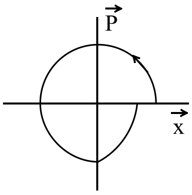
Physics|Chemistry|Maths

Time:03 HRS
Marks: 200

1. A proton of mass 1.6×10^{-27} kg goes round in a circular orbit of radius 0.10 m under a centripetal force of 4×10^{-13} N. The frequency of revolution of the proton is about
   a) 0.08×10^{8} cycles per s
   b) 4×10^{8} cycles per s
   c) 8×10^{8} cycles per s
   d) 12×10^{8} cycles per s
2. A fan is making 600 revolutions per minute. If after some time it makes 1200 revolutions per minute, then increase in its angular velocity is
   a) 10π rad/s b) 20π rad/s
   c) 40π rad/s d) 60π rad/s
3. A particle comes round a circle of radius 1 m once. The time taken by it is 10 s. The average velocity of motion is
   a) 0.2π m/s b) 2π m/s c) 2 m/s d) Zero
4. Imagine a light planet revolving around a very massive star in a circular orbit of radius r with period T. If gravitational force of attraction between planet and star is proportional to $R^{-\frac{5}{2}}$, then T^2 is proportional to
   a) $R^{\frac{7}{2}}$ b) $R^{-\frac{7}{2}}$ c) $R^{\frac{5}{2}}$ d) $R^{\frac{2}{5}}$
5. A satellite is moving very close to a planet of density 8×10^{3}kg m^{-3}. If $G = 6.67 \times 10^{-11}$Nm^{2}kg^{-2}, then the time period of the satellite is nearly
   a) 420 s b) 4200 s c) 1 hour d) 1 day
6. According to Kepler, the period of revolution of a planet (T) and its mean distance from the sun (r) are related by the equation
   a) $T^3 r^3 =$ constant b) $T^3 r^{-3} =$ constant
   c) $Tr^3 =$ constant d) $T^2 r =$ constant
7. Which of the following statements is true in case of the principal of perpendicular axes?
   a) It is applicable to only three dimensional objects
   b) It is applicable to planar as well as three dimensional objects
   c) It is applicable to only planar objects
   d) It is applicable to only denser objects
8. Unit of angular momentum is
   a) N s b) N s^{-1} c) J s^{-1} d) J s
9. A disc of uniform thickness and radius 50 cm is made of two zones. The central zone of radius 20.0 cm is made of metal and has a mass of 4.00 kg. The outer zone is of wood and has a mass of 3.00 kg. The M.I. of the disc about a transverse axis through its centre is
   a) 0.510 kg-m^2 b) 0.515 kg-m^2
   c) 0.500 kg-m^2 d) 0.525 kg-m^2
10. A ideal gas is kept in a cylinder of cross sectional area A and volume V_0. The mass of the gas enclosed is M and bulk modulus B. If the piston of the cylinder is pressed by small x, then find the time period of small oscillations,
    a) $2\pi\sqrt{\frac{BA^2}{MV_0}}$ b) $2\pi\sqrt{\frac{BA}{MV_0^2}}$ c) $2\pi\sqrt{\frac{BA}{MV_0}}$ d) $2\pi\sqrt{\frac{B^2A}{MV_0}}$
11. What will be the momentum v/s position plot of a spring mass oscillator kept on a rough horizontal surface? What should be the plot for one cycle?

a)


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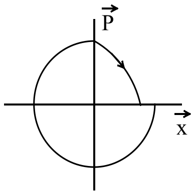

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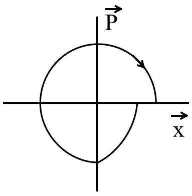

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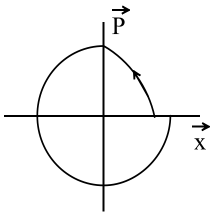
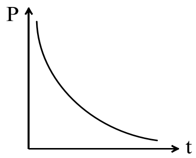
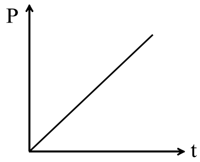
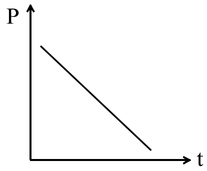


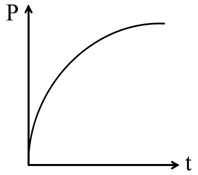
12. A body of mass 1 kg is executing simple harmonic motion. Its displacement y(cm) at t seconds is given by $y = 6\sin(100t + \pi/4)$. Its maximum kinetic energy is
    a) 6 J b) 18 J c) 24 J d) 36 J
13. A ring of radius R is made of a thin wire of material of density ρ, having cross-sectional area 'a' and Young's modulus Y. The ring rotates about an axis perpendicular to its plane and through its centre. Angular frequency of rotation is ω. The ratio of kinetic energy to potential energy is
    a) $\frac{Y}{\rho R^2 \omega^2}$ b) $\frac{2Y}{\rho R^2 \omega^2}$ c) $\frac{Y}{2\rho R^2 \omega^2}$ d) $\frac{Y}{4\rho R^2 \omega^2}$
14. Hooke's law defines
    a) Stress b) Strain
    c) Modulus of elasticity d) Elastic limit
15. A soap bubble is blown with the help of a

mechanical pump at the mouth of a tube. The pump produces a certain increase per minute in the volume of the bubble, irrespective of its internal pressure. The graph between the pressure inside the soap bubble and time t will be

a) 

b) 

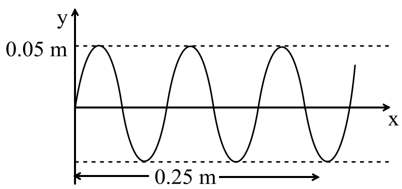
c) 

d) 

16. 8000 identical water drops are combined to form a big drop. Then the ratio of the final surface energy to the initial surface energy of all the drops together is
a) 1 : 10 b) 1 : 15 c) 1 : 20 d) 1 : 25

17. If NaCl is dissolved into water, then its surface tension
a) Decreases
b) Does not change
c) Increases
d) First increases than decreases

18. If the speed of the wave shown in the figure is 330 m/s in the given medium, then the equation of the wave propagating in the positive x-direction will be (all quantities are in M.K.S. units)



a) $y = 0.05 \sin 2\pi(4000t - 12.5x)$
b) $y = 0.05 \sin 2\pi(4000t - 122.5x)$
c) $y = 0.05 \sin 2\pi(3300t - 10x)$
d) $y = 0.05 \sin 2\pi(3300x - 10t)$

19. If $y_1 = \sin(2000\pi t)$ and $y_2 = a\sin(2008\pi t)$, then number of beats produced per second are
a) 2 b) 3 c) 4 d) 5

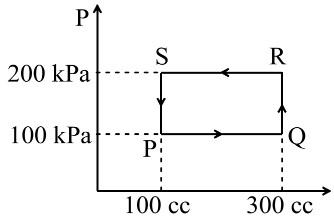
20. Two closed organ pipes of length 100 cm and 101 cm produce 16 beats in 20 s. When each pipe is sounded in its fundamental mode, calculate the velocity of sound
a) 303 ms^{-1} b) 332 ms^{-1}
c) 323.2 ms^{-1} d) 300 ms^{-1}

21. Stationary waves in closed pipe will produce
a) All the harmonics
b) All the even harmonics
c) All the odd harmonics
d) No harmonics

22. In an organ pipe whose one end is at x = 0, the pressure is expressed by
$P = P_0 \cos\frac{3\pi x}{2} \sin 300\,\pi t$ where x is in metre and t in seconds. The organ pipe can be
a) Closed at one end, open at another with length = 0.5 m
b) Open at both ends, length = 1 m
c) Closed at both ends, length = 2 m
d) Closed at one end, open at another with length = $\frac{2}{3}$ m

23. The mean free path of molecules of a gas (radius r) is inversely proportional to
a) r^3 b) r^2 c) r d) $\sqrt{r}$

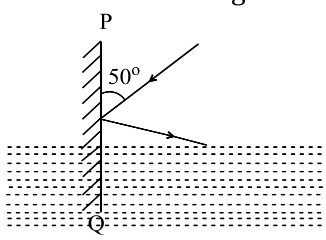
24. A thermodynamics system is taken through the cycle PQRSP process. The net work done by the system is



a) 20 J b) −20 J c) 400 J d) −374 J

25. A monoatomic gas is kept at room temperature 300 K. Calculate the average kinetic energy of gas molecule
(Use $K = 1.38 \times 10^{-23}$ M.K.S. units)
a) 0.138 eV b) 0.062 eV
c) 0.039 eV d) 0.013 eV

26. A plane mirror PQ is held normally to water surface of refractive index 1.33. A ray of light is incident at an angle of 50° with the mirror surface. After reflection the ray is refracted into water. The angle of refraction r is



a) 50° b) 35° c) 45° d) 60°

27. The refractive index of water and glass with respect to air is 1.3 and 1.5 respectively, what will be the refractive index of glass with respect to water?
a) $\frac{1.5}{1.3}$ b) $\frac{1.3}{1.5}$ c) $\frac{1.5}{2.6}$ d) $\frac{2.6}{1.5}$

