UNITS AND DIMENSIONS

MODEL-1

1) Check dimensionally the correctness of an equation $v^2 - u^2 = 2as$.
2) On the basis of dimensional analysis Show that the following relationship is correct $v = \sqrt{\frac{E}{d}}$

   Where 'v' is the velocity of sound, 'E' the elasticity of the medium and 'd' the density of the medium.
3) Using dimensional method, Check the correctness of the relation $v_e = \sqrt{\frac{2GM}{R}}$ where v_e escape velocity, M is mass, R is radius and G is gravitational constant.
4) By dimensional analysis show that 'J' is the angular momentum and E is the kinetic energy, then $\frac{E^2}{J}$ has the dimensions of power?
5) Show that $\sqrt{2gh}$ has the dimensions of velocity.
6) If 'p' is the momentum, m is the mass then show by dimensional method that $\frac{p^2}{2m}$ has dimensions of the energy?
7) By dimensional method, show that $\frac{GM}{R^2}$ represents acceleration. If G = gravitational constant, 'M' mass of the earth, R is radius.
8) Show that energy per unit volume represents pressure.
9) Prove by dimensional method the acceleration of a particle moving on the circumference of the circle is given by the formula $a = \frac{v^2}{R}$. Where 'v' is the linear velocity and 'r' the radius of the circle.
10) By the method of dimensions show that $\sqrt{\frac{R}{g}}$ represents time if 'g' is the acceleration due to gravity and 'R' is radius.
11) Dimensionally check the correctness of the following equation for Newton's law of gravitation $F = \frac{Gm_1m_2}{r^2}$ Where 'F 'is the force of attraction between two masses $m_1$andm_2, 'r' is the distance between them, 'G' is the gravitational constant.
12) By dimensional method check the correctness of the equation $T = 2\pi\sqrt{\frac{l}{g}}$ where 'T' is the time period, 'g' is the acceleration due to gravity and 'l' is the length of the pendulum.
13) Derive the dimensional formula of universal gas constant? (Ans: $R = ML^2T^{-2}k^{-1}\ mol^{-1}$)
14) If $x = at + bt^2$ where 'x' is meters and't' is in seconds. What are the dimensions and units of 'a' and 'b'.

    (Ans :a = LT^{-1} ,m/s; b = LT^{-2} ,m/s^2)
15) The velocity of a particle is given by the equation$V = At^2 + Bt + C$. Find the dimensions and units of the constant A, B and C. (Ans : A = LT^{-3} ,m/s^3 ; B = LT^{-2} ,m/s^2 ,C = LT^{-1} ,m/s)

16) The acceleration of a body is given by $a = At^2 + Bt$. Find the dimensional formulas for constants A and B, Where't' is time. (Ans : A = LT^{-4},m/s^4;b = LT^{-3},m/s^3)

17) If $\mu = A + \frac{B}{\lambda^2}$ where μ is a refractive index and λ is the wave length is dimensionally correct. What are the dimensions of A and B? (Ans : A = $M^0L^0T^0$, B = L^2)

18) If the expression $s = at + bt^2 + ct^3$ is dimensional true, find the dimensions of $\frac{c}{b}$?

(here's' is the displacement at any instant 't'? (Ans:T^{-1})

19) In the real gas equation $\left(P + \frac{a}{v^2}\right)(v - b) = RT$ what are the dimensions of the constants 'a' and 'b'.

(Ans : a = ML^5T^{-2}, b = L^3)

20) The velocity (v) of a particle is given in terms of time (t) by the equation $v = at + \frac{b}{t} + c$ find the dimensions of a, b and c? (Ans : LT^{-2}, L, LT^{-1})

21) In the equation $E = hv$ where 'E' is energy 'v' is frequency and 'h' is the Planck's constant. What is the dimensional formula of Planck's constant 'h'. (Ans : ML^2T^{-1})

22) If 'l' is length of a string of linear density (mass per unit length) 'm' under a tension 'T'. Show that $2l\sqrt{\frac{m}{T}}$ has the same dimensional formula as time.

23) By the method of dimensional analysis show that the relationship surface tension $T = \frac{hrdg}{2}$ Where 'h' is the height of liquid; 'r' is radius of the capillary tube ,'d' is the density of liquid and 'g' is the acceleration due to gravity.

24) If 'n' is the rigidity modulus, 'r' is the radius, 'l' is the length and 'c' is the moment of the couple, show that $\frac{2lc}{\pi nr^4}$ has no dimensions.

25) State whether the equation $h = \frac{2T\cos\theta}{rdg}$ where θ is the angle of contact, 'd' is the density of the liquid, 'r' is the radius of the tube, 'g' is the acceleration due to gravity, 'T' is the surface tension and 'h' is the height through which the liquid rises in a capillary tube is dimensionally correct or not.

26) Test by the method of dimensional analysis the accuracy of the following relation $\eta = \frac{\pi pr^4}{8vl}$ where 'p' is the pressure difference between two ends of the capillary tube, 'r' it`s radius, 'l' its length, 'v' is the rate of flow of liquid through it and η is the coefficient of viscosity?

27) If the energy is represented by 'E', mass 'm' angular momentum by 'L' and universal gravitational constant by 'G'. Show that $\frac{EL^2}{m^5G^2}$ is dimension less quantity?

MODEL-2

28) Convert a joule into erg (or) Convert the unit of energy from SI to C.G.S. system? (Ans:1 J = 10^7 erg)

29) Convert a dyne into newton (or) Convert the unit of force fromC.G.S. to SI system? (1 N=10^5 dyne)

30) Convert the units of density in C.G.S into S.I.

(or)

Convert gr/c.c. into kg / m^3 ? (Ans: 1 gr/c.c.=10^3 kg / m^3)

31) Convert the units of pressure in C.G.S. (dyne/cm^2)into S.I.(N / m^2) ? (Ans: 1 dyne/cm^2 = 10^{-1} N / m^2)

32) Convert C.G.S unit of young`s modulus (dyne/cm^2) into SI unit of (n/m^2) ?(1 dyne/cm^2 = 10^{-1} N/m^2)

33) The young`s modulus of steel is 1.6×10^{12} dyne/cm^2 find its value in SI system by dimensional method? (Ans: 1.6×10^{11} N/m^2)

34) Convert C.G.S unit of density (gr/cm^3) into SI unit of density (kg/m^3) ? (Ans: 1 gr/cm^3= 10^3 kg/m^3)

35) The density of oil is 0.75 gr/cm^3. What its value in SI system (kg/m^3) (Ans: 750 kg/m^3).

36) Convert the units of surface tension from SI (N/m) to C.G.S (dyne/cm) ? (Ans :1 N/m = 10^3 dyne/cm)

37) Convert the unit of torque from SI system (nm) into C.G.S system (dyne-cm)?(1 N-m =10^7 dyne-cm)

38) Find the ratio of SI unit of universal gravitational constant to C.G.S unit? (Ans: 10^3)

39) The ratio of SI unit to the CGS unit of plank`s constant? (Ans:10^7)

40) If units two systems of measurements are in the ratio 2:3, find the ratio of the units of angular momentum in those two systems? (Ans: 4:9)

41) If the fundamental units in the two systems of measurement are in the ratio 2:3 , then find the ratio of units of surface tension in those two systems? (Ans: 3:2)

MODEL-3

42) Derive the relationship that links KE, mass and velocity by dimensional analysis? (k=1/2) (KE =½mv^2)

43) Derive the equation connections the physical quantities energy, mass and velocity of light.(k=1).

(ANS: E =mc^2)

44) By the dimensional method obtain a relation that links the physical qualities PE , mass, acceleration due to gravity and height .(k=1) (ANS: PE = mgh)

45) The acceleration 'a' circle depends on radius 'r' of the circle and speed 'v' of the particle. Find the relation among them by dimensional method. (Ans: $a = \frac{v^2}{r}$).

46) The escape velocity v of a body depends upon the radius r of the planet and acceleration due to gravity g on the surface of the planet derive an expression for escape velocity by dimensional method?(k=1) (Ans: V=$\sqrt{rg}$).

47) Derive the equation connecting velocity of sound in air, elasticity of the medium and density of the medium? (k=1) (ANS: V =$\sqrt{E/d}$)

48) Velocity of sound in air depends on pressure P and density d. find the relation among them using dimensional analysis? (Ans: $V = k\sqrt{\frac{p}{d}}$)

49) Derive the equation for the period of oscillation of a simple pendulum. (Ans : $T = 2\pi\sqrt{\frac{l}{g}}$)

50) Obtain by the method of dimensional analysis an expression for the frequency 'n' of transverse vibrations produced in a string assuming that 'n' depends upon (1) length 'l' of the string, (2) tension 'T' in the string and (3) mass per unit length 'm' of the string. (K =1/2). (ANS: $n = \frac{1}{2l}\sqrt{\frac{T}{m}}$)

51) A gas bubble from an explosion under water, oscillates with a period 'T' proportional to $p^a d^b E^c$ where P is the pressure, 'd' is the density and 'E' is the energy of the explosion. Find the value of a, b and c ?

(ANS: a=-5/6, b=1/2, c=1/3).

52) For the equation $F \alpha A^a V^b d^c$ where F is the force A is the area 'v' is the velocity and'd' is the density. Find the value of a, b, c from dimensional analysis. (Ans : a = 1,b = 2,c = 1)

MODEL-4

53) If the unit of length is quadrupled and the unit of time is doubled how does the unit of velocity change?

(Ans : doubled)

54) If the unit of mass, unit of length each doubled and unit of time is doubled how does the unit of force change? (Ans: unchanged)

55) If the unit of length is doubled mass is tripled and time is halved how does the unit of pressure changes.

(ANS: 6 times increases)

56) If the unit of length and mass are doubled. How does the unit of density change? (ANS:1/4 times)

57) If the units of length and force be each increased four times. Show that the unit of energy is increased sixteen times.

58) If the unit of mass is made four times unit of length unchanged and unit of time is doubled. How does the unit of surface tension change? (ANS: unchanged)

59) If the unit of length mass and time each be doubled. How does the unit of work change? (ANS: doubled)

60) The dimensional formula of the product of two physical quantities 'a' and 'b' is ML^2T^{-2}. The dimensional formula of $\frac{a}{b}$ is ML^0T^{-2}. What are the dimensions and units of 'a' and 'b'. (a=MLT^{-2}, b=L)

61) What will be the unit of force when units of length mass and time are each doubled? (ans: unchanged)

62) If the velocity 'v', acceleration 'A' and 'F' are taken as fundamental quantities, obtain the dimensional formula of linear momentum? (Ans: $FA^{-1}v$)

63) If the energy 'E', velocity 'v', and time 'T' are taken as fundamental qualities, what is the dimensional formula of surface tension? (Ans: $E^1v^{-2}T^{-2}$)

64) If force, length time is taken bas fundamental qualities, what are the dimensions of mass? (Ans: $FL^{-1}T^{+2}$)

65) If energy E and volume v are the fundamental qualities, which physical quantity has dimensional formula EV^{-1} (Ans: Pressure)

66) When the pressure 'p', velocity 'v' and time 'T' are taken as fundamental quantities find dimensional formula of force. (Ans: $P^1V^2T^2$)

67) If the unit of mass is 1 gr. And the unit of length 1 mm, the unit of time is 1 μs, find the unit of force. (Ans:10^6N).

68) If the unit of work is 5×10^{-9} J, unit of mass is 500 gr, unit of time of time is 10^3 seconds. Find the (i) the unit of length (ii) unit of force. (Ans: L = 0.1m,F=5×10^{-8})

69) If the unit of length is doubled, unit of time is halved and unit of force is quadrupled, find the unit of power? (Ans: P =16p)

70) If the unit of mass is taken as 10 kg, unit of time of 1 minute and unit of 'g' as 0.81 m/s^2, what is the unit of energy? (Ans:23619.6 J)

Assignment Questions

1. Define unit and write its characteristics?
2. What is a physical quantity? Define fundamental and derived physical quantities and give examples?
3. Define fundamental unit and derived unit and give examples?
4. Define SI system and write the advantages of SI system?
5. State the rules followed in writing SI units?
6. Define the terms dimensions and dimensional formula of a physical quantity?
7. Derive dimensional formulae of different physical quantities?
8. Define dimensional constants and dimension less quantity with examples?
9. State the principle of homogeneity of dimensions?
10. Write the limitations of dimensional analysis?

