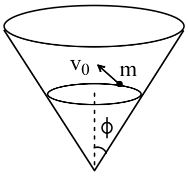
1. The force required to keep a body in uniform circular motion is
a) Centripetal force b) Centrifugal force
c) Frictional force d) Breaking force

2. Consider an object of mass m that moves in a circular orbit with constant velocity v_0 along the inside of a cone. Assume the wall of the cone to be frictionless. Find radius of the orbit



a) $\frac{{v_0}^2}{g}\tan^2\phi$ b) $\frac{{v_0}^2}{g}\cos^2\phi$
c) $\frac{{v_0}^2}{g}\tan\phi$ d) $\frac{{v_0}^2}{g}$

3. A body moves along circular path of radius 50 m and the coefficient of friction is 0.4. What should be its angular velocity in rad/s if it is not to slip from the surface? ($g = 9.8\ m/s^2$)
a) 2.8 b) 0.28 c) 0.27 d) 2.7

4. If the distance between two bodies is doubled, the force of gravitational attraction between them
a) Becomes four times
b) Is doubled
c) Is reduced to one-fourth
d) Is reduced to half

5. If the earth were to stop rotating, the value of acceleration due to gravity at Mumbai will
a) Increase b) Decrease
c) Become zero d) Remain unchanged

6. The binding energy of a body does not depend upon
a) Mass of the planet
b) Its distance from the centre of the planet
c) Mass of the body
d) Shape of the body

7. Four point masses, each of value m, are placed at the corners of a square ABCD of side l. The moment of inertia of this system about an axis passing through A and parallel to BD is
a) $\sqrt{3}ml^2$ b) $3ml^2$ c) ml^2 d) $2\ ml^2$

8. On account of melting of ice at the north pole, the moment of inertia of spinning earth
a) Increases b) Decreases
c) Remains unchanged d) Depends on the time

9. A hollow sphere of mass 'M' and radius 'R' is rotating with angular frequency 'ω'. If suddenly stops rotating and 75% of kinetic energy is converted to heat. If 'S' is the specific heat of the material in J/kg K then rise in temperature of the sphere is (M.I. of hollow sphere $= \frac{2}{3}MR^2$)
a) $\frac{R\omega}{4S}$ b) $\frac{R^2\omega^2}{4S}$ c) $\frac{R\omega}{2S}$ d) $\frac{R^2\omega^2}{2S}$

10. Starting from the origin, a body oscillates simple harmonically with a period of 2s. After what time will its kinetic energy be 75% of the total energy?
a) $\frac{1}{4}s$ b) $\frac{1}{3}s$ c) $\frac{1}{12}s$ d) $\frac{1}{6}s$

11. A second's pendulum is placed in a space laboratory orbiting around the earth at a height 3R, where R is the radius of the earth. The time period of the pendulum is
a) Zero b) $2\sqrt{3}$ s c) 4 s d) Infinite

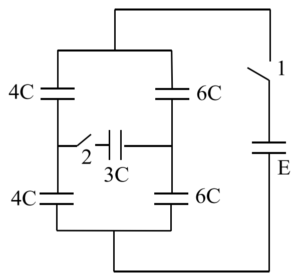
12. If the length of a simple pendulum is comparable to the radius of the earth, then find the time period for oscillation
a) $2\pi\sqrt{\frac{L}{g}}$ b) $2\pi\sqrt{\frac{1}{g\left(\frac{1}{L}+\frac{1}{R}\right)}}$
c) $2\pi\sqrt{\frac{R}{g}}$ d) $2\pi\sqrt{\frac{L+R}{g}}$

13. A catapault is stretched with a force of 100 N which changes the length of the band from 10 cm to 14 cm. A stone of mass 1 kg is fixed to the catapault and aimed at a mango. Find the velocity with which it will leave the catapault
a) 1 m/s b) 1 cm/s c) 2 m/s d) 2 cm/s

14. The Poisson's ratio cannot have the value
a) 0.7 b) 0.2 c) 0.1 d) 0.5

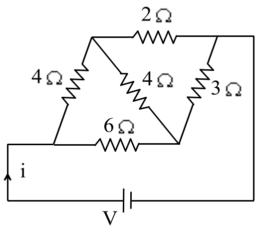
15. A glass tube of internal diameter 3.5 cm and thickness 0.5 cm is held vertically with its lower end immersed in water. The downward pull on the tube due to surface tension (S.T. of water = 0.074 N/m) is
a) $1.86 \times 10^{-2}N$ b) $1.86 \times 10^{-3}N$
c) $1.86 \times 10^{-1}N$ d) 1.86 N

16. If T is the surface tension, the work done in blowing a soap bubble of radius R is
a) $4\pi R^2T$ b) $\frac{4}{3}\pi R^3T$ c) $8\pi R^2T$ d) $\frac{4\pi R^2}{T}$
17. Angle of contact with a solid surface does not depend on
a) Angle between solid and liquid surfaces
b) The nature of liquid and solid
c) The nature of solid surface
d) Medium of the liquid surface
18. When two sound waves with a phase difference of $\pi/2$ and each having amplitude A and frequency ω are superimposed on each other, then the maximum amplitude and frequency of resultant wave is
a) $\frac{A}{\sqrt{2}}:\frac{\omega}{2}$ b) $\frac{A}{\sqrt{2}}:\omega$ c) $\sqrt{2}A:\frac{\omega}{2}$ d) $\sqrt{2}A:\omega$
19. Two sound waves with wavelengths 5.0 m and 5.5 m respectively, each propagate in a gas with velocity 330 m/s. We expect the following number of beats per second
a) 1 b) 6 c) 12 d) 0
20. In resonance,
a) The energy released by the vibrating body is maximum
b) Energy absorbed by the vibrating body is maximum
c) Neither energy is absorbed by the vibrating body nor energy is released
d) Energy form does not evolved
21. Node is that point in longitudinal stationary waves where pressure
a) Difference is maximum
b) Is maximum
c) Is minimum
d) Difference is minimum
22. If we study the vibration of a pipe open at both ends, then which of the following statements is not true?
a) Open end will be antinode
b) Odd harmonics of the fundamental frequency will be generated
c) All harmonics of the fundamental frequency will be generated
d) Pressure change will be maximum at both ends
23. The value of wavelength of maximum energy by a blackbody is inversely proportional to the absolute temperature. This law is
a) Stefan's law b) Wien's law
c) Kirchoff's law d) Newton's law
24. Mean kinetic energy (or average energy) per gm molecule of a monoatomic gas is given by
a) $\frac{3}{2}RT$ b) $\frac{1}{2}k_BT$ c) $\frac{1}{2}RT$ d) $\frac{3}{2}k_BT$
25. The molar heat capacity in a process of a diatomic gas, if it does a work of $\frac{Q}{4}$ when a heat of Q is supplied to it, is
a) $\frac{2}{5}R$ b) $\frac{5}{2}R$ c) $\frac{10}{3}R$ d) $\frac{6}{7}R$
26. The refractive index of glass w.r.t a medium is $\frac{4}{3}$. If $v_m - v_g = 6.25 \times 10^7 m/s$, then the velocity of light in the medium will be
a) $2.15 \times 10^8 m/s$ b) $2.5 \times 10^8 m/s$
c) $2.25 \times 10^8 m/s$ d) $1.5 \times 10^8 m/s$
27. Unpolarized light falls on two polarizing sheets placed one on top of the other. What must be the angle between the characteristic directions of the sheets if the intensity of the final transmitted light is one-third the maximum intensity of the first transmitted beam?
a) 75° b) 55° c) 35° d) 15°
28. Monochromatic light of wavelength 600 nm is used in a Young's double slit experiment. One of the slits is covered by a transparent sheet of thickness 18 μm made of a material of refractive index 1.6. The number of fringes that shift due to the introduction of the sheet is
a) 18 b) 10 c) 20 d) 8
29. Intensity of two waves which produce interference are 100 : 1. The ratio of maximum and minimum intensities is
a) 121 : 81 b) 100 : 1 c) 101 : 99 d) 100 : 99
30. If the ratio of intensities of two waves is 1: 25, then the ratio of their amplitudes will be
a) 1 : 25 b) 5 : 1 c) 26 : 24 d) 1 : 5
31. A capacitor of 20 μF charged up to 500 volts in connected in parallel with another capacitor of 10 μF which is charged up to 200 V. The common potential is
a) 500 V b) 400 V c) 300 V d) 200 V
32. Calculate the energy stored in the 6C capacitor when Switch-1 is closed. Switch-2 is closed now. Find the energy stored in the 3C capacitor (in S.I. units)