28. Two slits separated by a distance of 1 mm are illuminated with light of wavelength 4×10^{-7} m. The interference fringes are observed on a screen placed 1 m from the slits. The distance between fourth dark and sixth bright fringe on same side is equal to

a) 0.6 mm b) 1 mm c) 2 mm d) 0.4 mm

29. Diameter of the objective of a telescope is 200 cm. What is the resolving power of a telescope? Take wavelength of light = 5000 Å

a) 6.56×10^6 b) 3.28×10^5
c) 1×10^6 d) 3.28×10^6

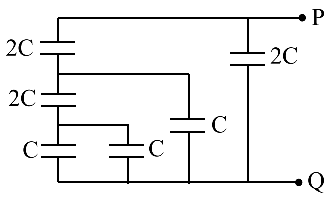
30. In a double slit experiment, the distance between the slit is 1 mm and screen is 25 cm away from the slits. The wavelength of light is 6000 Å. The width of the fringe on the screen

a) 0.15 mm b) 0.24 mm c) 0.30 mm d) 0.12 mm

31. Which of the following is not a solid dielectrics?

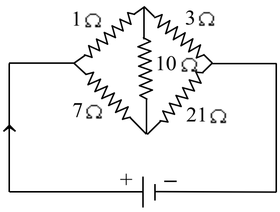
a) Ceramic b) Glasses c) Mica d) Magnesia

32. The resultant capacitance of given circuit is



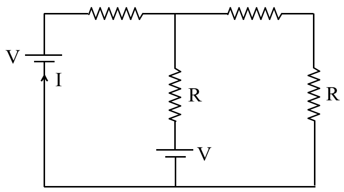
a) 3C b) 2C c) C d) $\frac{C}{3}$

33. In the circuit shown, the current drawn from the battery is 4 A. If 10 Ω resistor is replaced by 20 Ω resistor, the current drawn from the circuit will be



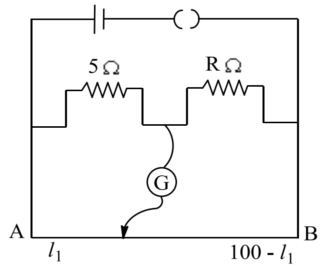
a) 1 A b) 1.5 A c) 3 A d) 3.5 A

34. In the given circuit, the current I equal to



a) $\frac{V}{5R}$ b) $\frac{V}{4R}$ c) $\frac{2V}{5R}$ d) 0

35. The resistances in the two arms of the meter bridge are 5 Ω and R Ω, respectively. When the resistance R is shunted with an equal resistance, the new balance point is at 1.6 l_1. The resistance R, is



a) 10 Ω b) 15 Ω c) 20 Ω d) 25 Ω

36. Three moving coil galvanometer A, B and C made of coil of three different material having torsional constant 1.8×10^{-8}, 2.8×10^{-8} and 3.8×10^{-8} respectively. If three galvanometers are identical in all other respects, then in which of above cases, sensitivity is maximum?

a) A b) B
c) C d) Constant in each case

37. A galvanometer may be converted into an ammeter or a voltmeter. In which of the following cases is the resistance of the device so obtained least?

a) Ammeter of range 1 A
b) Ammeter of range 10 A
c) Voltmeter of range 1 V
d) Voltmeter of range 10 V

38. In a moving coil galvanometer, a radial magnetic field is produced due to the

a) Concave pole pieces of the magnet
b) Iron core
c) Rectangular coil
d) Mirror

39. A paramagnetic liquid is filled in a glass U tube of which one limb is placed between the pole pieces of an electromagnet. When the field is switched on, the liquid in the limb, which is in the field, will

a) Rise
b) Fall
c) Remain stationary
d) Initially rise and then fall

40. If a paramagnetic substance is placed in a non-uniform magnetic field, then it will move from

a) Weaker to stronger part
b) Remains stable
c) Stronger to weaker field
d) Perpendicular to field

41. An A.C. voltage is applied to a resistance R and inductor L in series. If R and the inductive reactance are both equal to 3 Ω, the phase

difference between the applied voltage and the current in the circuit is

a) Zero b) $\pi/6$ c) $\pi/4$ d) $\pi/2$

42. Induction coil is an instrument based on the principle of
    a) Electromagnetic induction
    b) Mutual induction
    c) Self induction
    d) Induction furnace
43. The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential in volts is
    a) 2 b) 4 c) 6 d) 10
44. An electron is accelerated through a potential difference of 1000 volt. Its velocity is nearly
    a) 3.8×10^7 m/s b) 1.9×10^6 m/s
    c) 1.9×10^7 m/s d) 5.7×10^7 m/s
45. As an electron makes a transition from an excited state to the ground state of a hydrogen-like atom/ion
    a) Its kinetic energy increases but potential energy and total energy decrease
    b) Kinetic energy, potential energy and total energy decrease
    c) Kinetic energy decreases, potential energy increases but total energy remains same
    d) Kinetic energy and total energy decrease but potential energy increases
46. With increasing quantum number, the energy difference between adjacent energy levels in hydrogen atom
    a) Decreases
    b) Increases
    c) Remains constant
    d) Decreases for low Z and increases for high Z
47. A Zener diode
    a) Has negative temperature coefficient of resistance
    b) Has sharp breakdown at low reverse voltage
    c) Rectifies zener voltage
    d) Works only in forward bias
48. A photodiode is operated in
    a) Forward bias
    b) Reverse bias
    c) p-type semiconductor
    d) n-type semiconductor
49. For a perfect elastic collision
    a) $e > 1$
    b) $e < 1$
    c) $e = 1$
    d) None of these
50. In Bernoulli's theorem, which of the following is conserved?
    a) Mass b) Linear momentum
    c) Energy d) Angular momentum
51. In the face centred unit cell, the points are present at the
    a) Corners and face centre's of the unit cell
    b) Corners of the unit cell
    c) Face centre's of the unit cell
    d) Corners and centre of the unit cell
52. The unbalance spin of electron exhibit
    a) Magnetism b) Spectra
    c) Visible colours d) Allotropy
53. In the face-centred cubic unit cell of closest packed atoms, the radius of atom in terms of edge length (a) of the unit cell is
    a) $\frac{a}{2}$ b) $\frac{a}{\sqrt{2}}$ c) $\frac{a}{2\sqrt{2}}$ d) $\frac{\sqrt{3}}{4}a$
54. Which is not the correct statement for ionic solids in which positive and negative ions are held by strong electrostatic attractive forces?
    a) The radius ratio $\frac{r_+}{r_-}$ increases as coordination number increases
    b) As the difference in size of ions increases, coordination number increases
    c) When coordination number is eight, $\frac{r_+}{r_-}$ ratio lies between 0.225 to 0.414
    d) In ionic solid of the type AX (ZnS, Wurtzite), the coordination number of Zn^{2+} and S^{2-} respectively are 4 and4
55. When a non volatile solute is dissolved in a solvent, the relative lowering in vapour pressure is equal to
    a) Mole fraction of solvent
    b) Mole faction of solute
    c) Concentration of solute in gL^{-1}
    d) Concentration of solute in g per 100 mL
56. Osmotic pressure of a solution containing 0.1 mole of solute per litre at 273 K is (in atm)
    a) $\frac{0.1}{1}$ x 0.0821 x 273
    b) 0.1 X 1 X 0.0821 X 273
    c) $\frac{1}{0.1}$ x 0.0821 x 273
    d) $\frac{0.1}{1}$ x $\frac{273}{0.0821}$
57. Normality (N) of solution is equal to
    a) $\frac{\text{No. of moles of solute}}{\text{volume of solution in litre}}$

b) $\frac{\text{No. of gram equivalent of solute}}{\text{volume of solution in litre}}$

c) $\frac{\text{No. of moles of solute}}{\text{Mass of solvent in Kg}}$

d) $\frac{\text{No. of solute molecules}}{\text{volume of solutions}}$

58. C) Solubility of a gas in a liquid increases with
    a) Increase of pressure and increase of temperature
    b) Decrease of pressure and increase of temperature
    c) Increase of pressure and decrease of temperature
    d) decrease of pressure and decrease of temperature
59. The energy given out during a chemical change generally is in the form of
    a) Heat   b) Photo energy
    c) Electrical   d) All of these
60. Mark the correct statement.
    a) For a chemical reaction to be feasible, ΔG should be zero
    b) Entropy is a measure of order in s system
    c) For a chemical reaction to be feasible, ΔG should be positive
    d) The total energy for an isolated system is constant
61. Calorific values of good and fuel are determined by
    a) Bunsen's ice calorimeter
    b) Bomb calorimeter
    c) Beckmann's thermometer
    d) Spectrophotometer
62. Most disordered system is
    a) 1 mole of O_2 at NTP   b) 1 mole of N_2 at NTP
    c) 1 mole of air   d) 1 mole of CO_2 at NTP
63. In electrolysis of dil. H_2SO_4 the ratio by weight gases evolved at anode and cathode respectively are
    a) 1 : 16   b) 8 : 1   c) 16 : 1   d) 3 : 1
64. Units of Faradays are
    a) Ampere   b) C   c) C/mol   d) C/sec
65. E^0 of an electrode half reaction is related to ΔG^0 $= -\frac{\Delta G^0}{nF}$. If the amount of Ag^+ in the half react $Ag^+ + e^- \longrightarrow Ag$ is tripled then
    a) N is tripled
    b) ΔG^0 reduces to one third
    c) E^0 reduces to one third
    d) All the above
66. In Nernst equation the constant 0.0591 at 298K represents the value of
    a) $\frac{RT}{nF}$ b) $\frac{RT}{F}$
    c) $\frac{2.303\ RT}{nF}$ d) $\frac{2.303\ RT}{F}$
67. A first order reaction has specific rate constant of 2 min^{-1}. The half-life of this reaction will be
    a) 1.653 Min   b) 0.347 Min
    c) 2 Min   d) 0.5 Min
68. The concentration of a reactant in a solution falls (i) from 0.2 to 0.1 M in 2 hrs. (ii) from 0.2 to 0.05 m in 4 hrs. The order of the hydrolysis of the reactant is
    a) Zero   b) Two   c) One   d) Half
69. A reaction is first order with respect to reactant A and second order with respect to reactant B. The c) Rate Law for the reaction is given by
    a) rate = k $[A][B]^2$ b) rate = $[A][B]^2$
    c) rate = k $[A]^2[B]$ d) rate = k $[A]^0[B]^2$
70. The common method of extraction of metal from oxide ore involves
    a) Reduction with aluminium
    b) Reduction with hydrogen gas
    c) Reduction with coke
    d) Electrolytic method
71. Identify the process when an ore is heated in presence of oxygen.
    a) Smelting   b) Roasting
    c) Calcination   d) Liquation
72. In which of the following minerals, Aluminiumis not present?
    a) Cryolite   b) Fluorspar
    c) Mica   d) Fledspar
73. The oxidation number of Fe in brown ring $[Fe(H_2O)NO]^2$ is
    a) 0   b) +1   c) +2   d) +3
74. The first compound of noble gas was prepared by
    a) Barlett   b) Berzelius
    c) Ramsay   d) Cavendish
75. Calgon is
    a) Sodium hexametaphosphate
    b) Sodium phosphate
    c) Copper sulfate
    d) Arsenic sulfide
76. In which part of the periodic table inner transition elements are placed?
    a) Left   b) Right   c) Centre   d) Bottom
77. In the preparation of $KMnO_4$, Pyrolusite (MnO_2) is first converted to potassium