UNIT -2 **ELEMENTS OF VECTORS**

MODEL:-1

1. An aircraft of Indian airlines is climbing with a steady speed of 200m/s at an angle of 20° to horizontal. What are the horizontal and vertical components of its velocity? (Ans : Vx = 187.93 m/s,Vy = 68.40 m/s)
2. An aero plain takes off at an angle of 30^0 to the horizontal. If it's horizontal component of velocity has a magnitude of 250m/s. What is its actual velocity and vertical component of velocity? (Ans : V = 288.675 m/s,Vy = 144.33 m/s)
3. A force of 200N is inclined at an angle $30^0$to the horizontal. Find the component in the vertical and horizontal directions. (Ans : Fx = 173.2 N,Fy = 100 N)
4. The horizontal component of a force making an angle60^0 with the horizontal is 30N.What are the magnitudes of the force and the vertical component of the force. (Ans : F = 60 N,Fy = 51.96 N)
5. An aeroplane is heading north east at a speed of 141.4ms^{-1}. Find the northward component of its velocity? [100ms^{-1}]
6. If the vertical component of a vector is 60 units and the vector is making an angle 60° with the horizontal, find the horizontal component of the vector? [ANS: $20\sqrt{3}$ units]
7. A car weighing 100kg is on a slope that makes an angle 30° with the horizontal. Find the component of cars weight parallel to the slope (g = 10 m/s^2) [ANS: 500N]
8. The horizontal and vertical components of a force are 8N and 15N respectively. Find the force? [Ans: 17 N]
9. If the components of a force are P and P along east and north directions, find the force? (Ans :$\sqrt{2}\,P$)
10. If $\vec{A}$=3i+4j+5k, find the magnitude of $\vec{A}$? [ANS: $5\sqrt{2}$]
11. If $\vec{A} = 3\vec{\imath} - 4\vec{\jmath} - 2\vec{k}$ and $\vec{B} = 2\vec{\imath} + 4\vec{\jmath} - 5\vec{k}$ .Find (1)$|\vec{A}|$(2)$|\vec{B}|$(3)$|\vec{A} + \vec{B}|$(4)$|\vec{A} - \vec{B}|$ (Ans:$\sqrt{29}, \sqrt{45}, \sqrt{74}, \sqrt{74}$)
12. If $\vec{A} = 2\vec{\imath} + 3\vec{\jmath} + 4\vec{k}$ and $\vec{B} = \vec{\imath} - \vec{\jmath} - 6\vec{k}$, find the magnitudes of $\vec{A} + \vec{B}$ and $\vec{A} - \vec{B}$.[Ans: $\sqrt{17}$ and $\sqrt{117}$]
13. If $\vec{A} = i + j + k$ and $\vec{B} = 2i - j + 4k$, what is $\vec{C}$ such that 6$\vec{A}$+$\vec{B}$-2$\vec{C}$=0 ? [ANS: 4i+2.5j+5k]
14. Two vectors are given by ā=-2i+j-3k and $\bar{b}$=5i+3j-2k. find third vector $\vec{C}$ is if 3a+2b-c=0? [4i+9j-13k]
15. Find the unit vector parallel to the resultant of vectors $\vec{A} = 2\vec{\imath} + 4\vec{\jmath} - 5\vec{k}\ and \vec{B} = \vec{\imath} + 2\vec{\jmath} + 3\vec{k}$ ($\frac{3\vec{\imath}+6\vec{\jmath}-2\vec{k}}{7}$)
16. Find unit vector in the direction of $\vec{A} = 3\vec{\imath} + 4\vec{\jmath}$ (Ans :$\frac{3\vec{\imath}+4\vec{\jmath}}{5}$)
17. Find the unit vector parallel to vector $\vec{A} = 2\vec{\imath} + 3\vec{\jmath} + 4\vec{k}$ (Ans :$\frac{2\vec{\imath}+3\vec{\jmath}+4\vec{k}}{\sqrt{29}}$)
18. The horizontal and vertical components of a vector are 20 and 30 units respectively. Find the angle made by the vector with the horizontal? (Ans : $\tan^{-1}\left(\frac{3}{2}\right)$)
19. $\vec{P}$=i+2j-6k and $\vec{Q}$=2i+4j+k, find the unit vector parallel to $\vec{P}$+ $\vec{Q}$? [ANS: $\frac{3i+6j-5k}{\sqrt{70}}$]
20. If $\vec{A}$=3i+4j and $\vec{B}$=7i+24j, find the vector having the same magnitude as $\vec{B}$ and parallel to $\vec{A}$? [15i+20j]

21. Find the value of C if $\vec{P}$=0.3i+0.4j+Ck is a unit vector? [ANS: $\sqrt{0.75}$]

22. If $\vec{r}$=0.2i+aj-0.3k is a unit vector, find the value of a.? [ANS: $\sqrt{0.87}$]

23. Given $\vec{A}$=3i+j+k and $\vec{B}$=i-2j+3k. Find the unit vector parallel to $\vec{A}-\vec{B}$? [ANS: $\frac{2i+3j-2k}{\sqrt{17}}$]

24. A vector is represented by$3\vec{\imath}+\vec{\jmath}+2\vec{k}$. What is its length in X-Y plane? (Ans:$\sqrt{10}$)

25. If $\vec{P}$=i+2j+6k, find its direction cosines? [ANS: $\frac{1}{\sqrt{41}}$,$\frac{2}{\sqrt{41}}$ and $\frac{6}{\sqrt{41}}$]

MODEL:-2

26. Two forces 20N and 40N are acting simultaneously at a point. If the angle between the two forces is 45^0. Find the magnitude and direction of their resultant? (Ans : 55.95 N,$30^0 19^{l} 39^{ll}$)

27. The angle between two vectors of equal magnitude P is θ, Find the magnitude of the resultant vector? [ANS: 2P sin$\frac{\theta}{2}$]

28. Two equal forces have a resultant equal to either. Find the angle at which they are inclined? (Ans : 120^0)

29. The resultant of two equal forces is 141.4N when they are mutually perpendicular, find the magnitude of each force? [ANS: 100N]

30. The resultant of two equal forces acting at right angles to each other is 1414N. What are the magnitudes of each force? (Ans: 1000 N)

31. Two forces of magnitude 30N and 40N are acting on a body perpendicular to each other. Find the resultant force both in magnitude and direction. (Ans: 50 N,$53^0 7^{l}$)

32. If two forces of 30N and 40N act simultaneously on a particle inclined at $60^0$to each other. Find the magnitude and direction of the resultant? (Ans: 60.83 N,$34^0 42^{l} 51^{ll}$)

33. The resultant of two equal forces each of 100N is 150N. Find by calculation the angle between the directions of the two forces? (Ans: $82^0 49^{l}$)

34. The resultant of two forces 12N and 16N is 20N. Find the angle between them? (Ans: 90^0)

35. The resultant of two forces 8N and 6N is 10N. Find the angle between them? (Ans: 90^0)

36. The resultant of two forces 2P and $\sqrt{2}$P is $\sqrt{10}$P. Find the angle between the forces? [ANS: 45°]

37. A force $\vec{F}_1$ when added to a force $\vec{F}_2$ =3i-5j gives a resultant force$\vec{F}$= -4i. Find $\vec{F}_1$? [ANS: -7i+5j]

38. The square of the resultant of two forces 4N and 3N exceeds the square of the resultant of the two forces by 12 when they are mutually perpendicular. Find the angle between the vectors? [ANS: 60°]

39. The greatest and least resultants of two forces act at a point are 29N and 5N. If each force is increased by 3N and applied at right angles on a particle, find the new resultant force. [ANS: 25N]

40. The resultant of two forces at right angles is 13N. The minimum resultant of the two forces is 7N. Find the forces? [ANS: 5N,12N]

MODEL:-3

41. Find the dot product of two vectors $\vec{A} = 2\vec{\imath} + 5\vec{\jmath} + 7\vec{k} and\ \vec{B} = 3\vec{\imath} + 8\vec{\jmath} - 4\vec{k}$? (ANS : 18)

42. If $\vec{A} = 3\vec{\imath} + 2\vec{\jmath} - 7\vec{k}$ and $\vec{B} = 3\vec{\imath} - 5\vec{\jmath} + 4\vec{k}$. Find $\vec{A}.\vec{B}$? (ANS : - 29)

43. If $\vec{A} = 2\vec{\imath} + 3\vec{\jmath} + 7\vec{k}$, and $\vec{B} = 2\vec{\imath} + 3\vec{\jmath} + 5\vec{k}$. Find the magnitudes of $\vec{A}, \vec{B}\ and\ \vec{A}.\vec{B}$? $(\sqrt{62}, \sqrt{38}, 48)$

44. Calculate the work done when a force of $2\vec{\imath} + 5\vec{\jmath} + 5\vec{k}$ acts on a body producing a displacement of $2\vec{\imath} + 4\vec{\jmath} + 6\vec{k}$? (ANS : 54)

45. A force of $\vec{F} = \vec{\imath} + 5\vec{\jmath} + 7\vec{k}$ acts on a particle and displaces it through a distance $\vec{S} = 6\vec{\imath} + 9\vec{k}$.calculate the work done? (ANS : 69 J)

46. A Force $4\vec{\imath} + 6\vec{\jmath} + 3\vec{k}$ produces a displacement $3\vec{\imath} + 4\vec{\jmath} + 5\vec{k}$.Find the work done? (ANS : 51 J)

47. A force of $6\vec{\imath} + 12\vec{\jmath} + 8\vec{k}$ produces a displacement of $2\vec{\imath} + 8\vec{\jmath} + 2\vec{k}$. Find the work done? (ANS : 124 J)

48. Find the work done by the force $\vec{F} = 3\vec{\imath} + 5\vec{\jmath} + \vec{k}$ which produces a displacement of $\vec{S} = 2\vec{\imath} + \vec{\jmath} + 4\vec{k}$? (ANS:15 J)

49. A force $\vec{F}$=3i+j+5k displaces a particle from its initial position $\vec{r}_1$=i-2j+6k to $\vec{r}_2$=4i+5j-k. Find the work done by the force? [ANS: -19 units]

50. A force of $2\vec{\imath} + 3\vec{\jmath} + 4\vec{k}$N acts on a body for 4 seconds and produce a displacement of $3\vec{\imath} + 4\vec{\jmath} + 5\vec{k}$ Evaluate power. (ANS : 9.5 N)

51. Find the power if a force $\vec{F} = 3\vec{\imath} + 4\vec{\jmath} + 6\vec{k}$ N produces a displacement $\vec{S} = 5\vec{\imath} + 7\vec{\jmath} + 2\vec{k}$ m in 1 minute. (0.917 W)

52. A force $\vec{F}$=(i+j+k) newton produces a displacement $\vec{s}$=(2i-j+3k) metre in 10s. Find the power of the agency? [ANS: 0.4 W]

53. If a particle undergoes displacement (5i+2j+6k) when a force (i-2j+7k) acts for 10s, Find the power? [Ans: 4.3units]

54. Find the work done by a force (2i-j+5k) when it displaces the body from a point (34,-6) to a point (7,2,5). [ANS: 65 units]

55. Because of the application of force $\vec{F}$=4i-5j N, the velocity of a body at any instant is given by $\vec{v}$=2i-7j ms^{-1}. Find the instantaneous power? [ANS: 43 W]

56. When a force (8i+4j) N displaces a particle through (3i-3j) m, the power is 0.6W. Find time of action of the force? [ANS: 72 s]

57. A force (4i+j+k) N displaces a body from the position (i+j+k) to (3i-2j-2k) m. Find the work done by the force? (3 J)

58. Find the angle between the vectors $\vec{P} = 2\vec{\imath} + 2\vec{\jmath} - \vec{k}$ and $\vec{Q} = 6\vec{\imath} - 3\vec{\jmath} + 2\vec{k}$?(ANS: $79^0\ 1'$)

59. The angle between the vectors 2i+j-3k and 3i+2k? [ANS: 90°]

60. Find the angle between the vectors $\vec{A} = 2\vec{\imath} + 3\vec{\jmath} + 4\vec{k}$ and $\vec{B} = 3\vec{\imath} + 4\vec{\jmath} + 2\vec{k}$? (ANS : $\cos^{-1}\left(\frac{26}{29}\right)$)

61. If $\vec{A}$=i+j and $\vec{B}$=j-k, find the angle between $\vec{A}$ and$\vec{B}$? [ANS: 60°]

62. Find the angle between two vectors$\vec{A} = 2\vec{\imath} + 3\vec{\jmath} + \vec{k}$ and $\vec{B} = 2\vec{\imath} + 3\vec{\jmath} + 5\vec{k}$? (ANS : $38^0 44^{\prime}$)

63. The magnitudes of two vectors are 3 and 4 units and their scalar product is 6 units. Find the angle between them in radians? [ANS: $\frac{\pi}{3}$rad]

64. Find the angle between the vectors i+j+2k and 2i+3j-k? [ANS: $\cos^{-1}\frac{3}{\sqrt{84}}$]

65. If $\left|\vec{A} + \vec{B}\right| = \left|\vec{A} - \vec{B}\right|$ show that $\vec{A}\ and\ \vec{B}$ are perpendicular to each other?

66. If$\left|\vec{A} + \vec{B}\right| = \left|\vec{C}\right|$ and $A^2 + B^2 = C^2$ then show that the angle between A and B is 90^0?

67. Show that $\left|\vec{A} + \vec{B}\right|^2 - \left|\vec{A} - \vec{B}\right|^2 = 4\left(\vec{A}\,.\,\vec{B}\right)$

68. Two vectors $\vec{P} = 2\vec{\imath} + a\vec{\jmath} + \vec{k}$ and Q $= 3\vec{\imath} - \vec{\jmath} - \vec{k}$ are perpendicular to each other. Calculate the value of 'a'. (Ans: 5)

69. Find the value of 'n' if $\vec{\imath} + 2\vec{\jmath} + n\vec{k}$ and $4\vec{\imath} + 2\vec{\jmath} + 2\vec{k}$ are perpendicular? (ANS : - 4)

70. If $\vec{A}$=2i-3j+k, Find the$\vec{A}.\vec{A}$? [ANS: 14]

71. Find a vector perpendicular to the vector (3i+5j)? [ANS: 5k]

72. Find a vector perpendicular to the vector (i+2j) and having magnitude $3\sqrt{5}$ units. [ANS: 6i-3j]

73. The square of the resultant of two equal forces is equal to 3 times their product. Find angle between the two forces? (ANS : $\cos^{-1} 2$)

MODEL:-4

74. If $\vec{A} = -2\vec{\imath} + 3\vec{\jmath} + 4\vec{k}$ and $\vec{B} = \vec{\imath} - 6\vec{\jmath} + 5\vec{k}$ then find $\vec{A}X\vec{B}\ and\ \left|\overrightarrow{A}X\vec{B}\right|$? (ANS : $39\vec{\imath} + 14\vec{\jmath} + 9\vec{k}$,42.40)

75. If$\vec{A} = 2\vec{\imath} + 3\vec{\jmath} - 4\vec{k}$ and $\vec{B} = 3\vec{\imath} - 4\vec{\jmath} + 5\vec{k}$ find $\vec{A}X\vec{B}$ $(ANS: -1\vec{\imath} - 22\vec{\jmath} - 17\vec{k}$)

76. If $\vec{A} = -2\vec{\imath} + 3\vec{\jmath} + 4\vec{k}$ and $\vec{B} = \vec{\imath} - 6\vec{\jmath} + 5\vec{k}$ find the magnitude of $\vec{A}X\vec{B}$ (Ans: 44.271)

77. Find the cross product of the vectors (2i-3j+4k) and (i+4j-5k) $(ANS: -1\vec{\imath} + 14\vec{\jmath} + 11\vec{k})$

78. If $\vec{P}$=i+j+2k and $\vec{Q}$=3i-2j+k, find the unit vector perpendicular to both $\vec{P}$ and $\vec{Q}$? $\left(ANS: \left(\frac{5\,\vec{\imath}+5\vec{\jmath}-5\vec{k}}{5\sqrt{3}}\right)\right.$)

79. The radius vector $\vec{r}$=2i+5k and the angular velocity of a particle is $\vec{\omega}$=3i-4k. Find and then the linear velocity of the particle? $(ANS: (23\vec{\jmath})$

80. A particle of mass 0.2kg is moving with linear velocity (i-j+2k).if the radius vector$\vec{r}$=4i+j-k, find the angular momentum of the particle?