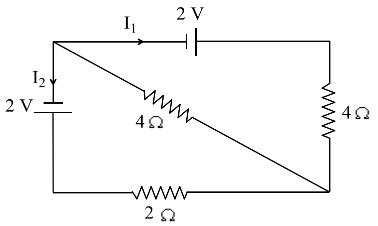
a) Zero b) 12 c) 15 d) 18

33. For the network shown in the figure, the value of the current i is



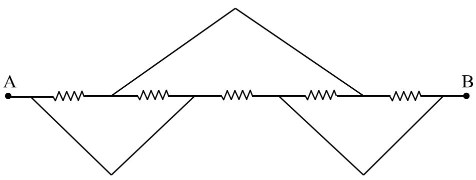
a) $\frac{9V}{35}$ b) $\frac{5V}{18}$ c) $\frac{5V}{9}$ d) $\frac{18V}{5}$

34. In the given circuit diagram, the internal resistance of the cell is negligible. The ratio of the currents I_2/I_1 is



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

35. Resistors, each of value 2 Ω, are arranged as shown in figure. The equivalent resistance between points A and B is



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

36. The deflection in a moving coil galvanometer falls from 50 divisions to 10 divisions, when a shunt of 12 Ω is connected across it. The resistance of the galvanometer is

a) 24 Ω b) 36 Ω c) 60 Ω d) 48 Ω

37. A 200 turn rectangular coil measuring 0.02 m × 0.08 m of an ammeter is in a magnetic field of induction 0.2 tesla. The torsional constant of the suspension fibre is 5×10^{-7} newton × metre/degree. The maximum reading of the ammeter corresponds to a deflection of the coil through 45°. If the magnetic field is radial, then the maximum current that can be measured with this ammeter is

a) 3.5×10^{-4} A b) 1.75×10^{-4} A
c) 7.0×10^{-4} A d) 14.0×10^{-4} A

38. A long wire carrying a steady current is bent into a single coil such that magnetic induction at centre is B. then same wire is bent to form a coil of smaller radius of n turns when magnetic induction at centre is B'. Then

a) $B' = B$ b) $B' = nB$ c) $B' = n^2B$ d) $B = n^2B'$

39. A neutral point in the magnetic field is a point, where

a) Magnetic moment of the magnet is balanced by the magnetic field of the earth
b) Magnetic field due to the magnet is zero
c) Magnetism is strongest
d) Earth's magnetic field is exactly neutralised by the field due to the magnet

40. Temperature above which a ferromagnetic substance becomes paramagnetic is called

a) Critical temperature b) Boyle's temperature
c) Debye's temperature d) Curie temperature

41. When the current changes from +2 A to −2 A in 0.05 second, an e. m. f. of 8 volt is induced in a coil. The coefficient of self induction of the coil is

a) 0.1 H b) 0.2 H c) 0.4 H d) 0.6 H

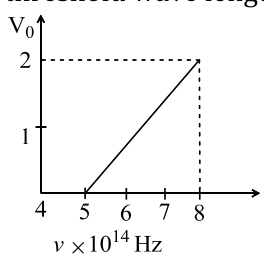
42. In a circuit L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is

a) $\frac{1}{2\pi f(2\pi fL + R)}$ b) $\frac{1}{\pi f(2\pi fL + R)}$
c) $\frac{1}{2\pi f(2\pi fL - R)}$ d) $\frac{1}{\pi f(2\pi fL - R)}$

43. Relation between the stopping potential V_0 of a metal and the maximum velocity of the photoelectrons is

a) $V_0 \propto \frac{1}{v}$ b) $V_0 \propto \frac{1}{v^2}$ c) $V_0 \propto v^2$ d) $V_0 = v$

44. The stopping potential (V_0) versus frequency (v) plot of a substance is shown in figure. The threshold wave length is

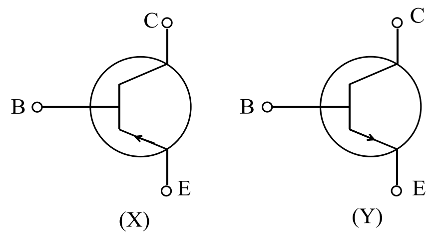


a) 5×10^{14}m
b) 6000Å
c) 5000 Å
d) Can not be estimated from given data

45. According to Bohr's postulates, which of the following quantities takes discrete values?
a) Kinetic energy b) Angular momentum
c) Potential energy d) Linear momentum

46. If the nuclear radius of ^{27}Al is 3.6 Fermi, the approximate nuclear radius of ^{64}Cu in Fermi is
a) 2.4 b) 1.2 c) 4.8 d) 3.6

47. Which of the following represents standard symbols for transistors?



a) Both represent p-n-p transistor
b) Both represent n-p-n transistor
c) X represents p-n-p transistor and Y represents n-p-n transistor
d) X represents n-p-n transistor and Y represents p-n-p transistor

48. The maximum wavelength which a photodiode can detect with $E_g = 0.74$ eV is,
a) 1680 nm b) 1764 nm c) 1847 nm d) 1932 nm

49. A blue glass plate is kept below sodium lamp, its colour will be ______.
a) White b) Yellow
c) Blue d) Black

50. Hypermetropia can be corrected using ______.
a) Concave lens b) Concave mirror c) Concave lens d) Convex mirror

51. In a closest rock-salt structure (edge length, a), which of the following expressions is correct?
a) $r_a=\sqrt{2}a$ b) $r_a=\frac{a}{\sqrt{2}}$ c) $r_a=\frac{a}{2\sqrt{2}}$ d) $r_a=\frac{a}{4}$

52. Which of the following fcc structure contains cations in alternate tetrahedral voids?
a) NaCl b) ZnS c) Na_2O d) CaF_2

53. Which of the following lattices does not have only primitive Bravais lattice?
a) Lattice with unit cell monoclinic
b) Lattice with unit cell trigonal
c) Lattice with unit cell triclinic
d) Lattice with unit cell hexagonal

54. The number of octahedral sites per sphere in fcc structure is
a) 2 b) 1 c) 4 d) 3

55. 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

56. Which statement is wrong regarding osmotic pressure (P), volume (V) and temperature (T)?
a) $P \propto \frac{1}{V}$ if T is constant
b) $P \propto T$ if V is constant
c) $P \propto V$ if T is constant
d) PV is constant if T is constant

57. The elevation in boiling point of a solution of 10 g of a binary electrolyte(molecular mass 100) in 100 g of water is ΔT_b. The value of K_b for water is
a) $\frac{\Delta T_b}{2}$ b) 10 c) $10\,\Delta T_b$ d) $\frac{\Delta T_b}{10}$

58. At 300 K when a solute is added to a solvent its vapour pressure over the mercury reduces from 50mm to 45mm. The value of mole fraction of solute will be
a) 0.005 b) 0.010 c) 0.100 d) 0.900

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. Which of the following is an intensive property?
a) Enthalpy b) Mass
c) Temperature d) Volume

61. The enthalpy of bond dissociation of $H_{2(g)}$, $C1_{2(g)}$ and $HC1_{(g)}$ are104, 58 and 103 kcal · mol^{-1} respectively. The enthalpy of formation of $HC1_{(g)}$ will be
a) -44 kcal · mol^{-1} b) -4.4 kcal · mol^{-1}
c) -22 kcal · mol^{-1} d) -220 kcal · mol^{-1}

62. For a reaction R_1, ΔG = xkJ mol^{-1}. For a reaction R_2, ΔG = ykJ mol^{-1}. Reaction R_1 is non-spontaneous but along with R_2 it is spontaneous. This means that
a) x is negative, y is positive but in magnitude x > y
b) x is positive, y is negative but in magnitude y

> x

c) Both x and y are negative but not equal

d) Both x and y are positive but not equal

63. The e.m.f. of the following cell,

$$Zn\left|\begin{matrix}ZnSO_4\\(1M)\end{matrix}\right|\left|\begin{matrix}H^+\\(1M)\end{matrix}\right|\begin{matrix}H_2\\(g, 1\ atm)\end{matrix}|Pt \quad \text{is } 0.769 \text{ volts.}$$