manganate (K_2MnO_4). In this conversion the oxidation state of manganese changes from

a) +1 to +3 b) +2 to +4 c) +3 to +5 d) +4 to +6

78. With the increase in atomic numbers the atomic radii go on decreasing in case of
a) d-block element b) f- block element
c) Radioactive series d) p- block element

79. Ethylenediamine is
a) Monodentate b) Bidentate
c) Tridentate d) Tetradentate

80. Which is colourless of the following?
a) Cu_2Cl_2 b) $CuSO_4 . 5H_2O$
c) $Cu_2 (CH_3COO)_4 . H_2O$ d) $[Cu(NH_3)_4]SO_4 . 4H_2O$

81. The IUPAC name of $[CoCl(NH_3)(en)_2]Cl_2$ is
a) Chloro ammine bis (ethylenediamine) cobalt (II) chloride
b) Ammine chlorobis (ethylenediamine) cobalt (II) chloride
c) Ammine chlorobis (ethylenediamine) cobalt (III) chloride
d) None of the above

82. The oxidation state of Co in $[Co(EDTA)]^{-1}$ is
a) +3 b) -3 c) +1 d) +2

83. Compare
(1) $[Ag(NH_3)_2]^+$ Diagonal
(2) $[Zn(BH_3)_4]^{2+}$ Tetrahedral
(3) $[Fe(CN)_6]^{3-}$ Square Planer
(4) $[Ni(CN)_4]^{2-}$ Octahedral
Which is /are correctly shaped?
a) 1 and 2 b) 2 and 3
c) 1 only d) 3 and 4

84. Among the following compounds, the optically active alkane having lowest molecular mass is
a) $CH_3 - CH_2 - CH_2 - CH_3$
b)
```
              CH3
               |
CH3 - CH2 - CH - CH3
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c)
```
        H
        |
CH3 - C—◁
        |
       C2H5
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d) $CH_3 - CH_2 - C \equiv CH$

85. Chlorination of chlorobenzene in presence of Fe gives
a) o-Dichlorobenzene
b) m-Dichlorobenzene
c) p-Dichlorobenzene
d) o- and p-Dichlorobenzene

86. The IUPAC name of $HOCH_2CH_2OC_2H_5$ is:
a) Hydroxy diethyl ether b) 2-ethoxy ethanol
c) Ethoxyethan 2-0l d) 2-Ethoxy propanol

87. Ethanol is used in the preparation of
a) DDT b) Gammexane
c) Throat point d) Tincture iodine

88. Which does not react with Fehling's solution?
a) CH_3CHO b) C_6H_5CHO
c) HCOOH d) $C_6H_{12}O_6$

89. Cross Cannizzaro reaction is
a) Condensation reaction
b) Addition reaction
c) Disproportionation reaction
d) Elimination reaction

90. Calcium salt of fatty acid 'A' is dry distilled to give 'B'. The compound 'B' is reacted with dil. NaOH to give 'C' which on dehydration gives 'D'. The compound 'D' is α, β unsaturated ketone, i.e. 5-ethyl-4-methyl-hept-4-en-3-one. Which of the following is A?
a) Calcium acetate b) Calcium formate
c) Calcium propionate d) Calcium Butyrate

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

92. Secondary amines on acetylation give
a) Monoacetyl derivative b) Diacetyl derivative
c) Do not react d) Triacetyl derivative

93. Identify the statement about the basic nature of amines.
a) Alkylamines are weaker bases than ammonia.
b) Arylamines are stronger bases than alkylamines.
c) Secondary aliphatic amines are stronger bases than primary aliphatic amines.
d) Tertiary aliphatic amines are weaker bases than arylamines.

94. Which of the following is not a protein?
a) Wool b) Hair
c) Cellulose d) Nail

95. Proteins does not given reaction with
a) Millon's reagent b) Biuret test
c) Fehling's reagent d) Protein

96. Which of the following is a copolymer?
a) Orlon b) Teflon c) PVC d) PHBV

97. An example of a natural biopolymer is
a) Teflon b) Rubber

c) Nylon-66 d) DNA

98. Cotton is a

a) Vegetable fibres b) Animal fibres

c) Regenerated fibres d) Synthetic fibres

99. Two hybrid orbitals is used have a bond angle of 120^o. The percentage of s character in the hybrid orbital is nearly

a) 25% b) 33%

c) 50% d) 66%

100. The oxidation number of chromium in potassium dichromate is

a) +2 b) +4

c) +6 d) +8

101. If p: Sita gets promotion, q: Sita is transferred to Pune

The verbal form of $\sim p \leftrightarrow q$ is written as

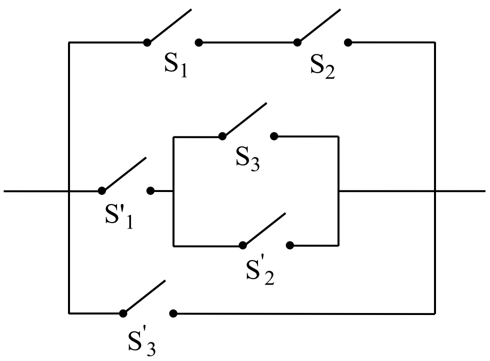
a) Sita gets promotion and Sita gets transferred to Pune

b) Sita does not get promotion then Sita will be transferred to Pune

c) Sita gets promotion if Sita is transferred to Pune

d) Sita does not get promotion if and only if Sita is transferred to Pune

102. The symbolic form of logic for the following circuit is



a) $(p \vee q) \wedge (\sim p \wedge r \vee \sim q) \vee \sim r$

b) $(p \wedge q) \wedge (\sim p \vee r \wedge \sim q) \vee \sim r$

c) $(p \wedge q) \vee [\sim p \wedge (r \vee \sim q)] \vee \sim r$

d) $(p \vee q) \wedge [\sim p \vee (r \wedge \sim q)] \vee \sim r$

103. Duals of the following statements are given. Which one is not correct?

a) $(p \vee q) \wedge (r \vee s), (p \wedge q)(r \wedge s)$

b) $[p \vee (\sim q)] \wedge (\sim p), [p \wedge (\sim q)] \vee (\sim p)$

c) $(p \wedge q) \vee r, (p \vee q) \wedge r$

d) $(p \vee q) \vee s, (p \wedge q) \vee s$

104. If $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ and $f(x) = \frac{1+x}{1-x}$, then f(A) is

a) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ b) $\begin{bmatrix} -1 & -1 \\ -1 & -1 \end{bmatrix}$

c) $\begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix}$ d) None of these

105. Let A be a 3×3 non-singular matrix with $|A| = \alpha$. If $A^{-1}(\text{adj}(\text{adj}A)) = kI$, then the value of k is

a) 1 b) A c) α^2 d) α^3

106. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 5 & 2 & 0 \\ -1 & 6 & 1 \end{bmatrix}$, then the adjoint of A is

a) $\begin{bmatrix} 2 & -5 & 32 \\ 0 & 1 & -6 \\ 0 & 0 & 2 \end{bmatrix}$ b) $\begin{bmatrix} -1 & 0 & 0 \\ -5 & -2 & 0 \\ 1 & -6 & 1 \end{bmatrix}$

c) $\begin{bmatrix} -1 & 0 & 0 \\ -5 & -2 & 0 \\ 1 & -6 & -1 \end{bmatrix}$ d) None of these