81. If the radius vector is $\vec{r}$=6i+j+3k and the force $\vec{F}$=i-4j+k, find the torque? $(ANS:$ (13i-3j+25k))

82. Find (i+j)x(i-j) ? $(ANS: -2\vec{k})$

83. Find (i+j+k)x(i+j-k) ? $(ANS:$ (-2i+2j)

84. Find the vector perpendicular to the plane of $\vec{A} = 2\vec{\imath} - 6\vec{\jmath} - 3\vec{k}$ and $\vec{B} = 4\vec{\imath} + 3\vec{\jmath} - \vec{k}$. Also find the unit vector perpendicular to the plane of $\vec{A} and\ \vec{B}$? (ANS : $15\vec{\imath} - 10\vec{\jmath} + 30\vec{k}$, $\frac{15\,\vec{\imath} - 10\vec{\jmath} + 30\vec{k}}{35}$)

85. What is the area of a parallelogram formed from the vectors $\vec{A} = \vec{\imath} + 2\vec{\jmath} + 3\vec{k}$ and $\vec{B} = 3\vec{\imath} - 2\vec{\jmath} + \vec{k}$ (Ans:13.856 square units)

86. Find the area of the parallelogram whose adjacent sides are (3i-j+2k) and (i+4j-6k)? (ANS : 23.93 square units)

87. Find the area of the parallelogram whose adjacent sides are given by $\vec{A}$=4i-5j+2k and $\vec{B}$=2i+3j-k? (ANS : 23.43 square units)

88. Find the area of the triangle formed by the adjacent sides with vectors $\vec{A} = -3\vec{\imath} + 2\vec{\jmath} - 4\vec{k}$ and $\vec{B} = -\vec{\imath} + 2\vec{\jmath} + \vec{k}$ (ANS: 12.542 square units)

89. Find the area of the triangle whose base is given by $\vec{A}$=i+j+k and one of the two sides by $\vec{B}$=4j+3k? (Ans:2.55 square units)

90. The scalar and vector products of two vectors are 173.2 and 100 units respectively. Find the between the vectors? [ANS: 30°]

91. The scalar and vector products of two vectors are 48 $\sqrt{3}$ and 144 units respectively. Find the angle between the vectors? (Ans: 60^0)

92. The magnitude of the vector product of two vectors is equal to the magnitude of their scalar product. What is the angle between the two vectors? (Ans: 45^0)

93. The magnitude of the vector product of two vectors is $\sqrt{3}\ times$ their scalar product. Find angle between the vectors. (Ans: 60^0)

94. Magnitude of the cross product is equal to $\frac{1}{\sqrt{3}}$times the dot product. Find the angle between the two vectors. (Ans: 30^0)

95. Find the value of $\left|\vec{A}X\vec{B}\right|^2 + \left|\vec{A}.\vec{B}\right|^2$ (Ans: A^2B^2)

ASSIGNMENT QUESTIONS

1. Define scalars and vectors. Give examples?
2. Define different types of vectors?
3. State parallelogram law of vectors?
4. Using parallelogram law, find the magnitude and direction of the resultant, when the angle between the two vectors is $\theta = 0^0$ and $\theta = 90^0$?
5. State and explain triangle law of addition of vectors?
6. State and explain polygon law of addition of vectors?
7. Define scalar product of two vectors?
8. Explain work done, power on the basis of scalar product?
9. Define vector product of two vectors?
10. Explain torque and linear momentum on the basis of vector product?
11. Write the properties of scalar product?
12. Write the properties of vector product?

Model - 1

1. A ball is dropped from the top of a building and is found to reach the ground in 4s. Find the height of the building? (HINT: $t_d=\sqrt{2h/g}$ =>h=$\frac{1}{2}gt_d^2$) (ANS: 78.4m)
2. In order to keep a body in air above the earth for 12seconds, with what velocity the body is to be thrown vertically up? (HINT:-T =$\frac{2u}{g}$) (ANS: 58.8m/s)
3. A stone is thrown up vertically with a velocity of 98m/s. Find the total distance travelled before it reaches the ground? (HINT:-total distance=2 H_{max}) (ANS: 980m)
4. A body is projected vertically upwards with a velocity of 128m/s. Find the time of ascent? (HINT:-t_a =$\frac{u}{g}$) (ANS: 13s)
5. If a body is thrown up with a velocity of 98m/s, find its position after 15 seconds of projection. (HINT:-S=ut-$\frac{1}{2}gt^2$) (ANS: 367.5m)
6. A body is dropped from the top of a building of height 40m. Find the velocity of the body on reaching the ground. (HINT: V=$\sqrt{2gh}$) (ANS: 28m/s)
7. A stone is dropped from a height of 1000m. Find the time taken by it to reach the ground and its velocity when it strikes the ground. (HINT: V=$\sqrt{2gh}$, t_d=$\sqrt{2h/g}$) (ANS: 140 m/s, 14.28 s)
8. A stone is dropped from a height of 80m. Find the velocity and time taken by the stone on reaching the ground. (HINT:-V=$\sqrt{2gh}$, t_d=$\sqrt{2h/g}$) (ANS: 39.6m, 4.04s)
9. A stone is dropped from the top of a tower freely . Find the velocity attained by it in 3 seconds? (HINT:-V=gt) (ANS: 29.4m/s)
10. A freely falling body strikes the ground in 6 seconds. Find the ratio of the distances travelled by it in last 3seconds of its travel? (ANS: 7:9:11)
11. A body is thrown vertically with a velocity of 19.6m/s. Find the maximum height reached and the total time taken to reach the ground?(HINT:-H_{max}=$\frac{u^2}{2g}$, T =$\frac{2u}{g}$) (ANS: 19.6m, 4s)
12. A stone is thrown vertically upwards from the ground with a velocity of 14m/s. Find the maximum height reached and time of descent? (HINT:-H_{max}= $\frac{u^2}{2g}$, t_d =$\frac{u}{g}$) (ANS: 10m, 1.43s)
13. A body projected vertically upwards from the ground reaches a maximum height of 44.1m and falls to the ground. Find the time taken by the body to reach the ground? (HINT:-u=$\sqrt{2g\mathrm{Hmax}}$ T =$\frac{2u}{g}$) (ANS:6s)
14. A body when dropped freely from certain height covers 24.5m during its last second of its motion. Calculate the height from which the body is dropped freely.(HINT:-h=ut-$\frac{1}{2}gt^2$ and h=$\frac{u^2}{2g}$) (ANS:44.1m)

15. A Stone is dropped from the top of a tower. If it travels 44.1m in the last second, calculate the height of the tower? (HINT:-h=ut-$\frac{1}{2}$gt^2 and h=$\frac{u^2}{2g}$) (ANS: 122.5m)

16. A stone falls from a cliff and travels 34.3m in the last second, before it reaches the ground at its foot. Find the height of the cliff. (HINT:-h=ut-$\frac{1}{2}$gt^2 and h=$\frac{u^2}{2g}$) (ANS: 78.4m)

17. A stone is allowed to fall freely from the top of a tower 100m high and at the same time another stone is Projected vertically up from the ground with a velocity of 25m/s. Find when and where the two stones will meet? (HINT:-h_1+h_2=100m,h_1=$\frac{1}{2}$gt^2 ,h_2=ut-$\frac{1}{2}$gt^2) (ANS: 4s, 21.6m)

18. A stone is allowed to fall from the top of a tower 300m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 75m/s. When and where the two stones will meet? (HINT:-h_1+h_2=300m,h_1=$\frac{1}{2}$gt^2 ,h_2=ut-$\frac{1}{2}$gt^2) (ANS: 4s, 221.6m)

19. A stone is allowed to fall from the top of a tower 78.4m high and at the same time another stone is projected vertically upwards with a velocity of 39.2m/s. Find when and where the two stones will meet? (HINT:-h_1+h_2=78.4m,h_1=$\frac{1}{2}$gt^2 ,h_2=ut-$\frac{1}{2}$gt^2) (ANS: 2s, 58.8m from ground)

20. A stone is projected vertically upwards from the ground with a velocity of 96m/s. after 2seconds another stone is projected upwards from the same place with velocity of 100m/s. When and where the two stones meet each other?(HINT:-h_1=h_2,h_1=96t-$\frac{1}{2}$gt^2 ,h_2=100(t-2)-$\frac{1}{2}$g(t-2)^2) (ANS: 469m, 9.3s)

21. A stone is dropped into a well and the sound of the splash is heard after3.91seconds. If the depth of the well is 67.6m, find the velocity of the sound? (HINT:-3.91= t_d+t_{sound} , t_d=$\sqrt{2h/g}$,V_{sound}=$\frac{h}{\text{tsound}}$) (ANS: 344.89 m/s)

22. A stone is dropped into a well 44.1m deep. If the velocity of sound is 330m/s, find after how much time the sound of splash is heard?(HINT:-t= t_d+t_{sound} , t_d=$\sqrt{2h/g}$,V_{sound}=$\frac{h}{\text{tsound}}$) (ANS: 3.13s)

23. A body falling freely under the action of gravity passes two points 9m apart vertically in 0.2s from what height above the higher point did it start to fall?(HINT:-h_1-h_2=9,h_1=$\frac{1}{2}$g(t+0.2)^2 ,h_2=$\frac{1}{2}$gt^2) (ANS: 98.87m)

24. A stone falls past a window 2.45m high in half a second from what height from the top of the window is it falling? (HINT:-h_1-h_2=2.45,h_1=$\frac{1}{2}$g(t+1/2)^2 ,h_2=$\frac{1}{2}$gt^2) (ANS: 0.306m)

25. A stone falls past a window 2m high in 0.2s. Find the height above the top of the window from which the stone was dropped. (g = 10 m/s^2) (HINT:-h_1-h_2=2m,h_1=$\frac{1}{2}$g(t+0.2)^2 ,h_2=$\frac{1}{2}$gt^2) (ANS: 4.05m)

26. A body is thrown up with a velocity reaches a maximum height of 100 m. Another body of double mass is thrown up with double initial velocity. What will be the maximum height of second body? (HINT:-$H_{max} \propto u^2$ $\frac{H1}{H2}$=U_1^2/U_2^2) (ANS: 400m)

27. A stone is thrown vertically upwards with a velocity of 9.8m/s. After one second another stone is thrown upwards with the same velocity. When and where the two stones will meet?

(HINT:-$h_1=h_2$, $h_1= ut-\frac{1}{2}gt^2$, $h_2= u(t-1)-\frac{1}{2}g(t-1)^2$) (ANS: 3.675m,1.5s)

28. A body is projected vertically upwards with a velocity of 30m/s. After 3 seconds another body is projected from the same point in the same direction with a velocity of 23 m/s. Find when and where they will meet? (HINT:-$h_1=h_2$, $h_1= ut-\frac{1}{2}gt^2$, $h_2= u_2(t-3)^2-\frac{1}{2}g(t-3)^2$) (ANS: 5.051s,26.52m)

29. A stone is projected vertically upwards from the ground with a velocity of 96m/s. After 2 seconds another stone is projected upwards from the same place with a velocity of 100m/s. Where the two stones will meet each other? (HINT:-$h_1=h_2$, $h_1=u_1t-\frac{1}{2}gt^2$, $h_2= u_2(t-2)^2-\frac{g}{2}(t-2)^2$) (ANS: 469m)

30. A body is projected upwards with a velocity of 25m/s. Find its velocity when it has reached a height of 20m. What least time it takes to get this velocity. (g = 10m/s^2)

(HINT:- $h_3= ut-\frac{1}{2}gt^2$, V=u-gt) (ANS: 15m/s, 1second)

Model - 2

31. A stone is projected vertically upwards from the top of a tower with a velocity 9.8m/s. It reached the ground after 6 seconds. What is the height of the tower? (HINT:- $h= -ut+\frac{1}{2}gt^2$) (ANS: 117.6m)

32. A stone is dropped from a balloon ascending with an uniform vertical velocity of 23.2m/s and reaches ground in 10 seconds. Find the height of the balloon when the stone is dropped.