The reduction potential of Zn electrode will be

a) Zero volt b) 0.769 V

c) -0.769 V d) -7.69 V

64. In a cell containing zinc electrode and hydrogen electrode, the zinc electrode acts as

a) Anode b) Cathode

c) Null electrode d) Either (a) or (b)

65. Which of the following ions will move towards anode during electrolysis of fused NaOH?

a) Na^+ ions b) H^+ ions

c) OH^- ions d) O^{2-} ions

66. The e.m.f. of the cell depends upon

a) Temperature

b) Nature of electrodes

c) Concentration of ions in solution

d) All of these

67. The rate constant of a reaction depends on

a) Initial concentration of the reactants

b) Time of reaction

c) Temperature

d) Extent of reaction

68. The Arrhenious equation is

a) $A = ke^{-E_a/RT}$ b) $\frac{A}{k} = e^{-E_a/RT}$

c) $k = Ae^{E_a/RT}$ d) $k = Ae^{-RT/E_a}$

69. The overall rate of a reaction is governed by

a) The rate of the fastest intermediate step

b) The rate of the slowest intermediate step

c) The sum total of the rates of all the intermediate steps

d) The average of the rates of all the intermediates steps

70. The principal reducing agent in the metallurgy of iron is ___________.

a) Aluminium b) Carbon

c) Carbon monoxide d) Carbon dioxide

71. For which of the following polling is used?

a) Reducing metal oxide

b) Oxidising metal to oxide

c) Oxidising impurities

d) Reducing metal sulphate to metal sulphide

72. Which method is not correct for refining of crude metals?

a) Zone refining : Silicon

b) Mond process : Aluminium

c) Electrolytic refining : Blister copper

d) Liquation : Tin

73. Which of the following leaves no residue on heating?

a) $Pb(NO_3)_2$

b) NH_4NO_3

c) $Cu(NO_3)_2$

d) $NaNO_3$

74. Cl_2O_7 can be regarded as an anhydride of

a) Hypochlorous acid b) Chlorous acid

c) Chloric acid d) Per chloric acid

75. Oxygen molecule shows:

a) Paramagnetism b) Dimagnetism

c) Ferro magnetism d) Ferri magnetism

76. Which of the following B) d Block Elements - Characteristics Of Transition Metals is associated with their catalytic activity?

a) High heat of atomisation

b) Paramagnetic behavior

c) Colour of hydrated ions

d) Variable oxidation states

77. Find out the smallest ion from those given below.

a) Gd^{+3} b) Sm^{+3} c) Yb^{+3} d) Ce^{+3}

78. Which is the strongest base among

a) $La(OH)_3$ b) $Lu(OH)_3$ c) $Ce(OH)_3$ d) $Yb(OH)_3$

79. The compounds $[Cr(H_2O)_6]Cl_3$ and $[Cr(H_2O)5C_1]Cl_2 . H_2O$ are example of

a) Linkage Isomerism

b) Hydrate Isomerism

c) Ionisation Isomerism

d) Co-ordination Isomerism

80. Which of the following complexes can form d and *l* isomers?

a) $[Co(NH_3)_3Cl_3]$

b) $[Co(NH_3)_4]^{+2}$

c) $Cis[Co(en)_2Cl_2]^+$

d) $Trans[Co(en)Cl_2]$

81. The compound which is not an organometallic compound is

a) C_6H_5MgBr b) $C_6H_5Ti(OC_3H_7)_2$

c) Both (a) and (b) d) $Ti(OC_2H_5)_4$

82. The complex ion $[Cu(NH_3)_4]^{2+}$ is

a) Square planer and diamagnetic

b) Square planer and paramagnetic

c) Tetrahedral and diamagnetic

d) Tetrahedral and paramagnetic

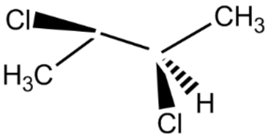
83. The value of Stability constant depends upon

a) The charge on the central metal ion

b) Nature of the ligand
c) Chelation
d) All of the above

84. A mixture of equal parts of (+) and (-) enantiomers is called
a) Homogeneous mixture
b) Equilibrium mixture
c) Racemic mixture
d) Resonance hybrid

85. The correct statements about the compound given below is



a) The compound is optically active
b) The compound possesses centre of symmetry
c) The compound possesses plane of symmetry
d) The compound possesses axis of symmetry

86. The general formula of monohydric phenol is
a) CH_3CH_2-OH b) Ar-OH
c) Ar-X d) Ar-CHO

87. Corresponding to alkanes ethers are their
a) Alkyl derivative b) Dialkyl derivative
c) Alkoxyderivative d) Trialkyl derivative

88. Clemmensen's reduction will convert cyclohexanone into
a) n-hexane b) Benzene
c) Cyclohexane d) Cyclohexanol

89. Isopropyl methyl ketone when treated with Zn-Hg and concentrated hydrochloric acid give
a) Iso-butane b) Iso-pentane
c) n-pentane d) Neo-pentane

90. Which of the following are function isomers?
a) CH_3CHO and CH_3COCH_3
b) CH_3COCH_3 and C_2H_5CHO
c) HCHO and CH_3OH
d) CH_3COCH_3 and CH_3OCH_3

91. Amines are more basic than
a) Alcohols b) NaOH c) LiOH d) KOH

92. Possible isomers of C_3H_9N are
a) Three b) Four c) Five d) Six

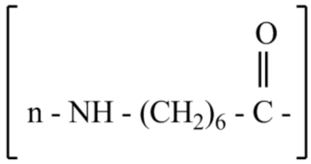
93. The following compound on reaction with HNO_2 gives an alcohol
a) RNH_2 b) $R - CONH_2$
c) R_2NH d) R_3N

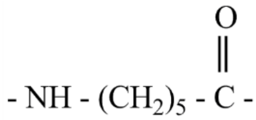
94. Which one of the following compound contains nitrogen?
a) Proteins b) Carbohydrates
c) Oils d) Fats

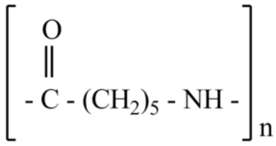
95. The number of chiral carbon atom present in a glucose molecule is
a) 16 b) 8 c) 4 d) 2

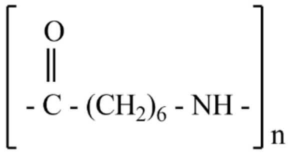
96. Natural silk is a
a) Polyester b) Polyamide
c) Polyacid d) Polysaccharide

97. Polymer nylon -6 is shown as

a)


b)


c)


d)


98. Which one of the following is used to make non stick cook ware
a) PVC
b) Polystyrene
c) Polyethylene
d) Polytetrafluoro ethylene

99. The adsorption of hydrogen by metals is called
a) Adsorption b) occlusion
c) Hydrogenation d) dehydrogenation

100. Only one element of _____ forms hydride
a) Group 6 b) Group 7
c) Group 8 d) Group 9

101. Which of the following is a tautology
a) $p \rightarrow (p \wedge q)$ b) $q \wedge (p \rightarrow q)$
c) $\sim (p \rightarrow q) \leftrightarrow p \wedge \sim q$ d) $(p \wedge q) \leftrightarrow \sim q$

102. The statement $\sim (p \leftrightarrow \sim q)$ is
a) A tautology
b) A fallacy
c) Equivalent to $p \leftrightarrow q$
d) Equivalent to $\sim p \leftrightarrow q$

103. When the compound statement is true for all its components then the statement is called
a) Negation statement
b) Tautology statement
c) Contradiction statement
d) Contingency statement

104. The inverse of $\begin{bmatrix} 1 & 2 & 4 \\ 3 & -19 & 7 \\ 2 & 4 & 8 \end{bmatrix}$ is

a) $\begin{bmatrix} 1 & 1 & 1 \\ 3 & 9 & 7 \\ 2 & 1 & 8 \end{bmatrix}$ b) $\begin{bmatrix} 1 & 1 & 1 \\ 19 & 7 & 8 \\ 2 & 1 & 3 \end{bmatrix}$

c) $\begin{bmatrix} 3 & 1 & 4 \\ 1 & 2 & 3 \\ 4 & 5 & 8 \end{bmatrix}$ d) Does not exist

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

a) $\mathrm{A}(z) = \mathrm{A}(x) + \mathrm{A}(y)$ b) $\mathrm{A}(z) = \mathrm{A}(x)[\mathrm{A}(y)]^{-1}$

c) $\mathrm{A}(z) = \mathrm{A}(x)\mathrm{A}(y)$ d) $\mathrm{A}(z) = \mathrm{A}(x) - \mathrm{A}(y)$