107. If $\cos^{-1}\sqrt{p} + \cos^{-1}\sqrt{1-p} + \cos^{-1}\sqrt{1-q} = \frac{3\pi}{4}$ then the value of q is

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

108. $\left[\sin\left(\tan^{-1}\frac{3}{4}\right)\right]^2 =$

a) $\frac{3}{5}$ b) $\frac{5}{3}$ c) $\frac{9}{25}$ d) $\frac{25}{9}$

109. If $x + \frac{1}{x} = 2$, the principal value of $\sin^{-1} x$ is

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

110. $6x^2 + hxy + 12y^2 = 0$ represents pair of parallel straight lines, if h is

a) $\pm 6\sqrt{2}$ b) $\pm\sqrt{2}$ c) $\pm 12\sqrt{2}$ d) $\pm\sqrt{6}$

111. Acute angle between the lines represented by $3x^2 - 48xy + 23y^2 = 0$ is

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

112. The angle between the pair of straight lines $3x^2 + 10xy + 8y^2 = 0$ is $\tan^{-1}(p)$, where p =

a) $\frac{-5}{11}$ b) $\frac{-3}{11}$ c) $\frac{2}{11}$ d) $\frac{8}{11}$

113. If $2\bar{a} + \bar{b} = 3\bar{c}$, then A divides BC in the ratio

a) 3 : 1 externally b) 3 : 1 internally

c) 1 : 3 externally d) 1 : 3 internally

114. If $\hat{i} + 2\hat{j} + 3\hat{k}$ and $3\hat{i} - 2\hat{j} + \hat{k}$ represents the adjacent sides of a parallelogram, then the area of this parallelogram is

a) $4\sqrt{3}$ b) $6\sqrt{3}$ c) $8\sqrt{3}$ d) $16\sqrt{3}$

115. If vectors $\bar{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}, \bar{B} = \hat{i} + \hat{j} + 5\hat{k}$, and $\bar{C}$ form a left handed system, then $\bar{C}$ is

a) $11\hat{i} - 6\hat{j} - \hat{k}$ b) $-11\hat{i} + 6\hat{j} + \hat{k}$

c) $11\hat{i} - 6\hat{j} + \hat{k}$ d) $-11\hat{i} + 6\hat{j} - \hat{k}$

116. The points (5,2,4), (6,−1,2) and (8,−7,k) are collinear if k is equal to

a) 2 b) −1 c) 3 d) −2

117. The angle between the two diagonals of a cube is

a) 30°　　b) 45°

c) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$　　d) $\cos^{-1}\left(\frac{1}{3}\right)$

118. The projection of the line segment joining the points $(-1,0,3)$ and $(2,5,1)$ on the line whose direction ratios are 6, 2, 3 is

a) $\frac{10}{7}$　　b) $\frac{22}{7}$　　c) $\frac{18}{7}$　　d) $\frac{7}{22}$

119. The length of perpendicular from $(2,-1,5)$ to the line $\frac{x-11}{10}=\frac{y+2}{-4}=\frac{z+8}{-11}$ and the co-ordinates of the foot are

a) $\sqrt{14},(1,2,-3)$　　b) $\sqrt{14},(1,-2,3)$

c) $\sqrt{14},(1,2,3)$　　d) $\sqrt{14},(-1,2,-3)$

120. Cartesian form of the equation of line $\bar{r}=3\hat{i}-5\hat{j}+7\hat{k}+\lambda(2\hat{i}+\hat{j}-3\hat{k})$ is

a) $\frac{x-2}{3}=\frac{y-1}{-5}=\frac{z+3}{7}$

b) $\frac{x-3}{2}=\frac{y+5}{1}=\frac{z-7}{-3}$

c) $\frac{x-2}{1}=\frac{y-1}{2}=\frac{z-7}{5}$

d) $\frac{x-2}{7}=\frac{y-1}{-5}=\frac{z+3}{3}$

121. The lines $x=ay+b, z=cy+d$ and $x=a'y+b', z=c'y+d'$ are perpendicular to each other, if

a) $aa'+cc'=1$　　b) $aa'+cc'=-1$

c) $ac+a'c'=1$　　d) $ac+a'c'=-1$

122. Let a, b and c be three real numbers satisfying

$$[a\ b\ c]\begin{bmatrix}1 & 9 & 7\\ 8 & 2 & 7\\ 7 & 3 & 7\end{bmatrix}=[0\ 0\ 0]$$

If the point P(a, b, c) lies on the plane $2x+y+z=1$, then the value of $7a+b+c$ is

a) 0　　b) 12　　c) 7　　d) 6

123. A plane meets the co-ordinate axes at A, B, C such that the centroid of the triangle is (3, 3, 3). The equation of the plane is

a) $9x+9y+9z=1$　　b) $x+y+z=3$

c) $3x+3y+3z=1$　　d) $x+y+z=9$

124. For the L.P.P Min $z=x_1+x_2$ such that $5x_1+10x_2\le 0, x_1+x_2\ge 1, x_2\le 4$ and $x_1,x_2\ge 0$

a) There is a bounded solution

b) There is no solution

c) There are infinite solutions

d) None of these

125. Minimize $z=\sum_{j=1}^{n}\sum_{i=1}^{m}c_{ij}x_{ij}$

Subject to : $\sum_{j=1}^{n}x_{ij}=a_i, i=1,\dots\dots,m$

$$\sum_{i=1}^{m}x_{ij}=b_j, j=1,\dots\dots,n$$

Is a L.P.P, with number of constraints

a) m + n　　b) m − n　　c) mn　　d) $\frac{m}{n}$

126. If $f(x)=\begin{cases}\frac{x^2-1}{x+1}; & \text{when } x\ne -1\\ -2; & \text{when } x=-1\end{cases}$, then

a) $\lim_{x\to(-1)^-}f(x)=-2$

b) $\lim_{x\to(-1)^+}f(x)=-2$

c) $f(x)$ is continuous at $x=-1$

d) All the above are correct

127. If $f(x)=\begin{cases}\frac{\sin 2x}{5x}; & \text{when } x\ne 0\\ k; & \text{when } x=0\end{cases}$ is continuous at $x=0$, then the value of k will be

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

128. The function $\frac{\sin x}{|x|}$ is

a) Continuous at $x=0$

b) Discontinuous at $x=0$

c) Continuous at $x=1$

d) Removable discontinuous

129. Derivative of 5^x with respect to $\log_5 x$ is

a) $x\,5^x$　　b) $5^x(\log 5)^2$

c) $x\cdot 5^x(\log 5)^2$　　d) $x(\log 5)^2$

130. If $y=x^2+2x+3$, then $\frac{d^2x}{dy^2}=$

a) $\frac{1}{2(x+1)^3}$　　b) $\frac{-1}{4(x+1)^3}$

c) $\frac{1}{2}$　　d) $\frac{1}{8(x+1)^4}$

131. 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) $-\frac{1}{2}$

132. The minimum value of $f(a)=(2a^2-3)+3(3-a)+4$ is

a) $\frac{15}{2}$　　b) $\frac{11}{2}$　　c) $\frac{-13}{2}$　　d) $\frac{71}{8}$

133. A ladder is resting with the wall at an angle of 30°. A man is ascending the ladder at the rate of 3 ft/sec. His rate of approaching the wall is

a) 3 ft/sec　　b) $\frac{3}{2}$ ft/sec　　c) $\frac{3}{4}$ ft/sec　　d) $\frac{3}{\sqrt{2}}$ ft/sec

134. The radius of the cylinder of maximum volume, which can be inscribed in a sphere of radius R is

a) $\frac{2}{3}R$　　b) $\sqrt{\frac{2}{3}}R$　　c) $\frac{3}{4}R$　　d) $\sqrt{\frac{3}{4}}R$

135. $\int\frac{dx}{(x-x^2)}=$

a) $\log x - \log(1-x) + c$
b) $\log(1-x^2) + c$
c) $-\log x + \log(1-x) + c$
d) $\log(x - x^2) + c$

136. $\int \frac{dx}{4\sin^2 x + 5\cos^2 x} =$

a) $\frac{1}{\sqrt{5}}\tan^{-1}\left(\frac{2\tan x}{\sqrt{5}}\right) + c$
b) $\frac{1}{\sqrt{5}}\tan^{-1}\left(\frac{\tan x}{\sqrt{5}}\right) + c$
c) $\frac{1}{2\sqrt{5}}\tan^{-1}\left(\frac{2\tan x}{\sqrt{5}}\right) + c$
d) None of these

137. $\int x^5 . e^{x^2} dx =$

a) $\frac{1}{2}x^4.e^{x^2} - x^2.e^{x^2} + e^{x^2} + c$
b) $\frac{1}{2}x^4.e^{x^2} + x^2.e^{x^2} + e^{x^2} + c$
c) $\frac{1}{2}x^4.e^{x^2} - x^2.e^{x^2} - e^{x^2} + c$
d) None of these

138. $\int_0^{\frac{\pi}{2}} \cos^6 x dx =$

a) $\frac{5\pi}{16}$ b) $\frac{5\pi}{32}$ c) $\frac{5}{16}$ d) $\frac{5}{32}$

139. $\lim_{n\to\infty} \frac{1 + 2^4 + 3^4 + \ldots + n^4}{n^5} - \lim_{n\to\infty} \frac{1 + 2^3 + 3^3 + \ldots + n^3}{n^5} =$

a) $\frac{1}{30}$ b) 0 c) $\frac{1}{4}$ d) $\frac{1}{5}$

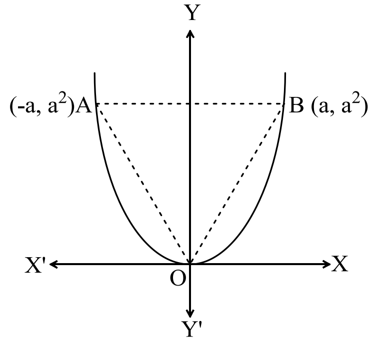
140. $\int_{-\pi/2}^{\pi/2} \sqrt{\frac{1}{2}(1 - \cos 2x)} dx =$