(HINT: $h_1=-u_1t+\frac{1}{2}gt^2$,) (ANS: 258m)

33. A stone is projected vertically upwards from the top of a tower with a velocity of 4.9m/s. If it reaches the ground after 5 seconds, find the height of the tower?(HINT:-$h=-ut+\frac{1}{2}gt^2$) (ANS:98m)

34. A stone is dropped from a balloon which is moving vertically upwards with a uniform velocity of15 m/s. If the stone reaches the ground in 4 seconds; find the height of the balloon from ground when the stone is dropped? (HINT: $h_1=-ut+\frac{1}{2}gt^2$,) (ANS: 18.4 m)

35. A stone is projected vertically upwards with a velocity of 20m/s from the top of a tower of height 105m. Find the time taken by it to reach the foot of the tower? (HINT:- $t=\frac{u+\sqrt{u^2+2gh}}{g}$) (ANS: 7s)

36. A stone dropped from a balloon which is moving with a velocity 9m/s at height of 122.4m from the ground. Find the time taken by the stone to reach the ground. (HINT:- $t=\frac{u+\sqrt{u^2+2gh}}{g}$) (ANS:6s)

37. A stone is dropped from a balloon which is moving vertically upwards with uniform velocity, when it is at a height 18.4m. If the stone reaches the ground in 4s, find the uniform velocity of balloon?

(HINT: $h_1=-ut+\frac{1}{2}gt^2$,) (ANS: 15m/s)

38. A balloon raising vertically up with uniform velocity releases a body at a height of 18.4m. If it reaches the ground in 8 seconds, find the velocity of the balloon.(HINT: h_1=-ut +$\frac{1}{2}gt^2$) (ANS: 36.9m/s)

39. A stone is dropped from a balloon moving vertically up with a uniform velocity of 4m/s. Find the velocity of the stone after 2 seconds and also calculate the distance between the stone and the balloon?

(ANS:15.58m/s,19.6m)

40. A stone is dropped at a height 100m from a balloon moving vertically upwards with a velocity of 15m/s. Find (i) the height of the stone above the ground after 4s(ii) The distance between balloon and the stone? (HINT:-100-h=-ut +$\frac{1}{2}gt^2$) (ANS: 81.6m,78.4m)

41. A bag dropped from a balloon ascending with uniform vertical velocity 19.6m/s, reached the ground in 10 seconds. Find the height of the balloon, when the bag reached the ground?

(HINT:-h= h_1+h_2, h_1=-ut +$\frac{1}{2}gt^2$, h_2= uxt) (ANS: 490m)

42. A body is projected vertically upwards from the top of a tower of height 49 m with a velocity of 19.6m/s. Calculate the maximum height reached from the ground and the velocity on reaching ground?

(HINT:-H_{max}=49+U^2/2g, V^2-U^2=2gh) (ANS: 68.6m,36.66m/s)

43. A balloon ascending with a velocity of 14m/s releases a body when it is at a height of 98m. find the time taken by the body to reach the ground and the velocity with which it hits the ground?

(HINT:- V^2 - U^2 = 2gh, t =$\frac{u+\sqrt{u^2+2gh}}{g}$) (ANS: 6.12s,46.01m/s)

44. A stone thrown vertically upwards with an initial velocity 'u' from the top of a tower reaches the ground with a velocity '3u'. What is the height of the tower?(HINT:- V^2 - U^2 = 2gh) (ANS: $4\frac{u^2}{g}$)

Model -3

45. An aeroplane moving at a speed of 300m/s is vertically above the point 'A' at a height of 1.96Km when it released a bomb. If hits the target at 'B', find the distance between A and B?

(HINT:-R=u$\sqrt{2h}/g$) (ANS:6000m)

46. From an aeroplane a bomb is dropped from an altitude of 1402.5m. If the velocity of the aeroplane at that point is 500Kmph. Find the distance at which the bomb strikes the ground?

(HINT:-R=u$\sqrt{2h}/g$) (ANS: 2350m)

47. A shot is fired horizontally at a velocity of 200m/s. Find the magnitude and direction of velocity after 10 seconds. (HINT:-V=$\sqrt{u2 + g2 + t2}$) (ANS: 222.72m/s,$26^0$6'17'')

48. A plane is flying at 1960m with a speed of 630Kmph. It drops a bomb. Calculate the time taken for the bomb to reach the ground? (HINT:-T=$\sqrt{2h}/g$) (ANS: 20s)

49. A gun fires a bullet horizontally with a certain velocity from 9.8m from the foot of elevation and reches the ground making an angle 45^0 with the ground.. Find the velocity of the bullet at the beginning?

(HINT:-R=u$\sqrt{2h}/g$) (ANS: 6.93m/s)

50. An aeroplane flying horizontally with a certain velocity released a body at a height of 90m above point'A'. It reaches the ground at a distance of 214.5m from 'A' then find the velocity of the aeroplane when the body is dropped? (HINT:-R=u$\sqrt{2h}/g$) (ANS: 180Kmph)

51. A bomb is dropped from an aeroplane flying horizontally with a velocity of 9.8m/s at a height of 44.1m from the ground. Find when and where it reaches the ground? (HINT:-T=$\sqrt{2h}/g$, R=uxT) (ANS:3s,29.4m)

52. An aeroplane flying horizontally with a speed of 360Kmph releases a bomb at a height of 490m from the ground. When and where the bomb will strike the ground?(HINT:-T=$\sqrt{2h}/g$, R=uxT) (ANS: 10s,1000m)

53. An aeroplane flying horizontally with a speed of 270Kmph releases a body at a height of 490m from the ground. Find when and where the body will strike the ground? (HINT:-T=$\sqrt{2h}/g$, R=uxT) (ANS: 750m,10s)

54. An aeroplane flying horizontally with a velocity of 540Kmph at a height 2940m dropped a body. Find the range of the projectile and time of flight? (HINT:-R=u$\sqrt{2h}/g$) (ANS: 3674.2m,24.5s)

55. 55. Two towers of 100m high are 40m apart. A stone is thrown horizontally from the top of one tower hits the other tower at a height of 20m above the ground. Find the velocity of projection of stone? (g = 10m/s^2) (HINT:-R=u$\sqrt{2h}/g$) (ANS: 10m/s)

56. From the top of a building 78.4m high, a ball is thrown horizontally which hits the ground at a distance. The line joining the building top to the point where it hits the ground makes an angle of 45^0 to the ground. Find the initial velocity of the ball?(HINT:-R=u$\sqrt{2h}/g$) (ANS: 19.6m/s)

57. A ball is thrown horizontally from the top of a building 122.5m high. The ball hits the ground at a distance the line joining the building top of the point where it hits the ground makes an angle of 45^0 to the ground. Find the velocity of the ball thrown horizontally.(HINT:-R=u$\sqrt{2h}/g$) (ANS: 24.5m/s)

Model- 4

58. The maximum height reached by a projectile is equal to its range. Find the angle of projection

(HINT:-$H_{max}=\frac{u^2sin^2\theta}{2g}$) (ANS: $75^057'50''$)

59. A ball is projected into air by making an angle of 60^0 to the horizontal and with velocity 19.6m/s. find its range. (HINT:-R =$\frac{u^2sin2\theta}{g}$) (ANS: 33.95m)

60. A projectile shot at an angle of 60^o strikes a building,30 m away at a point 15m above the point of projection. Find the velocity of projection. (HINT:-R= $\frac{u^2sin2\theta}{g}$) (ANS: 21.85m/s)

61. What should be the velocity with which bomb should be projected obliquely to have a maximum range of 1960m. (HINT:-$R_{max}=\frac{u^2}{g}$) (ANS: 138.59m/s)

62. A football is projected with a velocity of 29.4m/s at an angle of $30^0$to the horizontal. Find the maximum height reached by it and its range?(HINT:-$H_{max}=\frac{u^2sin^2\theta}{2g}$, R = $\frac{u^2sin2\theta}{g}$ (ANS: 11.03m, 76.38m)

63. A bullet is projected with a velocity of 196m/s at an angle of 30^0 to the horizontal. Find the greatest height attained and its time of flight?(HINT:-$H_{max}=\frac{u^2sin^2\theta}{2g}$, T = $\frac{2usin\theta}{g}$) (ANS: 490m,20s)

64. A body is projected into air at an angle of $30^0$to the horizontal with velocity 20m/s. Find the time of ascent and range.(g =10m/s^2) (HINT: R = $\frac{u^2sin2\theta}{g}$, ta $=\frac{usin\theta}{g}$) (ANS: 34.64m, t_a = 1 s)

65. A body is projected making an angle $30^0$with the horizontal with a velocity of 19.6m/s. Calculate (i) maximum height reaches by it and (ii) the range of the projectile.
(HINT:-$H_{max}=\frac{u^2sin^2\theta}{2g}$, R = $\frac{u^2sin2\theta}{g}$) (ANS: 4.9m, 33.95m)

66. A bullet is fired at an angle of 45^0 with the horizontal with a velocity of 49m/s. Find the time of flight maximum height reached and horizontal range?(HINT:-$H_{max}=\frac{u^2sin^2\theta}{2g}$, R = $\frac{u^2sin2\theta}{g}$, T = $\frac{2usin\theta}{g}$) (ANS:61.25m, 245m ,7s)

67. A ball is projected into air with velocity 10m/s and angle 60^0 with earth surface. Find the maximum height, time of ascent and range. (g = 10m/s^2) (HINT:-$H_{max}=\frac{u^2sin^2\theta}{2g}$,R =$\frac{u^2sin2\theta}{g}$, $t_a=\frac{usin\theta}{g}$) (ANS: 3.75m,8.66m, 0.866s)

68. A stone is projected so as to just clear the top of a wall of height 100m at a distance of 100m from the point of projection find the velocity of projection.(HINT:-H=$\frac{u^2sin^2\theta}{2g}$, R=$\frac{u^2sin2\theta}{g}$) (ANS: $63^o26'$, 49.49m/s)

69. A projectile has a maximum height of 15m and a range of 120m. Find the angle of projection.
(HINT:-$\frac{4H}{R}$= tanθ) (ANS: $26^033'54''$)

70. A ball is projected in to air has a maximum height of 11.025m and a range of 76.83m. Find the angle of projection.(HINT:-$\frac{4H}{R}$= tanθ) (ANS: 30^0)

71. From a point on the ground at a distance 2m from the foot of a vertical wall a ball is thrown at an angle of 45^o which just clear the top of the wall and afterwards strikes the ground at a distance 4m on the other side. The height of the wall is? (HINT:-$\frac{4H_{max}}{R}$= tanθ) (ANS:$\frac{3}{2}$m)

72. A body is projected obliquely with a velocity of 10m/s. Its range is twice of its maximum height. Find the range of the body. (g = 10m/s^2) (HINT:-$\frac{4H}{R}$=tanθ) (ANS: 10 m)

73. A bullet is fired with a speed of 200m/s at an angle of 30^o. What is its height after 5 seconds?
(HINT:- y=usinθt - $\frac{1}{2}$gt^2) (ANS: 377.5m)

74. The equations of motion of a body projected at an angle are given by X= 3t and Y= 2t -4.9t^2. What is the angle of projection? (HINT:-x=ucosθ ×t, y=usinθt - $\frac{1}{2}$gt^2) (ANS: $\tan^{-1}\left(\frac{2}{3}\right)$)

75. The equations of motion of a body at an angle are given by X = 5t and Y = 12t – 4.9t^2. What is the velocity of projection and angle of projection? (HINT:-x=ucosθt, y=usinθt - $\frac{1}{2}$gt^2) (ANS:13m/s and $\tan^{-1}\left(\frac{12}{5}\right)$)

76. A body is projected with a velocity of 19.6m/s is at 30^0 to the horizontal. Find the position after 1.5s.

(HINT:-x=ucosθ ×t, y=usinθt - $\frac{1}{2}$gt^2) (ANS: $25.46\ m, 3.67\ m$)

77. A stone is projected with a velocity of 20m/s at an angle of 30^0 to the horizontal. After 1.5 seconds, find its horizontal distance and vertical height from its starting point?

(HINT:-x=ucosθ ×t, y=usinθt-$\frac{1}{2}$gt^2) (ANS: $15\sqrt{3}\ m,\ 3.975\ m$)

78. A foot ball is hit at an angle of 60^0 with a velocity of 33m/s. When it has travelled a horizontal distance of 49.5m. What will be its height above the ground?(HINT:-x=ucosθ ×t, y=usinθt-$\frac{1}{2}$gt^2) (ANS: 17.54m)

ASSIGNMENT QUESTIONS

1) Write the equations of motion of freely falling body?
2) Write the equations of motion of a) vertically upward projected body b) vertically downward projected body?
3) Define acceleration due to gravity and write its unit and dimensional formula?
4) Write the characteristics of acceleration due to gravity?
5) Define vertical projection? Derive the expression for a) maximum height and b)time of flight of a vertically upward projected body?
6) Show that the time of ascent is equal to time of descent in case of a vertically projected body?
7) Derive an equation for the height of the tower, when a body is projected vertically upwards from the top of the tower?
8) Define projectile and write give examples?
9) Show that the path of a horizontally projected body is a parabola?
10) Derive the expression for maximum height and time of ascent of a body projected obliquely?
11) Derive the expression for time of descent and time of flight of a projectile in oblique projection?
12) Derive the expression for range and maximum range of a body projected upwards with an initial velocity 'u' making an angle θ with the horizontal?
13) Show that the path of a body projected upwards with an initial velocity 'u' making an angle θ with the horizontal is a parabola?
14) Show that for two angles of projection the range will be same?