106. If A and B are two square matrices such that $\mathrm{B} = -\mathrm{A}^{-1}\mathrm{BA}$, then $(\mathrm{A}+\mathrm{B})^2 =$

a) 0 b) $\mathrm{A}^2 + \mathrm{B}^2$

c) $\mathrm{A}^2 + 2\mathrm{AB} + \mathrm{B}^2$ d) A + B

107. $\tan(\cos^{-1} x)$ is equal to

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

108. If $\mathrm{a} = 9, \mathrm{b} = 8$ and $\mathrm{c} = x$ satisfies $3\cos \mathrm{C} = 2$, then

a) $x = 5$ b) $x = 6$ c) $x = 4$ d) $x = 7$

109. In ΔABC, cosec A(sin B cos C + cos B sin C) =

a) c/a b) a/c c) 1 d) c/ab

110. If the angle between the pair of straight lines represented by the equation $x^2 - 3xy + \lambda y^2 + 3x - 5y + 2 = 0$ is $\tan^{-1}\left(\frac{1}{3}\right)$, where 'λ' is a non-negative real number. Then λ is

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

111. The acute angle formed between the lines joining the origin to the points of intersection of the curve $x^2 + y^2 - 2x - 1 = 0$ and the line $x + y = 1$ is

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

c) $\tan^{-1}\frac{1}{2}$ d) 60°

112. $x^2 + \mathrm{k}_1 y^2 + 2\mathrm{k}_2 y = \mathrm{a}^2$ represents of pair of perpendicular straight lines if

a) $\mathrm{k}_1 = 1, \mathrm{k}_2 = \mathrm{a}$ b) $\mathrm{k}_1 = 1, \mathrm{k}_2 = -\mathrm{a}$

c) $\mathrm{k}_1 = -1, \mathrm{k}_2 = \pm\mathrm{a}$ d) $\mathrm{k}_1 = 1, \mathrm{k}_2 = \pm\mathrm{a}$

113. The position vector of the point which divides internally in the ratio 2 : 3, the join of the points $2\bar{a} - 3\bar{b}$ and $3\bar{a} - 2\bar{b}$, is

a) $\frac{12}{5}\bar{a} + \frac{13}{5}\bar{b}$ b) $\frac{12}{5}\bar{a} - \frac{13}{5}\bar{b}$

c) $\frac{3}{5}\bar{a} - \frac{2}{5}\bar{b}$ d) $\frac{2}{5}\bar{a} - \frac{3}{5}\bar{b}$

114. 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) $(\bar{c} \times \bar{a}).\bar{b} = 1$

115. Three points whose position vectors $\bar{a} + \bar{b}, \bar{a} - \bar{b}$ and $\bar{a} + \mathrm{k}\,\bar{b}$ are said to be collinear, then the value of k is

a) Zero

b) Only negative real number

c) Only positive real number

d) Every real number

116. The direction cosines of a vector $\bar{r}$ which is equally inclined with axes are

a) 1,1,1 b) $-\frac{4}{\sqrt{3}}, -\frac{4}{\sqrt{3}}, -\frac{4}{\sqrt{3}}$

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

117. If the angle between the lines whose direction ratios are $2, -1, 2$ and a, 3, 5 be 45°, then a =

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

118. If a line makes angles of 30° and 45° with X-axis and Y-axis, then the angle made by it with Z-axis is

a) 45° b) 60°

c) 120° d) No real value

119. Perpendicular distance of point (1, 2, 3) from the line $\frac{x-6}{3} = \frac{y-7}{2} = \frac{z-7}{-2}$ is

a) 8 b) 6 c) 7 d) 5

120. Equation of a line passing through the point with position vector $2\hat{\imath} - 3\hat{\jmath} + 4\hat{k}$ and in the direction of the vector $3\hat{\imath} + 4\hat{\jmath} - 5\hat{k}$ is

a) $4x + 3y = 17, 5y - 4z = 1$

b) $4x - 3y = 17, 5y + 4z = 1$

c) $4x + 5y = 12, 3y + 4z = 1$

d) $4x + 3z = 17, 5y + 4z = 1$

121. The shortest distance between lines $\bar{r} = (1-t)\hat{\imath} + (t-2)\hat{\jmath} + (3-t)\hat{k}$ and $\bar{r} = (s+1)\hat{\imath} + (2s-1)\hat{\jmath} - (2s+1)\hat{k}$ is

a) $\frac{1}{\sqrt{2}}$ b) $\frac{7}{\sqrt{2}}$

c) $\frac{3}{\sqrt{2}}$ d) None of these

122. 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) $2x + 6y + 12z = -13$

123. The sine of the angle between the straight line

$\frac{x-2}{3}=\frac{y-3}{4}=\frac{z-4}{5}$ and the plane $2x-2y+z=5$ is

a) $\frac{10}{6\sqrt{5}}$ b) $\frac{4}{5\sqrt{2}}$ c) $\frac{\sqrt{2}}{10}$ d) $\frac{2\sqrt{3}}{5}$

124. Inequation $y-x\le 0$ represents
a) The half plane that contains the positive X-axis
b) Closed half plane above the line $y=x$, which contains positive Y-axis
c) Half plane that contains the negative X-axis
d) None of these

125. The graph of $x\le 2$ and $y\ge 2$ will be lies in the
a) First and second quadrant
b) Second and third quadrant
c) First and third quadrant
d) Third and fourth quadrant

126. If $f(x)=\begin{cases}2 & ; 0\le x<1\\ c-2x ; & 1\le x\le 2\end{cases}$, is continuous at $x=1$, then c equals
a) 2 b) 4 c) 0 d) 1

127. If $f(x)=\begin{cases}1+x^2, \text{when } 0\le x\le 1\\ 1-x, \quad \text{when } x>1\end{cases}$, then
a) $\lim_{x\to 1^+} f(x)\ne 0$
b) $\lim_{x\to 1^-} f(x)\ne 2$
c) $f(x)$ is discontinuous at $x=1$
d) None of these

128. The function $f(x)=\frac{|3x-4|}{3x-4}$ is discontinuous at
a) $x=4$ b) $x=\frac{3}{4}$ c) $x=\frac{4}{3}$ d) $\frac{2}{3}$

129. If $y=\tan^{-1}\left[\frac{\log ex}{\log\frac{e}{x}}\right]+\tan^{-1}\left[\frac{8-\log x}{1+8\log x}\right]$, then $\frac{d^2y}{dx^2}$ is
a) 1 b) $\frac{1}{2}$ c) -1 d) 0

130. If $x=\sin t\cos 2t$ and $y=\cos t\sin 2t$, then at $t=\frac{\pi}{4}$, the value of $\frac{dy}{dx}$ is equal to
a) -2 b) 2 c) $\frac{1}{2}$ d) $-\frac{1}{2}$

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. The displacement of a particle in time t is given by $s=2t^2-3t+1$. The acceleration is
a) 1 b) 3 c) 4 d) 5

133. The diagonal of a square is changing at the rate of 0.5 cm/sec. Then the rate of change of area, when the area is 400 cm^2, is equal to
a) $20\sqrt{2}\ cm^2/sec$ b) $10\sqrt{2}\ cm^2/sec$
c) $\frac{1}{10\sqrt{2}}\ cm^2/sec$ d) $\frac{10}{\sqrt{2}}\ cm^2/sec$

134. The function f defined by $f(x)=4x^4-2x+1$ is increasing for
a) $x<1$ b) $x>0$ c) $x<\frac{1}{2}$ d) $x>\frac{1}{2}$

135. $\int\left[\frac{1}{\log x}-\frac{1}{(\log x)^2}\right]dx=$
a) $\frac{1}{\log x}+c$ b) $\frac{x}{\log x}+c$
c) $\frac{x}{(\log x)^2}+c$ d) None of these

136. $\int\frac{1}{\cos^6 x+\sin^6 x}dx=$
a) $\tan^{-1}(\tan x-\sec x)+c$
b) $\tan^{-1}(\sec x-\tan x)+c$
c) $\sec^{-1}(\tan x-\cot x)+c$
d) $\tan^{-1}(\tan x-\cot x)+c$