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

141. The area bounded by the curve $y = f(x)$, X-axis and ordinates $x = 1$ and $x = b$ is $(b-1)\sin(3b+4)$, then $f(x)$ is

a) $3(x-1)\cos(3x+4) + \sin(3x+4)$
b) $(b-1)\sin(3x+4) + 3\cos(3x+4)$
c) $(b-1)\cos(3x+4) + 3\sin(3x+4)$
d) None of these

142. The figure shows a ΔAOB and the parabola $y = x^2$. The ratio of the area of the ΔAOB to the area of the region AOB of the parabola $y = x^2$ is equal to



a) $\frac{3}{5}$ b) $\frac{3}{4}$ c) $\frac{7}{8}$ d) $\frac{5}{6}$

143. If A is the area of the region bounded by the curve $y = \sqrt{3x+4}$, X-axis and the lines $x = -1$ and $x = 4$ and B is that area bounded by curve $y^2 = 3x + 4$, X-axis and the lines $x = -1$ and $x = 4$, then A : B is equal to

a) 1 : 1 b) 2 : 1
c) 1 : 2 d) None of these

144. Integrating factor of $\frac{dy}{dx} + \frac{y}{x} = x^3 - 3$ is

a) x b) $\log x$ c) $-x$ d) e^x

145. If $y = a\sin(\log x) + b\cos(\log x)$, then the differential equation without the parameter a and b is

a) $\frac{d^2y}{dx^2} + x\frac{dy}{dx} + x^2 y = 0$
b) $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = 0$
c) $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$
d) $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} - y = 0$

146. The solution of the differential equation $x\cos y dy = (xe^x \log x + e^x)dx$ is

a) $\sin y = \frac{1}{x}e^x + c$
b) $\sin y + e^x \log x + c = 0$
c) $\sin y = e^x \log x + c$
d) None of these

147. Three coins are tossed. Then the probability distribution of number of heads is

a) X : 0 1 2 3; P(X) : $\frac{1}{8}$ $\frac{5}{8}$ $\frac{5}{8}$ $\frac{1}{8}$
b) X : 0 1 2 3; P(X) : $\frac{2}{8}$ $\frac{1}{8}$ $\frac{1}{8}$ $\frac{2}{8}$
c) X : 0 1 2 3; P(X) : $\frac{1}{5}$ $\frac{2}{5}$ $\frac{2}{5}$ $\frac{1}{5}$
d) X : 0 1 2 3; P(X) : $\frac{1}{8}$ $\frac{3}{8}$ $\frac{3}{8}$ $\frac{1}{8}$

148. The probability distribution of a random variable X is given below:

$X = x_1$	1	2	3

$P(X = x_1)$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{5}{8}$

Then its mean is

a) $\frac{19}{8}$ b) $\frac{5}{4}$ c) 1 d) $\frac{4}{5}$

149. $2\cos x - \cos 3x - \cos 5x =$

a) $16cos^3x\ sin^3\ x$ b) $16sin^3\ x\ cos^2x$ c) $4cos^3x\ sin^2\ x$ d) $4sin^3\ x\ cos^2x$

150. The equation of the line joining the origin to the point (- 4, 5), is

a) $5x + 4y = 0$ b) $3x + 4y = 2$ c) $5x - 4y = 0$ d) $4x - 5y = 0$

Physics|Chemistry|Maths

Time:03 HRS
Marks: 200

: ANSWER KEY :

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

: HINTS AND SOLUTIONS :

1 **(a)**

Using, $F = mr\omega^2 = m\,4\pi^2 n^2 r$

$\therefore m\,4\pi^2 n^2 r = 4 \times 10^{-13}$

$$\therefore n = \sqrt{\frac{4 \times 10^{-13}}{1.6 \times 10^{-27} \times 4 \times 3.14^2 \times 0.1}}$$

$\therefore n = 0.08 \times 10^8$ cycles/second

2 **(b)**

$n_1 = 600$ r.p.m., $n_2 = 1200$ r.p.m.,

Using,

Increment in angular velocity, $\omega = 2\pi(n_2 - n_1)$

$\omega = 2\pi(1200 - 600)$rad/min

$= (2\pi \times 600)/60$ rad/s

$\omega = 20\,\pi$ rad/s

3 **(d)**

In one complete revolution, total displacement is zero. So average velocity is zero

4 **(a)**

Since, $F = M r\omega^2$

$$\therefore T \propto \sqrt{\frac{R}{F}} \Rightarrow T^2 \propto \frac{R}{F}$$

$$\therefore T^2 \propto \frac{R}{\left(R^{-\frac{5}{2}}\right)} \Rightarrow T^2 \propto R^{\frac{7}{2}}$$

5 **(b)**

$$T = \sqrt{\frac{3\pi}{G\rho}} = \sqrt{\frac{3 \times 3.14}{6.67 \times 10^{-11} \times 8 \times 10^3}} = s$$

≈ 4200 s

6 **(b)**

$\frac{T^2}{r^3} =$ constant

$\therefore T^2 r^{-3} =$ constant

8 **(d)**

Unit of angular momentum, $L = kg\ m^2/s$

$= \frac{kg\ m^2}{s}\frac{s}{s}$

$= \frac{kg\ m^2}{s^2}s$

$= J\text{-}s$

9 **(b)**

M.I. of disc of central zone,

$I_1 = \frac{4 \times (0.2)^2}{2} = 0.08\ kgm^2$

M.I. of wooden annular disc,

$I_2 = \frac{3}{2}[(0.2)^2 + (0.5)^2] = \frac{3}{2}[0.04 + 0.25]$

$= 1.5 \times 0.29 = 0.435\ kg\ m^2$

$\therefore$ M.I. of whole disc $= I_1 + I_2 = 0.08 + 0.435$

$= 0.515\ kgm^2$

12 **(b)**

$K.E_{max} = \frac{1}{2}m\omega^2A^2$

$= \frac{1}{2} \times 1 \times (100)^2 \times (6 \times 10^{-2})^2 = 18\ J$

15 **(a)**

$\Delta P = \frac{4T}{r} \Rightarrow \Delta P \propto \frac{1}{r}$

Further, as radius of soap bubble increases with time, $\Delta P \propto \frac{1}{t}$

16 **(c)**

As volume remains constant,

$R^3 = 8000r^3 \Rightarrow R = 20r$

$\therefore \frac{\text{Surface energy of one big drop}}{\text{Surface energy of 8000 small drop}}$

$= \frac{4\pi R^2T}{8000\ 4\pi r^2T}$

$= \frac{R^2}{8000r^2} = \frac{(20r)^2}{8000r^2} = \frac{1}{20}$

18 **(c)**

Here, $A = 0.5m, \frac{5\lambda}{2} = 0.25 \Rightarrow \lambda = 0.1m$

Now using standard equation of wave,

$y = A\sin\frac{2\pi}{\lambda}(vt - x)$ we get,

$y = 0.05\sin 2\pi\,(3300t - 10x)$

19 **(c)**

Given equations are,

$y_1 = a\sin(2000\pi\,t) = a\sin 2\pi(1000\,t)$ and

$y_2 = a\sin(2008\pi\,t) = a\sin 2\pi(1004\,t)$

$\therefore$ Comparing with the standard form,

$y = A\sin 2\pi\ nt$ we get,

$n_1 = 1000$ Hz and $n_2 = 1004$ Hz

$\therefore$ Number of beats $= 1004 - 1000 = 4$ beats/s

20 **(c)**

Number of beats per second,

$n = \frac{16}{20} = \frac{4}{5} \Rightarrow n = n_1 - n_2 = \frac{v}{4}\left(\frac{1}{l_1} - \frac{1}{l_2}\right)$

$\therefore \frac{4}{5} = \frac{v}{4}\left(\frac{1}{1} - \frac{1}{1.01}\right) = \frac{0.01v}{4 \times 1.01} = \frac{v}{4 \times 101}$

$\therefore v = \frac{16 \times 101}{5} = 323.2\ ms^{-1}$

23 **(b)**

$\lambda = \frac{1}{\lambda d^2n\sqrt{2}} = \frac{1}{4\pi r^2n\sqrt{2}}$

$\Rightarrow \lambda \propto \frac{1}{r^2}$

24 **(b)**

Work done by the system = Area of shaded portion on P-V diagram

$= (300 - 100)10^{-6} \times (100 - 200) \times 10^3 = -20\ J$

25 **(c)**

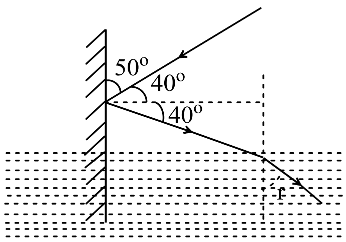
The average kinetic energy of monoatomic gas molecule K.E. $= \frac{3}{2}k_BT$

$K = \frac{3}{2} \times (1.38 \times 10^{-23} J\ K^{-1}) \times (300K)$

$= \frac{3 \times (1.38 \times 10^{-23} JK^{-1}) \times (300K)}{2 \times (1.6 \times 10^{-19} J/eV)}$