UNIT- 4 Friction

Motion on rough horizontal surface

1) A body of mass 10 Kg is moving on a rough horizontal surface. Find the force required by the body.(μ=0.5;g=9.8 m/s^2) (Ans:49 N)
2) A horizontal force of $4\sqrt{3}$kgwt is just sufficient to pull a body of 8kgwt on a horizontalsurface. Find the coefficient of friction between the surfaces. (Ans: $\mu_s=\sqrt{3}/2$)
3) A body of mass 10kg just slides downs a rough inclined plane that rises 3 in 5.Find the coefficient of static friction between the body and inclined plane? (Ans: μ_s=0.75)
4) A force of 98N is required to pull a body of mass 100kg over the surface with constant speed. Calculate the coefficient of friction between the body and the surface. (Ans: μ_k=0.1)
5) A body of mass 5 Kg rests on a horizontal table. Calculate the coefficient of limiting friction & angle of friction if a force of 30 N can set the body into motion. (Ans:0.612,31°28')
6) A force of 98 N is required to pull a body of mass 100kg over ice. What is the coefficient of friction?
7) The angle of friction between two surfaces is 37^0.Find the coefficient of static friction between these two surfaces? (Ans:3/4)
8) Calculate the distance travelled by a body before coming to rest moving on a smooth horizontal road with a velocity 5 m/s. (μ is given by 0.15) (Ans:8.503 m)
9) Calculate the angle of repose for an inclined plane whose coefficient of friction is 0.6(30°58')
10) A motor of a power 0.98 KW drags a man 100 kg through 4m on a surface having coefficient of friction 0.3. Find the time of motion of that man? (Ans: t=1.2s)
11) A disc revolves in a horizontal plane at steady rate of 2 rotations /second. A coin is placed at a distance of 3 cm from the center of the disc, remains at rest. Calculate the coefficient of friction between the coin and disc. (Ans: 0.0122)
12) A body of mass 100 Kg rests on a horizontal surface with coefficient of friction 0.2 in between the surfaces. Calculate the work done in dragging the body through a distance of 100 m. (Ans:19.6 KJ)
13) A body of mass 500 g rests on a horizontal surface. If μ_k = 0.25, find the work done in moving the body through a distance of 1 m along the plane (Ans : 1.225 J)
14) A body of mass 5 Kg rests on a horizontal table. Calculate the coefficient of limiting friction & angle of friction if a force of 30 N can set the body into motion. (Ans:0.612;31°28')
15) Calculate the distance travelled by a body before coming to rest moving on a smooth horizontal road with a velocity 5 m/s. (μ is given by 0.15) (Ans:8.503 m)
16) A book of mass 2kg is on the top of a car. The coefficient of static friction between the book and car is 0.6.What is the maximum acceleration of the car so that the book does not slide? (Ans : a=6 ms^{-2})

17) A car is moving on a horizontal surface. A body of mass 'm' was stuck on the front part of the car. If μ_s is coefficient of static friction between the surface of car and the body, what is the minimum acceleration of the car so that the book does not slide down? (Ans : $a=g/\mu_s$)

18) When a car of mass 2000kg is moving with a velocity of $20ms^{-1}$ on a smooth horizontal road, its engine is switched off. How far does the car move before it comes to rest if the coefficient of kinetic friction between the road and tyres of the car is 0.25? (Ans: s=80m.)

19) The coefficient of static and kinetic friction between the block and horizontal surface is 0.6 and 0.4 respectively. A horizontal force required to just move the block is applied on the block. If this force continues to act, what is the acceleration developed in the block? (Ans: $a=2ms^{-2}$).

Rough inclined plane

20) If a body mass 0.5 Kg rests on an inclined plane at 30° with the horizontal. Calculate i) the force required to stop the body from sliding and ii) the force required to move the body up the inclined plane, $\mu = 0.2$. (Ans : 1.6 N,3.299 N)

21) The angle of repose for an inclined plane is 30°.If the coefficients of static and kinetic frictions are equal, find the acceleration of a body down the inclined plane whose angle of inclination is 50° (Ans: 3.87 m/s^2)

22) Calculate the work done in pulling up a block of wood weighing 2 KN for a length of 10 m on a rough inclined plane inclined at an angle 15° with the horizontal. (Ans: 5176 J)

23) Calculate the time taken by a body to slide down on an inclined plane of length 3 m, if $\mu = 0.2$ & angle of inclination is 30°. (Ans : 1.37 s)

24) A body is on an inclined plane of length 12 m, inclined at 60° with the horizontal. If the coefficient of limiting friction is 0.2, find the time taken by the body to slide down the plane when released from the top of the inclined. (Ans: 1.78 s)

25) A body slides down a rough inclined plane of base 'x' meter. The angle of the plane so that the time taken by the body to reach the bottom of the plane will be minimum is. ($\theta = 45^0$)

26) A cube of weight 10N is on a rough inclined plane of slope 3 in 5.If the coefficient of friction is 3/5, the minimum force necessary to start the cube moving up the inclined plane is. (Ans: F=10.8)

27) A metal cube rests on an inclined plane with its four edges horizontal. If $\mu=0.364$, calculate the angle when the cube just begins to slide down. (Ans: $\theta=20^0$)

28) How much work will be done in dragging a body of mass 200kg through a distance of 80m on a level road if the coefficient of friction is 0.25? (Ans: W =39,200 J.)

29) A body placed at the top of the inclined plane of length 7 m, inclined at an angle of 28° is sliding down. If $\mu = 0.35$,find the velocity on reaching the bottom of the inclined plane. (4.69)

30) A body slides down on a rough inclined plane inclined at 30° to the horizontal. If $\mu = 0.4$, find the velocity after it has travelled 6 m along the plane (Ans : 4.25 m/s)

31) A body of man 10kg just slides down a rough inclined plane that rises 3 in 5.Find the coefficient of static friction between the body and inclined plane . (Ans: μ_s=0.75)

32) A body is sliding down on a rough inclined plane which makes an angle of 30° with the horizontal. Calculate the acceleration if the coefficient of friction is 0.25. (Ans:2.778 m/s^2)

33) A body of mass 40 Kg just slides down a rough plane that rises 5 cm in every 12 cm find the value of coefficient of friction? (Ans: 0.458)

34) Angle repose of a plane is 30°.Find the acceleration of a body down the plane, when the angle of inclination is 60°.(g=9.8 m/s^2) (Ans: 5.66 m/s^2)

35) A body slides down a rough inclined plane, inclined at an angle 30° with the horizontal. If μ = 0.2 .Calculate the acceleration. (Ans: 3.203 m/s^2)

36) A body of mass sliding down the inclined plane of inclination 30^0 with constant velocity. The coefficient of friction is $4/\sqrt{3}$. Find the force applied on the body parallel to the inclined plane? (Ans:F=29.4N)

37) A body of mass 11kg lise on a inclined plane of angle 60^0 to the horizontal. If the coefficient of friction is 0.4 the frictional force along the inclined plane is (Ans:f=1.96N)

Smooth inclined plane

38) Calculate the work done in pulling up a block of wood weighing 2 KN for a length of 10 m on a smooth inclined plane inclined at an angle 15° with the horizontal. (Ans: 5176 J)

39) A body slides down a smooth inclined plane having an inclination of 45° with the horizontal. It takes 2 s to reach the bottom. If the body is placed on a similar plane having μ = 0.5, what is the time taken for it to reach the bottom? (Ans: 2.83 s)

40) A body is sliding down along an inclined plane which makes an angle of 30° with the horizontal. Calculate the acceleration if i)the plane is smooth& ii)the plane is rough with coefficient of friction 0.1 (Ans: 4.051 m/s^2)

41) A body is sliding down along an inclined plane which makes an angle of 60° with the horizontal. Calculate the acceleration if i)the plane is smooth& ii)the plane is smooth with coefficient of friction 0.1

ASSIGNMENT QUESTIONS

1. Define friction and state its different types.
2. State the laws of friction.
3. Define angle of friction and Show that $\mu_s = \tan\theta$.
4. Define angle of repose and Show that $\mu_s = \tan\alpha$.
5. Describe the motion of the body on a rough horizontal surface.
6. Explain the motion of the body on a rough inclined plane.
7. Explain the motion of the body on a smooth inclined plane.
8. Write the advantages of friction.
9. Write the disadvantages of friction.
10. Write the methods to reduce the friction.

UNIT -5 Work, Power, Energy

Problems on work

1) A force of 8 N pulls a body at an angle 30° with the horizontal & displaced it by 10 m. Find the work done? (Ans :69.28 J)
2) A body of mass 10 Kg is lifted to a height 20 m from the ground. Find the work done. (Ans: 1960 J)
3) Calculate the work done in lifting a 3kg mass against gravity through a distance of 40cm? (Ans :11.8 J)
4) A force of 25 N in west direction is acting on a boat which is free to move in N-W direction & moves through a distance of 11.31 m, find the work done? (Ans :199.93 J)
5) What is the work done by a man carrying a load of 30 kg over his head when he travels a distance 5 m in i)the vertical ii)the horizontal directions ? (Ans : vertical-1470 J;horizontal-0 J)
6) What is the work done by a man carrying a load of 25 kg over his head when he travels a distance 6 m in i)the vertical ii)the horizontal directions ? (Ans : vertical-1470 J;horizontal-0 J)
7) A man of 60 kg carrying a suit case on his head of mass 40 kg to the top of a building of height 20 m. Find the work done? (Ans :19600 J)
8) The work done by a man carrying a box of mass 20 Kg through a vertical height of 5 m is 4900 J. Find mass of the man? (Ans: 80 Kg)
9) A body pulled by a force of 40N at angle of 60^0 to the horizontal. What is the work done .If it was displayed by 5m in horizontal direction? (Ans :100 joules)
10) A can of water 10kg is raised from the depth of 20m.when the can rises by 10m its velocity is 1 m/s. Find its work done? (Ans : 985 joules)
11) A body mass 500 g is accelerated from a velocity of (3i-4j) m/s to (-6j+2k) m/s, find work done? (Ans : 3.75 J)

Problems on power

12) A person of mass 60 Kg lifts a mass of 40 Kg to the top of a building of 10 m in 50 s. Find power? (Ans: 196 W)
13) An engine is used to lift water from a well of depth 60m to fill a tank of 3m×4m× $5m$ in 30 minutes.find power of engine? [$1m^3$ of water=10^3kg] (Ans:19,600 watts)
14) A machine gun fires 240 bullets/ minute. Mass of each bullet is 10 g. If the power of gun is 7.2 KW, find the velocity of bullet? (Ans:600 m/s)
15) A machine gun fires 360 bullets/minute & each bullet travels with a velocity of 600 m/s.If mass of each bullet is 5 g, find power? (Ans:5400 w)
16) Calculate the horse power of engine required to lift $1.08x10^6$ Kg of coal/hour from a mine 74.6 m deep? (Ans:294W)
17) A man weighing 80kg lifts a weight of 20kg to the top of the building 30m high in 131 seconds. Find the work done and the horsepower? (Ans:0.3008)

18) A rocket of mass $3x10^4$Kg is launched by applying a constant force of $6x10^5$ N for 20 s. Find the work done by the force during this time and the power developed in the rocket? (Ans:$12x10^7$W)

19) A pump can hoist 8400 Kg coal/hour from a mine of 100 m deep. Find the power if efficiency is 75%? (Ans:3.049 KW)

20) Calculate the power of engine used to pump up 2000 liters of water /minute from a well 30 m deep, if 25% of power is wasted? (Ans:13066.6 W)

21) An engine is used to lift water from a well 50m deep to fill a tank of dimensions 5m× 5m ×10m in 50minutes.find the power if 25% of energy is wasted?

22) A man cycles up a hill whose slope is 1 in 30 at the rate of 10.8 Kmph. The wt. of cycle and man is 125 Kg find power at which man is working? (Ans:2.5 KW)

23) The human heart discharges 4000 cc of blood /minute under a pressure of 130 mm of Hg. If the density of Hg is 13.6 g/cc. Find power of heart? (Ans:1.155 W)

24) Find power of engine if a train travelling with a uniform velocity of $2\bar{\imath}-\bar{\jmath}+4\bar{k}$ m/s on a level track.the engine has exert a force of $\bar{\imath}-3\bar{\jmath}+2\bar{k}$ N to overcome friction? (Ans:13w)

Problems on potential energy

25) A lift carried 10 persons each weighing 60 Kg to the top stair of building 100 m high. Calculate PE? (Ans: $5.88x10^5$ J)

26) The PE gained by a body when it is carried to a height of 80 m is 7480 J, find mass of body? (Ans: 10 Kg)

27) Find the PE of a rod of mass 5 Kg and length 10 m, kept vertical on ground? (Ans:245 J)

28) Two metal spheres 10 Kg & 20 Kg masses are allowed to fall freely from height 30m.When they are at a height of 10 m from the ground ,what are the ratios of PE ? (Ans:1:2)

Problems on kinetic energy and momentum

29) The K.E of a body moving with a velocity of 4m/s is 24J.find mass of the body? (3kg)

30) Find KE of a bullet of mass 50 g fired with a velocity of 300 m/s? (Ans:2250 J)

31) Find KE of a bullet of mass 10 g fired with a velocity of 300 m/s? (Ans:450 J)

32) If the mass of the body is reduced to half and the velocity is doubled what is its KE? (Ans :$KE_2=2KE_1$)

33) A body of mass 5 Kg initially at rest is subjected to force of 20 N what I the KE acquired by the body at the end of 10 s? (Ans:4000 J)

34) A car weighing 1000 Kg moving with a velocity of 10 m/s is uniformly accelerated at a rate of 2 m/s^2 for 30 s, find work done? (Ans:$2.4x10^6$ J)

35) A stone of mass 10 Kg is allowed to fall freely from a height 10 m, find KE on reaching ground? (Ans:980 J)

36) A ball of mass 5 Kg is thrown vertically upwards with a KE of 980 J. At what height will its KE be half the initial value? What is the maximum height it will reach? (h=10 m ; H=20 m)

37) A force of 8 N is applied continuously at an angle of 30° to a certain mass. Find the KE which the body acquires after moving through 6 m from rest. If the mass is 3√3 Kg, find its velocity?