137. The value of $\int\frac{1}{(x-5)^2}dx$ is
a) $\frac{1}{x-5}+c$ b) $-\frac{1}{x-5}+c$
c) $\frac{2}{(x-5)^3}+c$ d) $-2(x-5)^3+c$

138. If $\int_0^{2a}f(x)dx=2\int_0^a f(x)dx$, then
a) $f(2a-x)=-f(x)$ b) $f(2a-x)=f(x)$
c) $f(a-x)=-f(x)$ d) $f(a-x)=f(x)$

139. $\int_0^{\pi/6}(2+3x^2)\cos 3x\,dx=$
a) $\frac{1}{36}(\pi+16)$ b) $\frac{1}{36}(\pi-16)$
c) $\frac{1}{36}(\pi^2-16)$ d) $\frac{1}{36}(\pi^2+16)$

140. The value of $I=\int_0^{\pi/2}\frac{(\sin x+\cos x)^2}{\sqrt{1+\sin 2x}}dx$ is
a) 3 b) 1 c) 2 d) 0

141. The ratio of the areas bounded by the curves $y=\cos x$ and $y=\cos 2x$ between $x=0, x=\frac{\pi}{2}$ and X-axis, is
a) $\sqrt{2}:1$ b) $1:1$ c) $1:2$ d) $2:1$

142. The area common to the parabola $y=2x^2$ and $y=x^2+4$ is
a) $\frac{32}{3}$ b) $\frac{2}{32}$ c) $\frac{2}{3}$ d) $\frac{3}{2}$

143. Area included between the curves $y=x^2-3x+2$ and $y=-x^2+3x-2$ is
a) $\frac{1}{6}$ sq. unit b) $\frac{1}{2}$ sq. unit
c) 1 sq. unit d) $\frac{1}{3}$ sq. unit

144. The order and degree of the differential

equation $\left(\frac{d^2y}{dx^2}\right)^{1/3} + \left(x + \frac{dy}{dx}\right)^{1/2} = 0$ are

a) $O = 2, D = 2$ b) $O = 2, D = \frac{1}{3}$

c) $O = \frac{1}{3}, D = 2$ d) $O = 2, D = 3$

145. If $xdy = y(dx + ydy), y > 0$ and $y(1) = 1$, then $y(-3)$ is equal to

a) 1 b) 3 c) 5 d) -1

146. Solution of the equation $xdy - [y + xy^3(1 + \log x)]dx =$

a) $-\frac{x^2}{y^2} = \frac{2x^3}{3}\left(\frac{2}{3} + \log x\right) + c$

b) $\frac{x^2}{y^2} = \frac{2x^3}{3}\left(\frac{2}{3} + \log x\right) + c$

c) $-\frac{x^2}{y^2} = \frac{x^3}{3}\left(\frac{2}{3} + \log x\right) + c$

d) None of these

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

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

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

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

148. If the p.d.f of a c.r.v X is

$f(x) = K.e^{-0x}$; $\theta > 0, 0 \le x < \infty$

$= 0$; otherwise

Then K =

a) i b) $\frac{\theta}{2}$ c) θ d) 2θ

149. If the vertex of a parabola be at origin and directrix be $x + 5 = 0$, then length of its latus rectum is

a) 5 b) 10

c) 20 d) 40

150. If the latus rectum of an ellipse be equal to half of its minor axis, then its eccentricity is

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

: ANSWER KEY :

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

: HINTS AND SOLUTIONS :

3 **(b)**

Using,

$v = \sqrt{\mu rg} = \sqrt{0.4 \times 50 \times 9.8} = \sqrt{196}$

$v = 14\ m/s$

$\omega = \frac{v}{r} = \frac{14}{50} = 0.28\ rad/s$

4 **(c)**

$r' = 2r$ .....[Given]

Now, $F \propto \frac{1}{r^2}$

$\therefore F' \propto \frac{1}{(2r)^2} = \frac{1}{4r^2} \Rightarrow F' = \frac{F}{4}$

∴ Force is reduced to one-fourth

5 **(a)**

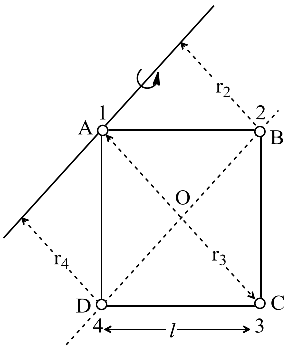
When the earth stops rotating, the centripetal force of $mR\omega^2$ vanishes. As a result of this, the acceleration due to gravity increases

7 **(b)**

$r_2 = r_4 = OA = \frac{1}{\sqrt{2}}$ and $r_2 = l\sqrt{2}$

Moment of inertia of the system about given axis,

$I = I_1 + I_2 + I_3 + I_4$



$\Rightarrow I = 0 + m(r_2)^2 + m(r_3)^2 + m(r_4)^2$

$\Rightarrow I = m\left(\frac{l}{\sqrt{2}}\right)^2 + m\left(l\sqrt{2}\right)^2 + m\left(\frac{l}{\sqrt{2}}\right)^2$

$\therefore I = 3ml^2$

9 **(b)**

Rotational K.E. of sphere $= \frac{1}{2} I\, \omega^2$
75% of K.E. = Heat energy
$\therefore \frac{1}{2} I\omega^2 \times \frac{75}{100} = MS\Delta\theta$
$\frac{1}{2} \times \frac{2}{3} MR^2\omega^2 \times \frac{75}{100} = MS\Delta\theta \quad \left[\because I_{sp} = \frac{2}{3} MR^2\right]$
$\frac{R^2\omega^2}{4S} = \Delta\theta$

10 **(d)**
Total energy of particle performing S.H.M. $= \frac{1}{2} m\omega^2 A^2$. Kinetic energy of particle performing S.H.M. $= \frac{1}{2} m\omega^2 A^2 \cos^2\left(\frac{2\pi}{T}\right) t$
According to problem, kinetic energy = 75% of total energy
$\Rightarrow \frac{1}{2} m\omega^2 A^2 \cos^2\left(\frac{2\pi}{T}\right) t = \frac{3}{4}\left(\frac{1}{2} m\omega^2 A^2\right)$
$\Rightarrow \cos^2\left(\frac{2\pi}{T}\right) t = \frac{3}{4} \Rightarrow \cos\left(\frac{2\pi}{T}\right) t = \frac{\sqrt{3}}{2}$
$\Rightarrow \left(\frac{2\pi}{T}\right) t = \frac{\pi}{6} \Rightarrow t = \frac{T}{12} s$
$\therefore t = \frac{1}{6} s$

11 **(d)**
In the given case, effective acceleration $g_{eff} = 0$
$\therefore T = \infty$

15 **(a)**
$F = T \times (2\pi\, r_1 + 2\pi r_2)$
$= T \times 2\pi \times (1.75 + 2.25) \times 10^{-2}$
$= 0.074 \times 2 \times 3.14 \times 4 \times 10^{-2}$
$= 1.86 \times 10^{-2}$ N

16 **(c)**
W = T × Surface area of bubble
Since the soap bubble has two surfaces,
$W = T \times 2 \times 4\pi R^2 = 8\pi R^2 T$

18 **(d)**
$A_{max} = \sqrt{A^2 + A^2} = A\sqrt{2}$, frequency will remain same i.e. ω

19 **(b)**
Using, $v = n\lambda$ or $n = \frac{v}{\lambda}$ we get,
$n_1 = \frac{v}{\lambda_1} = \frac{330}{5} = 66$Hz
and $n_2 = \frac{v}{\lambda_2} = \frac{330}{5.5} = 60$Hz
Number of beats per second,
$n_1 - n_2 = 66 - 60 = 6$

22 **(d)**
The air column in a pipe open at both ends can vibrate in a number of different modes subjected to the boundary condition that there must be an antinode at the open end. Hence option (A) is correct
The ratio of frequencies when pipe is open at both the ends is given as,
n: 2 n: 3 n: 4 n: 5 n
where $n = \frac{v}{2L}$
∴ Both odd as well even i.e., All harmonics are present
Hence, option (B) and (C) are correct
Pressure variation is minimum at antinode
∴ Option (D) is incorrect

25 **(c)**
$dU = C_v dT = \left(\frac{5}{2} R\right) dT$
$\therefore dT = \frac{2(dU)}{5R}$
From first law of thermodynamics,
$dU = dQ - dW = Q - \frac{Q}{4} = \frac{3Q}{4}$
∴ Molar heat capacity, $c = \frac{dQ}{dT} = \frac{Q}{\left(\frac{2(dU)}{5R}\right)}$
$= \frac{5RQ}{2\left(\frac{3Q}{4}\right)} = \frac{10}{3} R$