$= 3.9 \times 10^{-2} eV = 0.039$ Ev

26 **(b)**



Using, $\mu = \frac{\sin i}{\sin r}$ we get,

$\sin r = \frac{\sin 50°}{\mu} = \frac{0.76}{1.33} = 0.57$

$\therefore r = \sin^{-1}(0.57) \Rightarrow r = 35°$

27 **(a)**

${}_w\mu_g = \frac{{}_a\mu_g}{{}_a\mu_w} = \frac{1.5}{1.3}$

28 **(b)**

Distance of 6th bright fringe,

$X_6 = \frac{n\lambda D}{d} = \frac{6\lambda D}{d}$ ...(i)

Distance of 4th dark fringe,

$X'_4 = \frac{(2n-1)\lambda D}{2d} = \frac{7}{2}\frac{\lambda D}{d}$ ...(ii)

$\therefore X_6 - X'_4 = \frac{\lambda D}{d}\left(6 - \frac{7}{2}\right) = \frac{5}{2}\frac{\lambda D}{d}$

$= \frac{5}{2} \times \frac{4 \times 10^{-7} \times 1}{1 \times 10^{-3}}$

$= 10^{-3}m = 1\ mm$

29 **(d)**

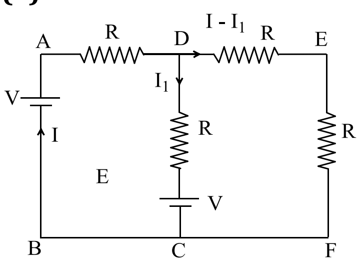
$R.P. = \frac{D}{1.22\lambda} = \frac{2}{1.22 \times 0.5 \times 10^{-6}}$

$= \frac{4}{1.22} \times 10^6$
$= 3.28 \times 10^6$

30 **(a)**
Using,
$X = \frac{\lambda D}{d} = \frac{6000 \times 10^{-7} mm \times 25 \times 10\ mm}{1\ mm}$
$= 15 \times 10^{-2}$
$= 0.15$ mm

33 **(d)**
The bridge is balanced.
The balance condition after replacing 10 Ω resistor by 20 Ω resistor will remain the same
$\therefore R_{eq.} = 4\Omega || 28\Omega = \frac{4 \times 28}{4 + 28} = \frac{4 \times 28}{32} = \frac{7}{2}\Omega$

34 **(a)**



For loop ABCDA,
$IR + I_1R + V - V = 0$
$\therefore (I + I_1)R = 0 \Rightarrow I_1 = -I$
Now, In loop ABFEA,
$IR + (I - I_1)R + (I - I_1)R - V = 0$
$\therefore IR + IR - I_1R + IR - I_1R = V$
$\therefore 3IR - 2I_1R = V$
$\therefore 3IR - 2(-I)R = V$
$\therefore 5IR = V \Rightarrow I = \frac{V}{5R}$

35 **(b)**
Initially, $\frac{5}{l_1} = \frac{R}{100 - l_1}$ ...(i)
Finally, $\frac{5}{1.6 l_1} = \frac{R/2}{(100 - 1.6 l_1)}$ ...(ii)
$\therefore \frac{R}{1.6(100 - l_1)} = \frac{R}{2(100 - 1.6 l_1)}$
$\therefore 100 - 1.6\, l_1 = 200 - 3.2\, l_1$
$\therefore 1.6\, l_1 = 40$
$\therefore l_1 = 25$
From equation (i),
$\frac{5}{25} = \frac{R}{75} \Rightarrow R = 15\ \Omega$

36 **(a)**
$S_i = \frac{d\theta}{dI} = \frac{nAB}{C}$
$\therefore S_i \propto \frac{1}{C} \Rightarrow$ A has maximum sensitivity

37 **(b)**
A voltmeter always has high resistance as R is in series
To increase the range of ammeter i.e. to increase I, its resistance must decrease
∴ High range ⇒ low resistance

41 **(c)**
$\tan\phi = \frac{X_1}{R} = 1 \Rightarrow \phi = 45°$ or $\pi/4$

43 **(b)**
$K_{max} = eV_0 \Rightarrow 4\ eV = eV_0$
$\therefore V_0 = 4V$

44 **(c)**
If the voltage given is V, then the energy of electron,
$\frac{1}{2}mv^2 = eV$
$\therefore v = \sqrt{\frac{2eV}{m}} = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 1000}{9.1 \times 10^{-31}}}$
$= 1.875 \times 10^7$
$\approx 1.9 \times 10^7$ m/s

45 **(a)**
$K.E. \propto \left(\frac{Z}{n}\right)^2$ and
$K.E. = -(T.E.), P.E. = -2(K.E.)$
This implies as K.E. increases and K.E. increases, T.E., P.E. decreases

46 **(a)**
As n increases, energy difference between adjacent energy levels decreases

53 **(c)**
In the face centred cubic unit cell atoms touch each other along the face diagonal of the cube .hence
$4r = \sqrt{2}\,a \ \therefore r = \frac{\sqrt{2}}{4}a = \frac{a}{2\sqrt{2}}$

54 **(c)**
When co-ordination number is eight ratio $\frac{r_+}{r_-}$ lies between 0.732 to 1 pm.

56 **(a)**
$\pi = CRT$

62 **(c)**
1 mole of air is more. It represents more disorder.

67 **(b)**
$t_{1/2} = \frac{0.693}{K} = \frac{0.693}{2} = 0.347\ min^{-1}$

77 **(d)**
In the pyrolusite (MnO_2), the oxidation state of Mn is +4; in K_2MnO_4, the oxidation state of Mn is +6.

79 **(b)**
Bidentate ligands have two donor atoms
$CH_2 - \ddot{N}H_2$
|

$CH_2-\ddot{N}H_2$ (Ethylene diamine)

103 **(d)**

Dual of $(p \vee q) \vee s$ is $(p \wedge q) \wedge s$

106 **(d)**

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 5 & 2 & 0 \\ -1 & 6 & 1 \end{bmatrix}$$

$$\Rightarrow adj(A) = \begin{bmatrix} 2 & -5 & 32 \\ 0 & 1 & -6 \\ 0 & 0 & 2 \end{bmatrix}^T = \begin{bmatrix} 2 & 0 & 0 \\ -5 & 1 & 0 \\ 32 & -6 & 2 \end{bmatrix}$$

107 **(d)**

Let $\alpha = \cos^{-1}\sqrt{p} : \beta = \cos^{-1}\sqrt{1-p}$

And

$\gamma = \cos^{-1}\sqrt{1-q}$ or $\cos\alpha = \sqrt{p}$;

$\cos\beta = \sqrt{1-p}$

And $\cos\gamma = \sqrt{1-q}$

$\therefore \sin\alpha = \sqrt{1-p}, \sin\beta = \sqrt{p}$ and $\sin\gamma = \sqrt{q}$

The given equation may be written as

$\alpha + \beta + \gamma = \frac{3\pi}{4}$ or $\alpha + \beta + \gamma = \frac{3\pi}{4} - \gamma$ or

$$\cos(\alpha + \beta) = \cos\left(\frac{3\pi}{4} - \gamma\right)$$

$$\Rightarrow \cos\alpha\cos\beta - \sin\alpha\sin\beta$$

$$= \cos\left\{\pi - \left(\frac{\pi}{4} + \gamma\right)\right\} = -\cos\left(\frac{\pi}{4} + \gamma\right)$$

$$\Rightarrow \sqrt{p}\sqrt{1-p} - \sqrt{1-p}\sqrt{p}$$

$$= -\left(\frac{1}{\sqrt{2}}\sqrt{1-q} - \frac{1}{\sqrt{2}}.\sqrt{q}\right)$$

$$\Rightarrow 0 = \sqrt{1-q} - \sqrt{q} \Rightarrow 1 - q \Rightarrow q = \frac{1}{2}$$

108 **(c)**

$$\left[\sin\left(\tan^{-1}\frac{3}{4}\right)\right]^2$$

$$= \left[\sin\left\{\sin^{-1}\left(\frac{\frac{3}{4}}{\sqrt{1+\left(\frac{3}{4}\right)^2}}\right)\right\}\right]^2$$

$$\ldots\ldots\left[\because \tan^{-1}x = \sin^{-1}\left(\frac{x}{\sqrt{1+x^2}}\right)\right]$$

$$= \left[\sin\left(\sin^{-1}\frac{3}{5}\right)\right]^2 = \left(\frac{3}{5}\right)^2 = \frac{9}{25}$$

109 **(b)**

$$x + \frac{1}{x} = 2 \Rightarrow x = 1$$

Therefore, the principal value of $\sin^{-1}x = \frac{\pi}{2}$

110 **(c)**

Comparing $6x^2 + hxy + 12y^2 = 0$

With $Ax^2 + 2Hxy + By^2 = 0$

We get $A = 6, B = 12$ and $H = \frac{h}{2}$

Since lines are parallel,

$$\therefore \frac{h^2}{4} = 6(12) \Rightarrow h^2 = (24)(12) \Rightarrow h = \pm 12\sqrt{2}$$