(Ans: KE - 24√3 J ; v = 4 m/s)

38) The momentum of a body of mass 2 Kg is 50 Kg m /s .Find KE ? (Ans :625 J)

39) If 60 Kg m/s is the momentum of the body of mass 0.6 Kg, find KE? (Ans :3000 J)

40) A car is moving with a velocity of 10 m/s. What velocity will double its momentum? (Ans:20 m/s)

41) If the KE of a body is doubled, how does its momentum change ? (Ans:$P_2 = \sqrt{2P_1}$)

42) If the momentum of a body is doubled, how does its KE change? (Ans :$E_2=4E_1$)

43) A body of mass 5 Kg is dropped from a height, what is it's KE at the end of 3rd second of its fall?(Ans:2161 J)

44) If the momentum of a body is increased by 50% what is the % increase in KE? (Ans:125%)

45) A lorry and a car moving with a same KE are brought to rest by application of brakes which provides equal retarding forces. Find out which of them will come to rest in a shorter distance?(Ans:$E_1=E_2$&$S_1=S_2$)

Work-Energy Theorem

46) A bullet of mass 15 g strikes a wooden plank with a velocity of 540 m/s and emerges from it with a velocity of 360 m/s, if thickness of plank is 20 cm, find work done by bullet against resisting force of the plank? (Ans:1215 J)

47) An engine of power 1.5 MW applies a force for 5minutes on a train moving with a velocity of 10m/s. If there is no friction and the velocity attained is 25m/s, find the mass of train?

Law of Conservation of Energy

48) A body of mass 0.5 Kg is allowed to fall from a height of 10 m from ground. Calculate its KE just before it strikes the ground? (Ans:49 J)

49) A body of mass 5 Kg is dropped from a height of 10 m .What is its KE when it is just before reaches the ground? (Ans:490 J)

50) A body of mass 0.1 Kg is allowed to fall from a height of 3 m from ground. Calculate its PE & KE at a height of 2 m from the ground? (Ans:PE -- 1.96 J;KE -- 0.98 J)

51) A stone of mass 1 Kg is falling from a height of 10 m. Find it's PE & KE after it has travelled a distance of 2 m from the top? (Ans:PE -- 78.4 J ; KE – 19.6 J)

52) A body of mass 10 Kg is allowed to fall from a height of 80 m from ground. Calculate its PE & KE at a height of 20 m from the ground? (Ans: PE: -- 1960 J; KE – 5880J)

53) A stone of mass 10 Kg is allowed to fall freely from a height 10 m. Find KE on reaching ground?(Ans:980 J)

54) A body of mass 100kg is allowed to fall from a height of 50m from the ground. Calculate its potential and kinetic energies at a height of 30m from its ground? (Ans:PE=29,400J,KE=19,600J)

55) A body is projected vertically upwards into air. Find the height at which its PE & KE are same? (Ans:h=H/2)

56) A body falls from a height of 10 m. If it loses 20% of its energy during collision with ground, to what height it can rise after collision ? (Ans:8 m)

ASSIGNMENT QUESTIONS

1. Define work, power and energy and write their units and dimensional formulas.
2. Define potential energy and give examples.
3. Show that PE= mgh.
4. Define kinetic energy and give examples.
5. Show that KE=1/2 mv^2.
6. Derive the relation between kinetic energy and momentum.
7. State and explain work-energy theorem.
8. State law of conservation of energy and give any four examples for energy transformation.
9. Verify law of conservation of energy in case of freely falling body.

UNIT -6 SIMPLE HARMONIC MOTION

DISPLACEMENT

1) Find amplitude, frequency, time period, epoch, angular velocity for a particle in S.H.M whose displacement in time't' is given by$y = 8\sin\left(2\pi t + \frac{\pi}{4}\right)$.
2) The displacement of a particle in SHM is formulated as $y = 6\sin\left(4\pi t + \frac{\pi}{3}\right)$.Calculated its amplitude, angular velocity and time period.
3) The displacement of a particle in SHM is given by y=3sin(0.57πz) where y is in metre , 't' seconds calculate (i)Amplitude (ii)Angular velocity and (iii)Time period. (ANS: 3m, 0.5π rad/s ,4s)
4) A particle executes SHM given by y=20sin $[\frac{2\pi t}{10} + \pi/4]$ find Amplitude, Frequency, Time period and Epoch. ANS:[20units, 0.1 HZ, 10s, π/4 rad]
5) If $y = 5\sin\left(\frac{2\pi}{3}t + \frac{\pi}{6}\right)$ is the expression for displacement of a particle in a simple harmonic motion, then find the (i) time period (ii) initial displacement and (iii) maximum velocity. (ANS:3 s,Y= 0.0457m,10.472m/s)
6) A body which executes SHM along a straight line has its motion represented by $y = 5\sin\frac{\pi t}{3}$. Find amplitude, period and velocity at t = 1 second. (ANS: $r = 5\ m, T = 6\ s,\ V = 2.619\ m/s$)
7) The displacement of a particle in S.H.M is given by $Y = 8\sin\left(4t + \frac{\pi}{6}\right)$. Find the initial displacement and velocity at that initial displacement? (ANS: 0.073m, 7.99m/s)
8) Calculate (i) initial displacement (ii) Amplitude (iii) phase constant for a particle in S.H.M whose displacement in time't' is given by$y = 5\sin\left(10t + \frac{\pi}{4}\right)$. (ANS: 0.069units, 5units,$\frac{\pi}{4}\ units$)

VELOCITY, ACCELERATION, TIMEPERIOD, FREQUENCY

9) A body is in SHM with amplitude 7cm and time period π/4s. Find its maximum velocity [Ans: 0.56 m/s].
10) A particle performing SHM has amplitude of 0.2 m and has a period of 2s. Find its velocity at the mean position. [ANS:0.63 m/s].
11) A particle executing SHM has an acceleration of 0.5m/s^2.When the displacement is 2m. Find its time period? (ANS:12.57s)
12) A particle moving with SHM has a velocity of 4m/s. When passing through the center of its path and its period is 3.142s. Find the amplitude.
13) A particle in SHM has a velocity of 0.77m/s at its mean position in a straight line path of 0.14m. Find its time period? (ANS:0.57s)
14) Velocity of simple harmonic motion particle is V=$\sqrt{144 - 16x^2}$ m/s where x is displacement in meter. then what is its maximum velocity . [ANS:12 m/s^2].
15) A particle is performing SHM with an amplitude of 0.5m and has an angular velocity of 1000rad/s. Find its velocity at a distance of 0.3m from the mean position (ANS: 400m/s)
16) A body executes SHM 80 vibrations/minute and has a velocity of 6m/s at its mean position. What is the length of the path? Calculate its velocity at a distance of 0.5m from the mean position. (Ans:4.293m/s)
17) A particle executing SHM passes through the mean position with a velocity of 4m/s. Find the velocity of the particle at the point where its displacement is half the amplitude. (ANS: V = 3.464m/s)
18) Find the value of the displacement when the velocity of the particle executing SHM is half that at the mean position? ANS:$\left(\frac{\sqrt{3}}{2}\ r\right)$
19) A body of mass 5gm is executing SHM about a point 'O' with an amplitude of 10cm. Its maximum velocity is 100 cm/s. At what distance will its velocity be 50 cm/s? (ANS: $5\sqrt{3}$)

20) A body describes SHM in a line 0.04m long. Its velocity through the center of the line is 0.12 m/s (a) Find the period (b) Find the velocity at distance 0.01732m from the central position. ($T = 1.047s, V = 0.06m$)

21) A body describes SHM in a line 0.04m long. Its velocity through the center of the line is 0.12 m/s (a) Find the period (b) Find the velocity at distance 0.01732m from the central position.($1.047s, 0.06m$)

22) A body is executing SHM when its displacement from the mean position is 4cm and 5cm the corresponding velocity of a body is 10cm/s and 8cm/s. calculate time period of -the body?(ANS:T = 3.142s)

23) A particle performing SHM has velocities of 8cm/s and 6cm/s when it is at a distance of 3cm and 4cm from the mean position. Find its period and amplitude. (ANS: T = 3.14s, r= $5cm$)

24) A body of man 100gm, executes SHM with amplitude of 5cm and time period 44/7 s, find the velocity and K.E of the body when its displacement is 4cm from the mean position. [V.3x10^{-2} m/s, K.E.45x10^{-6}J]

25) A particle executes SHM of period 10 seconds and amplitude 1.5metre. Calculate its maximum acceleration and velocity. (ANS: $a = \omega^2$y = 0.5915 m/ s^2, $V = r\omega = 0.942\ m$ / s)

26) A body executing SHM with an acceleration of 0.4m/s^2 at a displacement of 0.6m. Find its acceleration at displacement of 0.4m. (ANS: a = 0.27m/s^2)

27) The maximum acceleration and maximum velocity of a particle in SHM are 8 units and 4 units respectively. Find its frequency and time period of oscillation. (ANS:$\omega = 2\ units, n = 0.32\ units$)

28) The acceleration of a particle in SHM is 4 units when its displacement is 1 unit. Find its frequency of oscillation. (ANS: n = 0.32 units)

29) The acceleration of a particle executing SHM is 0.09m/s^2 at a distance of 0.25m from the equilibrium position. Find the time period. (ANS: T = 10.476s)

30) Find the time period of vibrating particle which has an acceleration of 48m/s^2, when its displacement from the mean position is 12m, assuming the motion to be SHM. (ANS:T = 3.142S)

31) A particle executes SHM along a straight line 4cm long when the displacement is 1cm,its velocity is numerically equal to acceleration. What is the period of the particle? (ANS:T = $\frac{2\pi}{\sqrt{3}}$)

32) The acceleration of a particle in SHM is 4 units when its displacement is 1 unit, find its frequency of oscillation. ANS:[n=1/ π HZ].

TIME PERIOD OF SIMPLE PENDULUM

33) Calculate the length of a second's pendulum at the equator where the value of 'g' is 9.78m/s^2. (l=$0.99m$)

34) If a simple pendulum of length 90cm completes 20 oscillations in 38s find acceleration due to gravity at that place. ANS:[g=9.97m/s^2].

35) At a given place length of a seconds pendulum is 98cm what is the value of 'g' at that place? (9.68m/s^2)

36) A simple pendulum is of length 50cm. find its time period and frequency of oscillation.[g=9.8 m/s^2] [ANS:T=1.42s, n=0.7HZ]

37) A pendulum is taken to three different planets whose acceleration due to gravity are in the ratio 36:9:4. What is the ratio of their time periods? (ANS:$T_1 : T_2 : T_3 = 1 : 2 : 3$)

38) A simple pendulum is taken to three different planets whose accelerations due to gravity are in the ratio 25:16:9 find the ratio of their time periods. [ANS: $T_1 : T_2 : T_3$=12:15:20].

39) The acceleration due to gravity on the surface of the moon is 1.63m/s^2, what is the time period of simple pendulum on the moon if period on earth is 3.4 seconds (ANS:$T\ \alpha \frac{1}{\sqrt{g}},\ T_m = 8.34s$)

40) A simple pendulum executes the same number of oscillation in 8 minutes 10seconds at Hyderabad as in 8 minutes 20seconds at vizag. Calculate the acceleration due to gravity at these two places.

(ANS:$g_1 : g_2 = 2500 : 2401$)

41) The time period of a pendulum is 3 seconds, if its length is made 4 times. What is the time period?(Ans:6 s)

42) If the length of pendulum and value of 'g' are doubled and halved respectively. Find the ratio between final and initial time periods? (ANS: $T_2 : T_1 = 2 : 1$)

43) If the length of a pendulum is doubled, how does the period change?[ANS:T increases by $\sqrt{2}$times.]

44) The acceleration due to gravity on the surface of the moon is 1.7 m/s^2 what is the time period of a simple pendulum on the moon of its time period on the earth is 3.5s (g=9.8m/s^2) [T_{moon}=8.4second].

45) The acceleration due to gravity on moon is $\frac{1}{6}th$ that on the earth. The length of a second's pendulum is 96cm on earth. What is its value on the moon? (ANS: $l_2 = 16cm$)

46) A simple pendulum of length 90cm has the time period of 1.9s at a place. Find the length of the pendulum, if the period is 1.5s at the same place. (ANS: $l_2 = 56.09cm$)

47) The acceleration due to gravity on the moon is(1/6)th of that on the earth. If the length of seconds pendulum on the earth is 1m, find the length of seconds pendulum on the moon [ANS: l_2 =0.1667m].

48) The acceleration due to gravity on moon is $\frac{1}{6}th$ that on the earth. The length of a second's pendulum is 96cm on earth. What is its value on the moon? (ANS: $l_2 = 16cm$)

49) A boy is oscillating in a swing in the standing position. If he sits, does the frequency increases or decreases? Explain

50) In a simple pendulum experiment, the length of the pendulum is increased from 60 cm to 100cm in equal steps. How does the value of 'g' change? Explain. ANS:[l∝g].

51) What is the percentage change in time period of simple pendulum if length decreased by 19%.[10%].

52) If the length of a seconds pendulum is increased by 2% find the percentage change in time period (g=10 m/s^2). [ANS:$\frac{T2-T1}{T1}$x 100=1].