26 **(b)**
${}_m\mu_g = \frac{\mu_g}{\mu_m} = \frac{v_m}{v_g} = \frac{4}{3}$
$\therefore \frac{v_m - v_g}{v_g} = \frac{4-3}{3} = \frac{1}{3}$
Given that, $v_m - v_g = 6.25 \times 10^7$
$\therefore v_g = 3 \times 6.25 \times 10^7$ m/s
$\therefore v_m = 6.25 \times 10^7 + 3 \times 6.25 \times 10^7$
$\therefore = 4 \times 6.25 \times 10^7 = 25 \times 10^7 = 2.5 \times 10^8$ m/s

27 **(b)**
$I' = \frac{I}{2} \cos^2\theta = \frac{I}{6}$
$\therefore \cos\theta = \frac{1}{\sqrt{3}} \quad \therefore \theta = 55°$

28 **(a)**
$\lambda = 600$ nm $= 600 \times 10^{-9}$m
$t = 18\ \mu$m $= 18 \times 10^{-6}$m
$S = (\mu - 1)\frac{tD}{d}$ ...(i)
Fringe width,
$X = \frac{\lambda D}{d}$ ...(ii)
∴ From equations (i) and (ii),
$S = \frac{(\mu - 1)t.X}{\lambda}$
∴ No. of fringes $= \frac{S}{X} = \frac{(\mu-1)t}{\lambda}$
$= \frac{(1.6 - 1) \times 18 \times 10^{-6}}{600 \times 10^{-9}}$

$= \frac{0.6 \times 18 \times 10^3}{600} = 18$

29 **(a)**

$\frac{I_1}{I_2} = \frac{a_1^2}{a_2^2} = \frac{100}{1}$

$\therefore \frac{a_1}{a_2} = \frac{10}{1} \Rightarrow \frac{a_1 + a_2}{a_1 - a_2} = \frac{11}{9}$

$\therefore \frac{I_{max}}{I_{min}} = \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2 = \left(\frac{11}{9}\right)^2 = \frac{121}{81}$

30 **(d)**

$\frac{I_1}{I_2} = \frac{1}{25}$

$\therefore \frac{a_1^2}{a_2^2} = \frac{1}{25}$ ...[$\because I \propto a^2$]

$\therefore \frac{a_1}{a_2} = \frac{1}{5}$

31 **(b)**

Common potential $= \frac{C_1V_1 + C_2V_2}{C_{eff.}}$

$= \frac{20 \times 10^{-6} \times 500 + 10 \times 10^{-6} \times 200}{20 \times 10^{-6} + 10 \times 10^{-6}}$

$= \frac{12000}{30} = 400\ V$

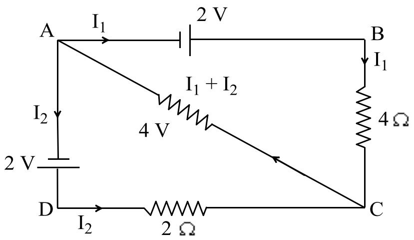
33 **(b)**

The given network is a balanced Wheatstone bridge. It's equivalent resistance will be

$R = \frac{18}{5}\Omega$

$\therefore i = \frac{V}{R} = \frac{V}{18/5} = \frac{5V}{18}$

34 **(c)**



Applying Kirchhoff's voltage law to ABCA,

$2 - 4I_1 - 4(I_1 + I_2) = 0$ ...(i)

Applying Kirchhoff's voltage law to ADCA,

$2 - 2I_2 - 4(I_1 + I_2) = 0$ ...(ii)

Subtracting equation (ii) from equation (i),

$-4I_1 + 2I_2 = 0$

$\therefore 2I_2 = 4I_1 \Rightarrow I_2/I_1 = 2$

36 **(d)**

$S = 12\ \Omega = \frac{G}{n-1}, n = \frac{50}{10} = 5$

$\therefore S = \frac{G}{n-1} = \frac{G}{5-1} = \frac{G}{4}$

$\therefore G = 4\ S = 4 \times 12 = 48\ \Omega$

37 **(a)**

$I = \frac{C\theta}{nAB} = \frac{5 \times 10^{-7} \times 45}{200 \times 0.02 \times 0.08 \times 0.2}$

$\therefore I = 3.5 \times 10^{-4}\ A$

41 **(a)**

$|e| = L\frac{dI}{dt} \Rightarrow L = e.\frac{dt}{dI}$

$dI = 2 - (-2) = 4\ A$

$\therefore L = \frac{8 \times 0.05}{4} = 0.1\ H$

42 **(a)**

$\tan\phi = \frac{X_C - X_L}{R} \Rightarrow \tan 45° = \left(\frac{\frac{1}{2\pi fC} - 2\pi fL}{R}\right)$

$\therefore C = \frac{1}{2\pi f(2\pi fL + R)}$

44 **(b)**

$\lambda_0 = \frac{c}{v_0} = \frac{3 \times 10^8}{5 \times 10^{14}}$

$= 6 \times 10^{-7}m = 6000\ Å$

46 **(c)**

$R = R_0(A)^{1/3}$

$\therefore \frac{R_2}{R_1} = \left(\frac{A_2}{A_1}\right)^{1/3} = \left(\frac{64}{27}\right)^{1/3} = \frac{4}{3}$

$\therefore R_2 = 3.6 \times \frac{4}{3} = 4.8$

51 **(c)**

In a closest Rock Salt structure, anion touches each other along the face diagonal of a cubic unit cell.

hence $4r_a = \sqrt{2}a$ i.e. $r_a = \frac{a}{2\sqrt{2}}$

58 **(c)**

$\frac{P^0 - P}{P^0} = X_B$

$\frac{5}{50} = X_B$

59 **(b)**

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

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

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

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

61 **(c)**

Reaction : $\frac{1}{2}\ H_2 + \frac{1}{2}\ Cl_2 \rightarrow HCl$

$\Delta H = \sum$B.E. (Reactants) - $\sum$B.E. (Products)

$\Delta H = $ B.E. (HCl) - $\left[\frac{1}{2}\ B.E.(H2) + \frac{1}{2}\ B.E.(Cl_2)\right]$

$\Delta H = -103 - \left[\frac{1}{2} \times (-104) + \frac{1}{2} \times (-58)\right]$

$= -103 - (52 - 29) = -22$ kcal

62 **(b)**

For R_2, ΔG should be negative and greater than positive value of ΔG for R_1 in magnitude.

65 **(c)**

OH^- ions being negatively charged move towards positively charged anode during electrolysis.

74 **(d)**

Per chloric acid is $HClO_4$

77 **(c)**

From La to Lu, ionic radius decreases. Yb is the second last element of the 4th series. Therefore Yb^{+3} ion is the smallest ion.

87 **(c)**

Definition of ethers.

88 **(c)**

Clemmenson's reaction : $-\overset{|}{C}=O \xrightarrow{[H]} -\overset{|}{C}H_2$

101 **(c)**

p	q	$\sim q$	$p \to q$	$\sim (p \to q)$	$p \wedge \sim q$	$\sim(p \to q) \leftrightarrow (p \wedge \sim q)$
T	T	F	T	F	F	T
T	F	T	F	T	T	T
F	T	F	T	F	F	T
F	F	T	T	F	F	T

102 **(c)**

1	2	3	4	5	6
p	q	$\sim q$	$p \leftrightarrow q$	$p \leftrightarrow \sim q$	$\sim (p \leftrightarrow \sim q)$
T	T	F	T	F	T
T	F	T	F	T	F
F	T	F	F	T	F
F	F	T	T	F	T

The entries in the columns 4 and 6 are identical

$\therefore \sim (p \leftrightarrow \sim q) \equiv p \leftrightarrow q$

103 **(b)**

It is a property

106 **(b)**

Given, $B = -A^{-1}BA$

$\therefore AB = -AA^{-1}BA = -IBA = -BA$

$\therefore AB = -BA$

Now $(A+B)^2 = (A+B)(A+B)$

$= A^2 + AB + BA + B^2$

$= A^2 + B^2 \quad [\because BA = -AB]$

Thus, $(A+B)^2 = A^2 + B^2$

107 **(a)**

$\tan(\cos^{-1} x)$

$= \tan\left[\tan^{-1} \frac{\sqrt{1-x^2}}{x}\right]$

$\ldots.. \left[\because \cos^{-1} x = \tan^{-1} \frac{\sqrt{1-x^2}}{x}\right]$

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

108 **(d)**

$\cos C = \frac{81 + 64 - x^2}{2.9.8} \Rightarrow \frac{2}{3} = \frac{145 - x^2}{144}$