111 **(a)**

$a = 3, h = -24, b = 23$

$$\therefore \tan\theta = \left|\frac{2\sqrt{h^2 - ab}}{a+b}\right| = \left|\frac{2\sqrt{576-69}}{3+23}\right|$$

$$\Rightarrow \tan\theta = \left|\frac{2\sqrt{507}}{26}\right| = \left|\frac{2\times 13\sqrt{3}}{26}\right| = \sqrt{3}$$

$$\Rightarrow \theta = \tan^{-1}(\sqrt{3}) = \frac{\pi}{3}$$

112 **(c)**

$$p = \left|\frac{2\sqrt{h^2-ab}}{a+b}\right| = \left|\frac{2\sqrt{25-24}}{11}\right| = \left|\frac{2}{11}\right| = \frac{2}{11}$$

113 **(a)**

$2\bar{a} + \bar{b} = 3\bar{c}$

$\therefore 2\bar{a} = 3\bar{c} - \bar{b}$

$$\therefore \bar{a} = \frac{3\bar{c} - \bar{b}}{2} = \frac{3\bar{c} - \bar{b}}{3-1}$$

A divides BC in the ratio 3 : 1 externally

114 **(c)**

$$\text{Area of parallelogram} = |a \times b| = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 3 \\ 3 & -2 & 1 \end{vmatrix}$$

$$= |8\hat{i} + 8\hat{j} - 8\hat{k}| = 8\sqrt{3}$$

116 **(d)**

Let $A(5,2,4), B(6,-1,2), C(8,-7,k)$ be the given points

$\therefore$ The direction – ratios of AB are

$< 6-5, -1-2, 2-4 >$

i.e., $< 1, -3, -2 >$

and direction – ratios of BC are

$< 8-6, -7+1, k-2 >$

i.e., $< 2, -6, k-2 >$

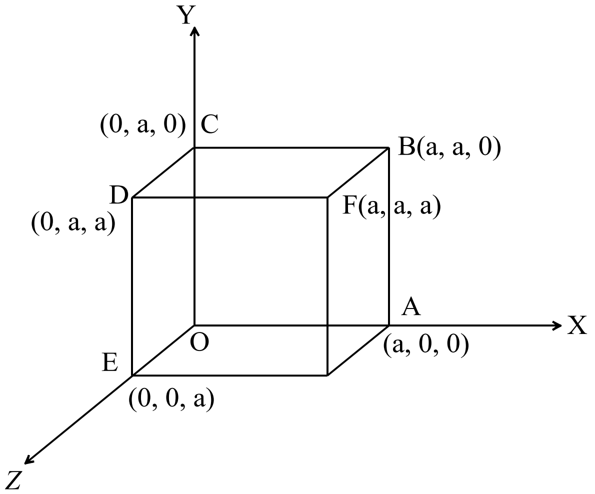
since A, B, C are collinear,

$$\therefore \frac{2}{1} = \frac{-6}{-3} = \frac{k-2}{-2}$$

$\Rightarrow k - 2 = -4$

$\Rightarrow k = 2 - 4 = -2$

117 **(d)**



D.r.s of diagonal $EB = (a, a, -a)$

D.r.s of diagonal $AD = (-a, a, a)$

Angle between them,

$\cos\theta = \left|\frac{-a^2 + a^2 - a^2}{3a^2}\right|$

$\therefore \theta = \cos^{-1}\left(\frac{1}{3}\right)$

118 **(b)**

Here, $\bar{a} = 3\hat{i} + 5\hat{j} - 2\hat{k}$

$\therefore$ Projection $= \frac{\bar{a}.\bar{b}}{|b|}$

$= \frac{18 + 10 - 6}{7} = \frac{22}{7}$

119 **(c)**

Let $\frac{x-11}{10} = \frac{y+2}{-4} = \frac{z+8}{-11} = \lambda$

Is $P(10\lambda + 11, -4\lambda - 2, -11\lambda - 8)$

Let $A(2, -1, 5)$

The direction ratios of the line AP are

$P(10\lambda + 11 - 2, -4\lambda - 2 - (-1), -11\lambda - 8 - 5)$

Since, the given line $\frac{x-11}{10} = \frac{y+2}{-4} = \frac{z+8}{-11}$ and the line AP are perpendicular to each other, we have

$10(10\lambda + 11 - 2) - 4(-4\lambda - 2 + 1) - 11(-11\lambda - 8 - 5) = 0$

$\therefore 10(10\lambda + 9) - 4(-4\lambda - 1) - 11(-11\lambda - 13) = 0$

$\therefore 100\lambda + 90 + 16\lambda + 4 + 121\lambda + 143 = 0$

$\therefore 237\lambda + 237 = 0 \Rightarrow \lambda = -1$

$\therefore$ P is $(-10 + 11, 4 - 2, 11 - 8)$

i.e., $P(1, 2, 3)$

$d = AP = \sqrt{(2-1)^2 + (-1-2)^2 + (5-3)^2}$

$= \sqrt{1 + 9 + 4} = \sqrt{14}$

120 **(b)**

The given vector equation is

$\bar{r} = 3\hat{i} - 5\hat{j} + 7\hat{k} + \lambda(2\hat{i} + \hat{j} - 3\hat{k})$

Substitute $\bar{r} = x\hat{i} + y\hat{j} + z\hat{k}$

Now comparing the coefficient of $\hat{i}$, $\hat{j}$ and $\hat{k}$, we get

$x = 3 + 2\lambda; y = -5 + \lambda, z = 7 - 3\lambda$

$\Rightarrow \frac{x-3}{2} = \lambda, y + 5 = \lambda, \frac{z-7}{-3} = \lambda$

Eliminating λ, we get

$\frac{x-3}{2} = \frac{y+5}{1} = \frac{z-7}{-3}$

121 **(b)**

Given equation of lines are

$x = ay + b, z = cy + d$

$\Rightarrow \frac{x-b}{a} = \frac{y}{1}, \frac{z-d}{c} = \frac{y}{1}$

$\Rightarrow \frac{x-b}{a} = \frac{y}{1} = \frac{z-d}{c}$

and $x = a'y + b', z = c'y + d'$

$\Rightarrow \frac{x-b'}{a'} = \frac{y}{1}, \frac{z-d'}{c'} = \frac{y}{1}$

$\Rightarrow \frac{x-b'}{a'} = \frac{y}{1} = \frac{z-d'}{c'}$

Since, the lines are perpendicular to each other

$\therefore a_1a_2 + b_1b_2 + c_1c_2 = 0$

$\Rightarrow aa' + 1(1) + cc' = 0$

$\Rightarrow aa' + cc' = -1$

122 **(d)**

$[a\ b\ c]\begin{bmatrix}1 & 9 & 7\\ 8 & 2 & 7\\ 7 & 3 & 7\end{bmatrix} = [0, 0, 0]$

$\Rightarrow a + 8b + 7c = 0, 9a + 2b + 3c = 0,$

$7a + 7b + 7c = 0$

$\Rightarrow a = 1, b = 6, c = -7$

$\therefore P(a\ b\ c)$ lies on the plane $2x + y + z = 1$

$\therefore 7a + b + c = 7 + 6 - 7 = 6$

123 **(d)**

The equation of the plane which cuts intercepts on the co-ordinate axes is

$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$

Let the co-ordinates of the points where the plane cuts the axes are $(a, 0, 0), (0, b, 0), (0, 0, c)$

Since, centroid is $(3, 3, 3)$

$\therefore \frac{x_1 + x_2 + x_3}{3} = \frac{a + 0 + 0}{3} = 3$

$\Rightarrow a = 9$

Similarly $\frac{y_1+y_2+y_3}{3} = \frac{0+b+0}{3} = 3$

$\Rightarrow b = 9$

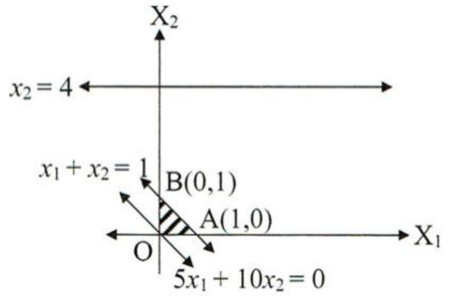
and $\frac{z_1+z_2+z_3}{3} = \frac{0+0+c}{3} = 3$

$\Rightarrow c = 9$

$\therefore$ The equation is $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1 \Rightarrow x + y + z = 9$

124 **(c)**

As there may be infinite values of x_1 and x_2 on lies $x_1 + x_2 = 1$



125 **(a)**

Condition (i),

$i = 1, x_{11} + x_{12} + x_{13} + \cdots + x_{1n}$

$i = 2, x_{21} + x_{22} + x_{23} + \cdots + x_{2n}$

$i = 3, x_{31} + x_{32} + x_{33} + \cdots + x_{3n}$

....

$i = m, x_{m1} + x_{m2} + x_{m3} + \cdots + x_{mn} \to m$ constraints

condition (ii),

$j = 1, x_{11} + x_{21} + x_{31} + \cdots + x_{m1}$

$j = 2, x_{12} + x_{22} + x_{32} + \cdots + x_{m1}$

....