53) A pendulum beats seconds at a place where g = 9.8m/s^2, if it is taken to a place where g = 9.75m/s^2. How many seconds per day does it loss or gain? (ANS: 224.8s)

54) A pendulum clock is brought from London to Madras. By how much should the length of pendulum clock be altered so that it shows correct time? (ANS: $l_L = 0.9949m, l_m = 0.9919m,\ l_L - l_m = 0.003m$)

(Given: 'g' at madras = 9.78m/s^2, 'g' at London 'g' = 9.8m/s^2)

ASSIGNMENT QUESTIONS

1. Define SHM and give examples.
2. Write the conditions of SHM.
3. Show that the projection of a particle executing uniform circular motion is in SHM.
4. Derive the expression for displacement and velocity of a particle in SHM.
5. Derive the expression for acceleration of particle in SHM.
6. Define time period, frequency and phase of a particle in SHM.
7. Define ideal simple pendulum and derive the expression for time period of a simple pendulum.
8. State the laws of simple pendulum.
9. Define the terms seconds pendulum and length of the simple pendulum.

Charle's first Law

1) A gas at 30^0c has its temperature raised so that volume is doubled. The pressure remaining constant, what is its final temperature? (Ans: 333^0c)
2) A gas of volume 40liters is heated to 90^0c at constant pressure. If the gas expands to 46.39 liters, find its initial temperature. (Ans:T_1=313k, $t_1=40^0$c)
3) A gas at 27^0c has its temperature raised so that its volume is doubled, the pressure remaining constant. What is its final temperature? (Ans:T_2=600k&$t_2=327^0$c)
4) 273c.c of gas at 0^0cis heated at constant pressure until its volume is doubled. What is the final temperature of the gas? (Ans:273^0c)
5) A liter of air is heated from 27^0c to 177^0c at constant pressure. Find the increase in the volume of the gas. (Ans:V_2=1.5lt,increase in volume=0.5lt)
6) The volume of a gas at 30^0c is 200c.c.What is the volume of gas if temperature of the gas is raised to 100^0c at constant pressure? (Ans: V_2=246.2c.c)
7) A gas at 30^0c occupies $75x10^3$liters.Find its volume at 90^0c when heated at constant pressure? (Ans: $89.85x10^3$ lt)
8) A gas at 30^0c is heated to 100^0c at constant pressure. If the final volume is 246c.c, find its initial volume. (Ans: 199.83c.c)
9) 1000liters of oxygen is collected at 30^0c.Find the volume when the gas is heated to 100^0c keeping pressure constant. (Ans:1231lt.)
10) A cylinder contains 25 liters of gas at 17^0c.Find the volume of gas, if it is heated to 37^0c keeping pressure constant. (Ans:26.72lt)

Charle's second Law

11) The pressure of a gas is 70cm of Hg at 27^oc. Find the final pressure when the gas is heated to 227^oc keeping its volume constant (ANS: $P_2 = 116.66cm\ of\ Hg$)
12) A given mass of gas at -73^oc exerts a pressure of 60cm of Hg. What pressure will it exert at 27^oc if the volume remains constant? (ANS:$P_2 = 90cm\ of\ Hg$)
13) A gas at 10^0c is heated at constant volume. If the pressure is 75 cm of Hg at 27^0c is its initial pressure. (Ans:66.75 cm of Hg)
14) A gas at 20^0c was heated at constant volume up to 37^0c at which the pressure is 75 cm of Hg. Find its original pressure. (Ans:1.21cm of Hg)
15) A gas at 627^oc is cooled at constant volume such that its pressure is reduced to $\frac{1}{3}$rd of its initial pressure. What is the final temperature of the gas? (Ans:T_2=300k & $t_2=27^0$c)

16) A gas at a pressure of 72 cm of Hg is heated to 102^0c at constant volume. If the final pressure is 90 cm of Hg, calculate the initial temperature of the gas. (Ans:T_1=300k & t_1=27^0c)

17) A certain mass of gas exerts of 72cm of mercury at 27^oc. It is heated at constant volume and pressure is observed after sometimes is 90cm of mercury. Calculate temperature. (102^oC)

Ideal gas equation

18) 100c.c of a gas is collected at 27^0c and 38 cm of mercury pressure. Calculate the volume of gas at NTP. (Ans:45.4c.c)

19) 37X 10^{-3} m^3 of a gas is collected at 27^oc and 750mm pressure of mercury. What would be its volume at 7^oc and 760mm pressure of mercury? (ANS : 35 X 10^{-3} m^3)

20) The pressure of a gas is increased four times and its absolute temperature is increased tow times. What is the ratio of its initial volume to its final volume? (Ans:V_1:V_2=2:1)

21) The volume of a gas at 27^0c and 2 atmospheres pressure is 2 liters. If the pressure is doubled and the absolute temperature is made half, what is the new volume of the gas? (0.455 liters)

22) A gas of certain mass has a volume of one liter at a temperature of 7^oc and pressure of 700mm of Hg. What will it occupy at temperature 27^oc and at a pressure 600mm of Hg? (1.25litres)

23) If a gas occupies 25litres under a pressure of 72cm of Hg at 37^oc, what is its volume when 75cm of Hg pressure is applied at 27 ^{o}C? (ANS:22.23litres)

24) One liter of helium is at 2 atmospheres and 27^0c temperature. If the gas is heated, its volume and pressure are doubled. Calculate final temperature. (Ans:927^0c)

25) The pressure of a given mass of gas enclosed in a bulb increases by three times and the volume reduced by 1/5 of its initial volume. If the gas is initially at 27^0c,what will be its final temperature? (Ans:93^0c)

26) One liter of air at 27^oc is heated until its pressure and volume are doubled. Find the final temperature. (ANS:T = 927^oc)

27) Calculate the value of R for one gram mole of a gas. (ANS: R = 8.31 J / mol/ K)

28) If the density of air at S.T.P is 1.293 X 10^{-3} kg/lit. Find its gas constant. (0.28725 J / mol/ K)

29) The density of Hydrogen at N.T.P is 0.09987 grams/liter. Calculate its gas constant. (3.72)

30) If the density of oxygen at N.T.P is 1.429 grams/liter. Calculate its gas constant.(0.259)

31) If the density of carbon dioxide at N.T.P is 1.977 grams/liter. Find its gas constant.(0.259)

32) The density of a gas at STP is 1.3 kg m^{-3}.What is the density of the gas at 27^0c and at a pressure of 86 cm of Hg. (Ans:1.338 kg/m^3)

33) The density of air at NTP is 1.293 grams/lit. Find its density at 45^oc and at a pressure of 70cm of Hg. (ANS: $d_2 = 1.022kg/m)^3$

34) The density of a gas at N.T.P is 1.3 kg/m^3.Find the density of the gas at 15^0c and at a pressure of 84 cm of Hg. (Ans:1528 kg/m^3)

35) The density of air at 0^0c and 760 mm of pressure is 1.2911 kg/m^3.Find the density at 30^0c and 750 mm of Hg pressure. (Ans:1.148 kgm^{-3})

36) The mass of 1 liter of hydrogen gas at NTP is 0.9 gram. What is the mass of the gas of same volume at a temperature of 27^0c and pressure of 75 cm of Hg. (Ans:0.8082 g)

Isothermal process

37) A gas at a pressure of 10^5 Nm^{-2} is allowed to expand isothermally until its volume is doubled. Find its final pressure. (Ans:0.5x10^5 N/m^3)

38) A vessel containing 20 liters of an ideal gas at 76 cm of Hg pressure is connected to an evacuated vessel of 10 liters. Find the resultant pressure. (Ans:51 cm of Hg)

39) A vessel containing 10 liters of an ideal gas at 760mm of Hg pressure is connected to an evacuated 9 liters vessel. Keeping temperature constant, find the resultant pressure. (ANS:$400\ mm\ of\ Hg$)

40) A gas is compressed to $\frac{1}{8}^{\text{Th}}$ of its original volume isothermally. What is the ratio of initial and final pressure? (ANS :$1:8$)

Adiabatic process

41) A gas at a pressure of 100 Nm^{-2} is compressed to half the original volume. Calculated the pressure if the compression is adiabatic and γ=1.4. (Ans:263.9 N/m^2)

42) A gas of volume 2m^3 having pressure 4 X 10^5 N/m^2 is compressed adiabatically so that the volume becomes 0.5m^3. Find the new pressure (γ =1.4). (ANS :27.86 x 10^5 N/m^2)

43) An ideal gas is compressed adiabatically so that the volume becomes 1/3rd of its initial volume. If the initial pressure 1 atm, Find the final pressure(γ=1.4) (Ans:4.65 atm)

44) Find the pressure required to compress adiabatically a gas at normal atmospheric pressure to one fifth of its volume (γ=1.4) (Ans:9.64x10^5Pa)

45) A gas is expanded adiabatically and the pressure reduced to $\frac{1}{8}th$ of its original pressure. Find the ratio of initial volume to final volume (γ =1.4). (ANS :$V_1:V_2 = 1:4.42$)

46) A gas at a pressure of 100N/m^2 is compressed to half of its original volume. Calculate the pressure if the expansion is (i) isothermal (ii) adiabatic [$P_2 = 200Nm^{-2}, P_2 = 63.9Nm^{-2}$]

Thermodynamics

47) Calculate the work done when a perfect gas expand from a volume of 1 liter to 4 liter at a constant pressure of 3x10^5 N m^{-2} (Ans:900 J)

48) The initial volume of an ideal gas at NTP is 2x10^{-3} m^{-3}.If its volume increases by 20% on heating find the work done by the gas. (Ans: 40.52 J)

49) To a gas at constant pressure 3x10^5 Pa some energy is supplied. Then its volume increases by 10x10^{-3} m^3. If the increase in internal energy of the gas is 1570 J find the energy supplied to the gas. (Ans: 4570 J)

50) 1500 J of heat is given to a gas when its volume increased by 0.004 m^3 at a constant pressure of $2x10^5$ Pa. Calculate increase in the internal energy of the gas. (Ans: 700 J)

51) A gas is compressed at a constant pressure of 20 Nm^{-2} from a volume 10 m^3 to 5 m^3. Later energy of 100 joules is added to the gas by heating it. What is the change in internal energy? (Ans:200 J)

52) The latent heat of vaporization of water is 538 J. If the increase in internal energy is 370 J. Find the external work done by the gas in expansion. (Ans:168 J)

53) When heat energy of 1500 joules is supplied to a gas at constant pressure $2.1x10^5$ Nm^{-2} there was an increase in volume equal to $2.5x10^{-3}$ m^3.Find the increase in internal energy of the gas. (Ans:975 J)

54) To compress a gas adiabatically, 400 joules of work is done. Find the change in internal energy of the gas. (Ans:400 J)

55) For a gas at constant pressure $1.25x10^5$Pa, energy of 2200 J is supplied. If the volume of gas increased by $5x10^{-3}$ m^3, find the increase in its internal energy.) (Ans:1575 J)

56) The ratio of specific heats of gas is 1.4. Its molar specific heat at constant volume is 4.96cal/mol/k. find the value of universal gas constant. (ANS :R = 1.984cal/mol/k)

ASSIGNMENT QUESTIONS

1. State and explain Boyle's law and derive the relation between pressure and density of a gas.
2. State and explain Charel's law at constant pressure and constant temperature.
3. State gas laws?
4. Define absolute zero and absolute scale of temperature.
5. Define ideal gas and derive ideal gas equation.
6. Derive ideal gas equation in terms of density.
7. Write the differences between R and r.
8. Why universal gas constant is same for all gases.
9. Calculate the value of R.
10. Define entropy and write its physical significance.
11. Draw P-V diagram and T-S diagram for isothermal process.
12. Draw P-V diagram and T-S diagram for adiabatic process.
13. Write the differences between isothermal and adiabatic processes.
14. State first and second law of thermodynamics.
15. Write the differences between C_P and C_V.
16. Derive the relation $C_p - C_v = R$.
17. Why Cp greater than Cv.

UNIT -8 SOUND

BEATS

1) The frequency of sound is 110Hz and wave length is 3m. Calculate the velocity of the wave?
2) The velocity of sound wave is 330m/s and its frequency is 110HZ .calculate its wavelength?
3) Frequencies of two tuning forks are in the ratio 20:21. When sounded together, 8 beats are heard per second. What are their frequencies?
4) Frequencies of two tuning forks are in the ratio 20:21. When sounded together, 6 beats are heard per second. What are their frequencies?
5) Two tuning forks A and B originally are in uniform. The frequency of B is 250 HZ. When a piece of wax is attached to fork A, 4 beats per second are produced when sounded with B. Find the frequencies of A after attaching wax?
6) Two tuning forks produce 5 beats per second when sounded together. The frequency of one is 200 HZ and when the other is loaded with a little wax, the beats stop. Find the frequency of second tuning fork?
7) Two tuning forks produce 5 beats per second when sounded together. The frequency of one is 200Hz and when the other is loaded with a little wax, the beats are stopped. Find the frequency of the second tuning fork. (Ans: 205Hz)
8) Two tuning forks 'A' and 'B' produces 5 beats per second. The frequency of 'B' is 514Hz. 'A' is loaded with wax and found that beats occur at shorter intervals. Find the frequency of A'.(Ans: 509Hz)
9) The two tuning forks 'A' and 'B' give 5 beats per second. The frequency of A=512Hz. When 'B' is filed 5 beats per second are again produced. Find the frequency of 'B' before and after filing. (507Hz,517Hz)
10) A tuning fork, when sounded with a fork frequency 256Hz gives 4 beats. When small amount of wax is attached to the unknown fork 3 beats are heard. What is the frequency of the fork?(260Hz)
11) A tuning fork of unknown frequency, when sounded with another fork of frequency 260Hz gives 5 beats. When loaded with small amount of wax, if again gives 5 beats. Find the unknown frequency. (Ans:265Hz)
12) Two notes of frequency 512HZ and 512HZ and are sounded together explain the possibility of formation of beats?
13) Two notes of frequency 500HZ and 505HZ and are sounded to get in vacuum how many beats per second are card? Explain?
14) Two notes of frequency 500HZ and 200HZ are sounded together simultaneously, find the number of beats produced per second?
15) Two tuning forks produce 4 beats per second, when sounded together. The frequency of one is 200Hz. When the other is loaded with a little wax, the beats stops. Find the frequency of the second tuning fork. (ANS:204Hz)

16) A frequency of a tuning fork 'A' is 3% less than that of a standard fork 'P'. The frequency of another fork 'B' is 3% greater than that of 'P'. Find the frequencies of two tuning forks 'A' and 'B' if 5 beats / second are heard when they are sounded together? (ANS: A = 80.33Hz, B = 85.33Hz)

17) Two forks when sounded together produce 6 beats per second. The first fork has the frequency 3% greater than a standard one and the second has the frequency 2% lesser than the same standard fork. Find the frequencies of the forks. (ANS:123.6Hz,117.6Hz)

18) Two sound waves of wave lengths 1.01m and 1m produced 3.5 beats per second. Find the velocity of sound in air? (ANS: 353m/s)

19) When two tuning forks are sounded together, 20beats are produced in 10s. On loading of the forks with wax, the no. of beats/second increases. If the frequency of unloaded fork is 512Hz, calculate the frequency of the other. (ANS: 510Hz)

20) When two tuning forks were sounded together, 24beats were produced in 8 seconds. After loading one of the forks with wax, they produce 32beats in 8 seconds. If the loaded fork had frequency 512Hz calculate the frequency of the other. (ANS: 515Hz)

21) Two sound waves of wave length 1.01m and 1m produced by 3.5 beats per second. Find the velocity of sound in air.