$\Rightarrow x^2 = 49 \Rightarrow x = 7$

109 **(c)**

$\frac{\sin B \cos C}{\sin A} + \frac{\cos B \sin C}{\sin A}$

$= \left(\frac{b}{a}\cos C + \frac{c}{a}\cos B\right)$

$= 1$ ....[By projection rule]

110 **(a)**

Comparing given equation with standard form,

$a = 1, h = -\frac{3}{2}, b = \lambda,$

$\theta = \tan^{-1}\left(\frac{1}{3}\right) \Rightarrow \tan\theta = \frac{1}{3}$

Since, $\tan\theta = \frac{2\sqrt{h^2 - ab}}{a+b}$

$\therefore \frac{1}{3} = \frac{2\sqrt{\left(\frac{-3}{2}\right)^2 - \lambda}}{\lambda + 1}$

$\therefore (\lambda+1)^2 = 9(9 - 4\lambda)$

$\therefore \lambda^2 + 38\lambda - 80 = 0$

$\Rightarrow (\lambda + 40)(\lambda - 2) = 0 \Rightarrow \lambda = 2$

111 **(b)**

Here, $l = 1, m = 1, n = -1$ and $a = 1, b = 1, h = 0, g = -1, f = 0, c = -1$

From the given curve and line, we get

$x^2 + y^2 - 2x(x+y) - (x+y)^2 = 0$

$\Rightarrow 2x^2 + 4xy = 0$

$\Rightarrow x^2 + 2xy = 0$

$\therefore \tan\theta = \frac{2\sqrt{h^2 - ab}}{a+b}$

$\therefore \tan\theta = \frac{2\sqrt{1^2 - 0}}{1}$

$\Rightarrow \theta = \tan^{-1}(2)$

112 **(c)**

Since, the lines are perpendicular,

$\therefore a + b = 0 \Rightarrow k_1 = -1$

Putting $k_1 = -1$, we get the lines as

$x^2 + 0.xy - y^2 + 0.x + 2k_2 y - a^2 = 0$

Since, $h = 0, g = 0, c = -a^2$

We get $a^2 - k_2^2 = 0 \Rightarrow k_2 = a, -a$

113 **(b)**

Position vector of the line joining the given points which divides internally in the ratio 2 : 3 is

$\frac{3(2\bar{a}-3\bar{b})+2(3\bar{a}-2\bar{b})}{5}=\frac{12\bar{a}-13\bar{b}}{5}$

114 **(c)**

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

115 **(d)**

$\overrightarrow{AB}=\lambda\,\overrightarrow{BC}$

Here, $\overrightarrow{AB}=-2b, \overrightarrow{BC}=(k+1)b$

Hence $\forall\, k\in R \Rightarrow \overrightarrow{AB}=\lambda\,\overrightarrow{BC}$

116 **(c)**

Let l, m, n be the d.c.s of $\bar{r}$

$\therefore l=m=n$

$\ldots.[\because \alpha=\beta=\gamma \Rightarrow \cos\alpha=\cos\beta=\cos\gamma]$

Now, $l^2+m^2+n^2=1$

$\Rightarrow l=\pm\frac{1}{\sqrt{3}}$

117 **(d)**

$\cos\theta=\frac{1}{\sqrt{2}}=\left|\frac{2a-3+10}{\sqrt{2^2+(-1)^2+2^2}\,\sqrt{a^2+3^2+5^2}}\right|$

$\Rightarrow 9(a^2+34)=2(2a+7)^2=2(4a^2+28a+49)$

$\Rightarrow a^2-56a+208=0 \Rightarrow a=4$

118 **(d)**

$\cos\gamma=\sqrt{1-\frac{3}{4}-\frac{1}{2}}=\sqrt{\frac{-1}{4}}$ which is not possible

119 **(c)**

Let M be the foot of perpendicular drawn from the point P(1, 2, 3) to the line

$\frac{x-6}{3}=\frac{y-7}{2}=\frac{z-7}{-2}=\lambda$

Coordinates of any point on the line is

$\therefore M\equiv(6+3\lambda, 7+2\lambda, 7-2\lambda)$

Direction ratios of PM are

$6+3\lambda-1, 7+2\lambda-2, 7-2\lambda-3$

i.e., $5+3\lambda, 5+2\lambda, 4-2\lambda$

Direction ratios of the given line are $(3, 2, -2)$

Since, PM is perpendicular to the given line

$\therefore 3(5+3\lambda)+2(5+2\lambda)-2(4-2\lambda)=0$

$\Rightarrow 15+9\lambda+10+4\lambda-8+4\lambda=0$

$\Rightarrow 17\lambda+17=0$

$\Rightarrow \lambda=-1$

$\therefore M\equiv(3, 5, 9)$

$\therefore PM=\sqrt{(3-1)^2+(5-2)^2+(9-3)^2}$

$=\sqrt{4+9+36}$

$=7$

120 **(b)**

Equation of any line passing through the point whose position vector is a and is parallel to the b is $\bar{r}=\bar{a}+\lambda\,\bar{b}$ where λ is a parameter

$\therefore$ Required equation is

$\bar{r}=2\hat{\imath}-3\hat{\jmath}+4\hat{k}+\lambda(3\hat{\imath}+4\hat{\jmath}-5\hat{k})$

This is a line passing through $(2, -3, 4)$ and whose direction cosines are proportional to $(3, 4, -5)$. So the Cartesian equation of the line is $\frac{x-2}{3}=\frac{y+3}{4}=\frac{z-4}{-5}$

$\therefore 4x-8=3y+9$ and $-5y-15=4z-16$

i.e., $4x-3y=17$ and $5y+4z=1$

121 **(c)**

The lines can be rewritten as

$\bar{r}=(\hat{\imath}-2\hat{\jmath}+3\hat{k})+t(-\hat{\imath}+\hat{\jmath}-\hat{k})$ and

$\bar{r}=(\hat{\imath}-\hat{\jmath}-\hat{k})+s(\hat{\imath}+2\hat{\jmath}-2\hat{k})$

$$d=\frac{\begin{vmatrix}1-1 & -1+2 & -1-3\\ -1 & 1 & -1\\ 1 & 2 & -2\end{vmatrix}}{\sqrt{(-2+2)^2+(-1-2)^2+(-2-1)^2}}$$

$$=\frac{\begin{vmatrix}0 & 1 & -4\\ -1 & 1 & -1\\ 1 & 2 & -2\end{vmatrix}}{\sqrt{9+9}}$$

$$=\frac{|0-1(3)-4(-3)|}{3\sqrt{2}}$$

$$=\frac{9}{3\sqrt{2}}=\frac{3}{\sqrt{2}}$$

122 **(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

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

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

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

123 **(c)**

$$\sin\theta=\frac{(2)(3)+(-2)(4)+(1)(5)}{\sqrt{2^2+(-2)^2+(1)^2}\cdot\sqrt{3^2+4^2+5^2}}$$

$$=\frac{3}{\sqrt{9}\sqrt{50}}=\frac{1}{5\sqrt{2}}=\frac{\sqrt{2}}{10}$$

126 **(b)**

$\lim_{x\to1^-} f(x) = \lim_{x\to1^+} f(x)$

$\therefore 2 = \lim_{x\to1^+}(c-2x)$

$\therefore 2 = c-2$

$\therefore c = 4$

127 **(c)**

$\lim_{x\to1^+} f(x) = 0$ and $\lim_{x\to1^-} f(x) = 1+1 = 2$

Hence, $f(x)$ is discontinuous at $x=1$

128 **(c)**

As $\frac{|x|}{x}$ is discontinuous at $x=0$

$\therefore \frac{|3x-4|}{3x-4}$ is discontinuous at $3x-4=0$

$\therefore x = \frac{4}{3}$

129 **(d)**

$y = \tan^{-1}\left[\frac{\log ex}{\log\frac{e}{x}}\right] + \tan^{-1}\left[\frac{8-\log x}{1+8\log x}\right]$