$j = n, x_{1n} + x_{2n} + x_{3n} + \cdots + x_{mn} \to n$

$\therefore$ Total constraints $= m + n$

126 **(d)**

$\lim_{x\to -1} f(x) = -2$ and $f(-1) = -2$

127 **(b)**

$$\lim_{x\to 0} f(x) = \lim_{x\to 0} \frac{2\sin 2x}{2x.5} = \frac{2}{5} = k$$

128 **(b)**

$$\lim_{x\to 0^+} \frac{\sin x}{|x|} = \lim_{x\to 0} \frac{\sin x}{x} = 1$$

and $\lim_{x\to 0^-} \frac{\sin x}{|x|} = \lim_{x\to 0} \frac{\sin x}{-x} = -1$

129 **(c)**

Let $u = 5^x, v = \log_5 x$

$\therefore \frac{du}{dx} = 5^x \log 5,$ ......(i)

$\frac{dv}{dx} = \frac{1}{x \log 5}$ .....(ii)

$$\therefore \frac{du}{dv} = \frac{\frac{du}{dx}}{\frac{dv}{dx}}$$

$\therefore \frac{du}{dx} = \frac{5^x \log 5}{\frac{1}{x \log 5}}$ .....[From (i) and (ii)]

$= x.5^x (\log 5)^2$

130 **(b)**

$$y = x^2 + 2x + 3 \Rightarrow \frac{dy}{dx} = 2x + 2$$

$$\therefore \frac{dy}{dx} = \frac{1}{2x+2}$$

$$\Rightarrow \frac{d^2x}{dy^2} = \frac{-1}{2(x+1)^2}.\frac{dx}{dy} = \frac{-1}{4(x+1)^3}$$

131 **(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 $t = \frac{\pi}{4}, \frac{dy}{dx} = \frac{1}{2}$

132 **(d)**

$f(a) = 2a^2 - 3a + 10$

$\Rightarrow f'(a) = 4a - 3 \Rightarrow f''(a) = 4 > 0$

Now, $f'(a) = 0 \Rightarrow a = \frac{3}{4}$

$\therefore f(a)$ is minimum at $a = \frac{3}{4}$

$$\therefore [f(a)]_{min} = 2\left(\frac{3}{4}\right)^2 - 3\left(\frac{3}{4}\right) + 10 = \frac{71}{8}$$

133 **(b)**

Diagram

His rate of approaching the wall $= 3 \times \cos 60°$

$= \frac{3}{2}$ ft/sec

134 **(b)**

Let r be the radius and h be the height, then from the figure, $r^2 + \left(\frac{h}{2}\right)^2 = R^2$

$h^2 = 4(R^2 - r^2)$

Now, $V = \pi r^2 h = 2\pi r^2 \sqrt{R^2 - r^2}$

$$\therefore \frac{dV}{dr} = 4\pi r \sqrt{R^2 - r^2} + 2\pi r^2.\frac{(-2r)}{2\sqrt{R^2 - r^2}}$$

For max. or min., $\frac{dV}{dr} = 0$

$$\Rightarrow 4\pi r \sqrt{R^2 - r^2} = \frac{2\pi r^3}{\sqrt{R^2 - r^2}} \Rightarrow 2(R^2 - r^2) = r^2$$

$$\Rightarrow 2R^2 = 3r^2 \Rightarrow r = \sqrt{\frac{2}{3}}R \Rightarrow \frac{d^2V}{dr^2} = -ve$$

Hence V is max., when $r = \sqrt{\frac{2}{3}}R$

135 **(a)**

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

$= \log x - \log(1 - x) + c$

136 **(c)**

Let $I = \int \frac{dx}{4\sin^2 x + 5\cos^2 x} = \int \frac{\sec^2 x \, dx}{4\tan^2 x + 5}$

$$= \frac{1}{4}\int \frac{\sec^2 x \, dx}{\tan^2 x + \frac{5}{4}}$$

Put $\tan x = t$

$$\Rightarrow I=\frac{1}{4}\int\frac{dt}{t^2+\left(\frac{\sqrt5}{2}\right)^2}=\frac{2}{4\sqrt5}\tan^{-1}\left(\frac{2t}{\sqrt5}\right)+c$$

$$=\frac{1}{2\sqrt5}\tan^{-1}\left(\frac{2\tan x}{\sqrt5}\right)+c$$

137 **(a)**

Put $x^2=t$

$\Rightarrow 2x\,dx=dt$

$$\therefore \int x^5 e^{x^2}dx=\frac{1}{2}\int t^2 e^t dt$$

$$=\frac{1}{2}\left[e^t t^2-2\int te^t\,dt\right]$$

$$=\frac{t^2e^t}{2}-(te^t-e^t)+c$$

$$=\frac{1}{2}x^4e^{x^2}-x^2e^{x^2}+e^{x^2}+c$$

138 **(b)**

$\int_0^{\frac{\pi}{2}}\cos^n x dx=\frac{(n-1)(n-3)\ldots.1}{n(n-2)\ldots.2}\cdot\frac{\pi}{2}$, if n is even

$$\therefore \int_0^{\frac{\pi}{2}}\cos^6 x dx=\frac{(6-1)(6-3)(6-5)}{6(6-2)(6-4)}\cdot\frac{\pi}{4}$$

$$=\frac{5\pi}{32}$$

139 **(d)**

$$\lim_{n\to\infty}\frac{1+2^4+3^4+\ldots+n^4}{n^5}-\lim_{n\to\infty}\frac{1+2^3+3^3+\ldots+n^3}{n^5}$$

$$=\lim_{n\to\infty}\frac{1}{n}\left\{\left(\frac{1}{n}\right)^4+\left(\frac{2}{n}\right)^4+\left(\frac{3}{n}\right)^4+\cdots+\left(\frac{n}{n}\right)^4\right\}-\lim_{n\to\infty}\frac{1}{n}\left\{\left(\frac{1}{n^4}\right)+\left(\frac{2^3}{n^4}\right)+\ldots+\left(\frac{n^3}{n^4}\right)\right\}$$

$$=\lim_{n\to\infty}\sum_{r=1}^{n}\left[\left(\frac{r}{n}\right)^4\right].\frac{1}{n}-0$$

$$=\int_0^1 x^4dx=\left[\frac{x^5}{5}\right]_0^1=\frac{1}{5}$$

140 **(b)**

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

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

141 **(a)**

According to the given condition,

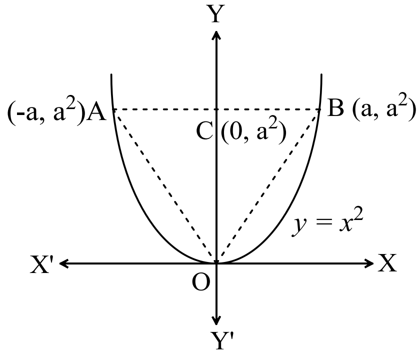
$$\int_1^b f(x)\,dx=(b-1)\sin(3b+4)$$

Differentiate with respect to b, we get

$f(b).1=3(b-1)\cos(3b+4)+\sin(3b+4)$

$\therefore f(x)=3(x-1)\cos(3x+4)+\sin(3x+4)$

142 **(b)**



Area of the region AOB

$$=2\int_0^{a^2}x\ dy=2\int_0^{a^2}\sqrt{y}\ dy=2\left[\frac{y^{3/2}}{\frac{3}{2}}\right]_0^{a^2}=\frac{4}{3}a^3$$

Now, area of $\Delta AOB=\frac{1}{2}\times AB\times OC$

$$=\frac{1}{2}\times 2a\times a^2=a^3$$

$$\therefore \frac{\text{area of }\Delta AOB}{\text{Area of the region AOB}}=\frac{a^3}{\frac{4}{3}a^3}=\frac{3}{4}$$

143 **(a)**

In both cases area will be same

$\therefore A:B=1:1$

144 **(a)**

$I.F.=e^{\int P.dx}=e^{\int\frac{1}{x}dx}=e^{\log_e x}=x$

145 **(c)**

$y=a\sin(\log x)+b\cos(\log x)$ ... (i)

$$\Rightarrow \frac{dy}{dx}=\frac{a\sin(\log x)}{x}-\frac{b\sin(\log x)}{x}$$

$$\Rightarrow x\frac{dy}{dx}=a\cos(\log x)-b\sin(\log x)$$

$$\Rightarrow x\frac{d^2y}{dx^2}+\frac{dy}{dx}=\frac{-a\sin(\log x)}{x}-\frac{b\cos(\log x)}{x}$$

$$\Rightarrow x\frac{d^2y}{dx^2}+\frac{dy}{dx}=-\frac{1}{x}[a\sin(\log x)+b\cos(\log x)]$$

$\Rightarrow x\frac{d^2y}{dx^2}+x\frac{dy}{dx}=-y$ ....[From (i)]

$$\Rightarrow x\frac{d^2y}{dx^2}+x\frac{dy}{dx}+y=0$$

146 **(c)**

$x\cos y dy=(xe^x\log x+e^x)dx$

$$\Rightarrow \cos y dy=\left(e^x\log x+\frac{e^x}{x}\right)dx$$

On integrating both sides, we get

$\sin y=e^x\log x+c$

147 **(d)**

When three coins are tossed, there may be 1 head,

2 heads, 3 heads or no heads at all
Thus, the possible values of X are 0, 1, 2 and 3
Now, $P(X = 0) = P$ (getting no head)
$= P(TTT) = \frac{1}{8}$
$P(X = 1) = P$ (getting one head)
$= P(HTT, THT, TTH) = \frac{3}{8}$
$P(X = 2) = P$ (getting two heads)
$= P(HHT, THH, HTH) = \frac{3}{8}$
$P(X = 3) = P$ (getting three heads)
$= P(HHH) = \frac{1}{8}$
∴ Option (D) is the correct answer

148 **(a)**
$\text{Mean} = (1)\left(\frac{1}{4}\right) + (2)\left(\frac{1}{8}\right) + (3)\left(\frac{5}{8}\right) = \frac{19}{8}$