$= \tan^{-1}\left[\frac{1+\log x}{1-\log x}\right] + \tan^{-1}\left[\frac{8-\log x}{1+8\log x}\right]$

$\therefore y = \tan^{-1}1 + \tan^{-1}(\log x) + \tan^{-1}8 - \tan^{-1}(\log x)$

$\therefore y = \tan^{-1}1 + \tan^{-1}8$

$\therefore \frac{dy}{dx} = 0, \quad \therefore \frac{d^2y}{dx^2} = 0$

130 **(c)**

Let $x = \sin t\cos 2t$ ......(i)

and $y = \cos t\sin 2t$ ......(ii)

differentiable (i) w.r.t. t, we get

$\frac{dx}{dt} = \cos t\cos 2t - 2\sin t\sin 2t$ ....(iii)

Differentiate (ii), w.r.t. t, we get

$\frac{dy}{dt} = 2\cos t\cos 2t - \sin t\sin 2t$ ....(iv)

$\therefore$ Dividing equation (iv) by (iii), we get

$\frac{dy}{dx} = \frac{2\cos t\cos 2t - \sin t\sin 2t}{\cos t\cos 2t - 2\sin t\sin 2t}$

At $t = \frac{\pi}{4}, \frac{dy}{dx} = \frac{1}{2}$

131 **(a)**

$x = a\cos^3\theta$

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

$y = a\sin^3\theta$

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

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

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

132 **(c)**

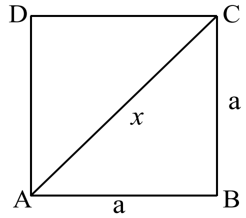
Given that $s = 2t^2 - 3t + 1$

$\therefore \frac{ds}{dt} - 4t - 3$ (velocity),

$\therefore \frac{d^2s}{dt^2} = 4$

133 **(b)**

$\frac{dx}{dt} = 0.5$ cm/sec



$\therefore$ Area $= \frac{x^2}{2}$

$\therefore \frac{dA}{dt} = \frac{2x}{2}.\frac{dx}{dt}$

$\therefore \left[\frac{dA}{dt}\right]_{A=400} = \frac{1}{2}\sqrt{800} \quad ...\left[\begin{matrix}\because A = 400\ cm^2\\ \therefore x = \sqrt{800}\ cm\end{matrix}\right]$

$= 10\sqrt{2}\ cm^2/sec$

135 **(b)**

$\int\left[\frac{1}{\log x} - \frac{1}{(\log x)^2}\right]dx$

$= \int\frac{1}{\log x}dx - \int\frac{1}{(\log x)^2}dx$

$= \frac{x}{\log x} + \int\frac{1}{(\log x)^2}.\frac{1}{x}\,x dx - \int\frac{1}{(\log x)^2}dx$

$= \frac{x}{\log x} + c$

137 **(b)**

$\int\frac{1}{(x-5)^2}dx = \frac{(x-5)^{-2+1}}{-2+1} + c$

$= \frac{(x-5)^{-1}}{-1} + c = -\frac{1}{(x-5)} + c$

138 **(b)**

It is a fundamental property

139 **(d)**

$\int_0^{\pi/6}(2+3x^2)\cos 3x\,dx$

$= \left[\frac{\sin 3x}{3}(2+3x^2)\right]_0^{\frac{\pi}{6}} - \int_0^{\pi/6}\frac{\sin 3x}{3}.6x\,dx$

$= \frac{1}{36}(\pi^2+16)$

140 **(c)**

$I = \int_0^{\pi/2}\frac{(\sin x+\cos x)^2}{\sqrt{1+\sin 2x}}dx$

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

$$= \int_0^{\pi/2} (\sin x + \cos x)\mathrm{d}x = [-\cos x + \sin x]_0^{\pi/2}$$

$= \mathrm{I} - (-1) = 2$

141 **(d)**

$$\mathrm{A}_1 = \int_0^{\pi/3} \cos x \ \mathrm{d}x = \frac{\sqrt{3}}{2}$$

$$\mathrm{A}_2 = \int_0^{\pi/3} \cos 2x \ \mathrm{d}x = \frac{\sqrt{3}}{4}$$

$\therefore \mathrm{A}_1 : \mathrm{A}_2 = 2 : 1$

142 **(a)**

$2x^2 = x^2 + 4$

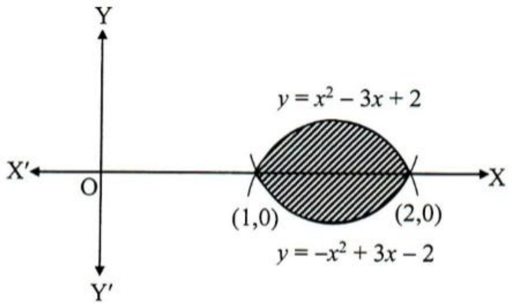
$\therefore x^2 = 4 \Rightarrow x = \pm 2$

$\therefore$ Required area $= \int_{-2}^{2} (x^2 + 4 - 2x^2)\,\mathrm{d}x$

$$= \int_{-2}^{2} (4 - x^2)\,\mathrm{d}x = \left[4x - \frac{x^3}{3}\right]_{-2}^{2}$$

$$= \left(8 - \frac{8}{3}\right) - \left(-8 + \frac{8}{3}\right) = \frac{32}{3}$$

143 **(d)**



Required area $= 2\int_1^2 (-x^2 + 3x - 2)\mathrm{d}x$

$$= 2\left[\frac{-x^3}{3} + \frac{3x^2}{2} - 2x\right]_1^2$$

$$= 2\left(\frac{-8}{3} + 6 - 4 + \frac{1}{3} - \frac{3}{2} + 2\right)$$

$= \frac{1}{3}$ sq. units

144 **(a)**

$$\left(\frac{\mathrm{d}^2 y}{\mathrm{d}x^2}\right)^{1/3} + \left(x + \frac{\mathrm{d}y}{\mathrm{d}x}\right)^{1/2} = 0$$

$$\Rightarrow \left(\frac{\mathrm{d}^2 y}{\mathrm{d}x^2}\right)^{1/3} = -\left(x + \frac{\mathrm{d}y}{\mathrm{d}x}\right)^{1/2}$$

$$\Rightarrow \left(\frac{\mathrm{d}^2 y}{\mathrm{d}x^2}\right)^{2} = \left(x + \frac{\mathrm{d}y}{\mathrm{d}x}\right)^{3}$$

$\therefore$ Order = 2, degree = 2

145 **(b)**

$x\mathrm{d}y = y(\mathrm{d}x + y\mathrm{d}y)$

$$\Rightarrow \frac{x\mathrm{d}y - y\mathrm{d}x}{y^2} = \mathrm{d}y$$

$$\Rightarrow -\mathrm{d}\left(\frac{x}{y}\right) = \mathrm{d}y$$

On integrating both sides, we get $\frac{x}{y} + y = \mathrm{c}$

Since, $y(1) = 1 \Rightarrow \mathrm{c} = 2$

$\therefore \frac{x}{y} + y = 2$

For $x = -3$,

$y^2 - 2y - 3 = 0$

$\Rightarrow y = -1$ or $3 \Rightarrow y = 3$ …..[$\because y > 0$]

148 **(c)**

Since, $\mathrm{f}(x)$ is the p.d.f. of X

$$\therefore \int_{-\infty}^{\infty} \mathrm{f}(x)\mathrm{d}x = 1$$

$$\therefore \int_0^{\infty} \mathrm{K}.\,\mathrm{e}^{-\theta x}\,\mathrm{d}x - 1$$

$$\therefore \mathrm{K}\left[\frac{\mathrm{e}^{-\theta x}}{-\theta}\right]_0^{\infty} = 1$$

$$\Rightarrow -\frac{\mathrm{K}}{\theta}\left[\frac{1}{\mathrm{e}^{\theta x}}\right]_0^{\infty} = 1$$

$$\Rightarrow -\frac{\mathrm{K}}{\theta}\left[\frac{1}{\mathrm{e}^{\infty}} - \frac{1}{\mathrm{e}^{0}}\right] = 1$$

$$\Rightarrow -\frac{\mathrm{K}}{\theta}\left[\frac{1}{\infty} - \frac{1}{1}\right] = 1 \Rightarrow \frac{\mathrm{K}}{\theta} = 1 \Rightarrow \mathrm{K} = \theta$$