22) Two sound waves of wave lengths 1.01m and 1m produced 4 beats per second. Find velocity of sound in air ? (Ans:404m/s)

DOPPLER EFFECT

23) A railway engine whistling with a frequency of 240Hz. Approaches a station with a velocity of 30m/s. Find the frequency of sound heard by a listener standing on platform. Find also the frequency of sound heard by listener when the engine moves away with the same velocity. (V = 330m/s) (Ans: 264Hz, 220Hz)

24) A fire engine by ringing its bell with a frequency of 630Hz is moving with a velocity of 54Kmph towards an observer at rest near a hut on fire. If the velocity of sound in air is 330m/s, find the apparent frequency heard by the observer. (ANS:660Hz)

25) A source of sound of frequency 300Hz is moving towards a stationary observer with a speed of 80m/s. Find the frequency as heard by the observer? (ANS: 396Hz)

26) A source of sound of frequency 300Hz is moving towards a stationary observer with a speed of 80m/s. Find the frequency as heard by the observer. (V = 330m/s) (ANS:396Hz)

27) A train is travelling at 120Kmph and blows a whistle of frequency 1000Hz. What will be the frequency of the note heard by the stationary observer:(i)If the train is approaching him and (ii)If the train is moving away from him?(V =330m/s) (ANS: 1112Hz, 908Hz)

28) A train is moving at 180Kmph and blows a whistle of frequency 500Hz. find the frequency of sound observed by the stationary observer when the source is moving towards and away from the observer. (V = 340m/s) (ANS: 586.2Hz, 435.9Hz)

29) When a source of sound is approaching a stationary listener with a certain velocity, find the frequency of the sound heard is increased by 10%. Find the velocity of the source. (V = 330m/s) (ANS:30m/s)

30) Find the velocity of source of sound when frequency appears to be (a) half (b) double the original frequency to a stationary observer? (ANS: V, V/2)

31) A locomotive whistle with a frequency of 226Hz is moving towards the stationary observer with a velocity of 1/20th of that of sound. Calculate the frequencies heard by the observer before and after the locomotive passes. (ANS: 237.89Hz, 215.24Hz)

32) The apparent frequency of the whistle of a locomotive changes in the ratio 9: 5 as it passes the stationary observer. Calculate the velocity of locomotive if the velocity of sound is 350m/s. (100m/s)

33) A policeman blows a whistle of frequency 350Hz as a car passes him with a velocity of 18Kmph. Find the change in frequency heard by the driver as he just passes policemen velocity of sound is 350m/s. (10Hz)

34) A person is travelling with a constant velocity of 30m/s towards a source of frequency 990Hz. Find the apparent frequency of sound heard by the person. The velocity of sound is given by 30m/s.(1080Hz)

35) A motor cyclist is travelling away with a velocity of 10m/s from a river that produces sound of frequency 660Hz. Find the apparent frequency of the sound heard by the motor cyclist. (V = 330m/s.) (ANS: 640Hz)

36) If an observer is moving towards a stationary vehicle with a certain velocity, he finds that the pitch is increased by 15%. Calculate his velocity. (ANS:49.5m/s)

37) A person is moving with a velocity of 50m/s towards a stationary source of frequency 800Hz. Find the apparent frequency if he is moving away from the source (V = 340m/s) (917.6Hz)

38) The apparent frequency of whistle of an engine changes in the ratio 3: 2 as the engine passes a stationary observer. If the velocity of sound is 345m/s, calculate the velocity of the engine.(69)

39) Sound of same frequency 660Hz is given out from sirens at two places 'A' and 'B' separated by some distance. If the cyclist is moving from place 'A' to 'B' with speed 4.5Kmph, find the no.of beats heard by him in one second. (V = 330m/s)

Sabine's formula

40) The reverberation time of a theater is 3sec and 2 sec when it is empty and completely filled with audience respectively .what is the reverberation time when half filled with audience

{Ans: when empty $T=3=0.17v/A_0$ When filled $T'=2=0.17v/A_0+A$ When half-filled $T''=2.4$ s}

41) Reverberation time of a cinema hall is 0.1 second. The volume of another theater is half that of the cinema hall. If the absorbing area is same for two, find the reverberation time of small hall.(Ans:0.05 s)

42) The reverberation time measured in a closed chamber ($v=1000m^3$) without paint and after painting inside are 5 seconds and 2 seconds respectively. The absorption coefficient without and write paints are 0.115 and 0.20metric Sabine's. Then, Find the inner area of chamber ($600m^2$)

43) When all the audience come out of the auditorium the reverberation time becomes (4/3) of that when packed with 400 audience. What is the ratio of the absorption to that of a person?

44) The time period of reverberation of an empty hall without and with 500 audience is 1.5sec and 1.4 sec respectively. Find the time of reverberation with 1000members in the hall

45) The ratio of the absorption of the person to that of the auditorium is 1/1500. In order to make the reverberation time $3/5^{th}$ of the initial value how many number of persons are accommodated in the auditorium?

ECHO

46) A boy hears an echo of his own voice from distant hill after 2 seconds. If the velocity of sound is 340m/s, find the distance of hill. (ANS : 340m)

47) A man is at a distance from a hill and produces sound. If he hears an echo after 3 seconds. Find the distance from the hill.(V = 340m/s) (ANS : 510m)

48) Calculate the velocity of sound in air, if an observer at a distance of 400m from a building hears an echo after 2.5s. (ANS: 320m/s)

49) A person standing between two hills fires a gun. He hears first echo after 1s and second echo after 2s. IF the distance between the hills is 510m, find the velocity of sound. (ANS:340m/s)

50) A person standing between two parallel hills fires a gun. He hears the first echo after 2.4s and the next after 4s. If the velocity of the sound is 350m/s, find the distance between the two hills. **(**ANS:1120 m)

51) A man standing between two parallel walls fires a gun. He hears the first echo after 3.4s and next after 6s. Find the distance between the two walls if the velocity of sound in air is 340m/s.(ANS:1598m)

52) A car approaching a tower with a velocity of 25m/s sounds the horn at a distance 890m from the tower and an echo is heard after 5 seconds. Find the velocity of sound? (ANS:331m/s)

53) A man is driving at 72Kmph on a straight road heading towards a hill. He sounds the horn and hears its echo 4 seconds afterwards, at what distance from the hill the horn was sounded?

54) An engine approaching a cliff blows a whistle when it is a distance of 1.8 Km from it the echo is heard by the driver after 10s. If the velocity of sound in air is 340 m/s. What is the velocity of the engine?(20 m/s)

55) A man standing between two parallel walls fires a gun. He hears the first echo after 3.4 seconds and next after 6 seconds. Find the distance between the two walls if the velocity of sound in air is $340ms^{-1}$

56) A person standing between two hills fires a gun. He hears first echo after 1 sec .one and second echo after 2 seconds. If the distance between the hills is 510m.Find velocity of sound in air.

57) A man is driving a car at a speed of 72kmph towards a hill. He sounds the horn and hears its echo after 2 seconds .At what distance from the hill the horn was sounded.(v=340 m/s) (Ans: 360m)

58) A person fired a bullet against a wall and heard an echo after 2 s. He walked 85meters towards wall and fired another bullet and heard echo 1.5 s after. What is the distance from the wall to first fired place (Ans:340 m)

59) A person hears an echo of his own voice from a distant hill after 2.6 s. If the velocity of sound is 350m/s. what is the distance of the person from the hill? (Ans: 455m)

60) A boy hears an echo of his own voice from a distant hill after 2 s. If the velocity of sound i.e, 340m/s. find the distant of the hill. (Ans: 340m)

61) Calculate the time in which an echo can be detected by an observer at a distance of 680m from a hill?

62) A boy hears an echo of his own voice from a distant hill after 2 seconds. if the velocity of sound is 340m\s, find the distance of the hill?

63) A man is at a certain distance from a hill and produces a sound. If he hears an echo after 3 seconds, find the distance from the hill?

ASSIGNMENT QUESTIONS

1. Write the differences between musical sound and noise?
2. Write any 4 differences between transverses and longitudinal waves?
3. What is noise pollution? Name the unit of sound intensity?
4. Write the causes and effects of noise pollution?
5. Write the methods of controlling noise pollution?
6. Explain beats and write the applications of beats?
7. What is Doppler Effect and write its applications.
8. What is reverberation time? Give an expression for the time of reverberation (Sabine's formula).
9. Define echo? Give the formula for the time of echo?
10. Write applications of echo?

UNIT-9 PROPERTIES OF MATTER

Model1:

1) A wire of length 2cm is fixed at one end and a force of 10N is applied at the other end. The area of cross section of the wire is 2 X $10^{-6}m^2$ and the Young's modulus of elasticity of its material is 2 X $10^{11}N/m^2$ Calculate the stress, strain and increase in length of the wire.
(hint:Y=Fl/AΔl) (ANS:l =increase in length = 5 X 10^{-5}m)
2) What is the force required to stretch a steel wire 1 sq.cm in cross section to double its length?
(Y = 2 X10^{12} dynes/cm^2) (hint:Y=Fl/AΔl) (ANS: force= 2 X10^{12} dynes)
3) A copper wire 2m long and 0.5mm in diameter supports a mass 3kg. It is stretched by 2.38mm. Calculate Y? (hint:Y=Fl/AΔl) (ANS: Y = 1.258 X$10^{11}N/m^2$ (or) Y = 1.258 X 10^{12}dynes/cm^2)
4) A Force of 20N is applied at the free end of a wire of length 4m and diameter 2mm, produces an elongation of 0.24mm. Find 1) the stress in the wire 2) its strain and 3) Young's modulus
(hint:Y=Fl/AΔl) (ANS: Young's modulus = 1.06 X $10^{11}N/m^2$)
5) Determine the force to be applied on a wire of length 6m and diameter 1.6mm to produce an elongation of 1mm. The Young's modulus of elasticity is given by 200Gpa. (hint:Y=Fl/AΔl) (ANS: Force F = 66.67N)
6) What force is required to stretch a steel wire of $1cm^2$cross section to double its length. Young's modulus is given by 2 X $10^{11}N/m^2$.(hint:Y=Fl/AΔl) (ANS:2 X 10^7Newtons)
7) Two wires of same length and same materials are stretched with the same force. If the radii of the wires are in the ratio 1:3, Calculate the ratio of their elongations (hint:Y=Fl/AΔl) (ANS: $\Delta l_1 : \Delta l_2 = 9:1$)
8) The diameter of a brass rod is 6mm. What force in dynes will stretch by 0.2% of its length?
(Y = 9 X 10^{11}dynes/cm^2) (hint:Y=Fl/AΔl) (ANS: F = 5.1 X 10^8dynes)
9) A force of 20 N is applied at the free end of a wire of length 4 m and diameter 2 mm, produces an elongation of 0.24 mm . Find (i)the stress in the wire (ii) its strain and (iii) Young's modulus.
(hint: σ =F/A , s=Δl/l , Y=σ/s) (Ans:6.3x10^6 Nm^2; 6x10^{-5}; 1.06x10^{11} Nm^2)
10) Determine the force to be applied on a wire of length 6 m and diameter 1.6mm to produce on elongation of 1mm. The Young's modulus of elasticity is given by 200 Pa.(hint:Y=Fl/AΔl) (Ans:66.67 N)
11) A steel rod of length 1 m and area of cross-section 400 mm^2 is subjected to a tensile force of 40 kN.If modulus of elasiticity of material of the rod is 200 GPa.Find the elongation of the rod. (hint:Y=Fl/AΔl)
(Ans:0.5 mm)
12) What force is reqired to stretch a steel wire of 1 cm^2 cross-section to double its length.Young's modulus is given by 2x10^{11} Nm^{-2}. (hint:Y=Fl/AΔl) (Ans:2x10^7 N)
13) Two wires of same length and same material are stretched with the same force.If the radii of the wires are in the ratio 1:3.Calculate the ratio of their elongations. (hint:Y=Fl/AΔl) (Ans:9:1)

Surface tension

1) The radius of a capillary tube is 0.025mm. The tube is dipped vertically in a liquid of density 0.8 X 10^3Kg/m^3 and surface tension is 3 X 10^{-2}N/m. Angle of contact $\theta = \cos^{-1}(0.3)$.calculate the height to which liquid rises in the capillary tube.Take g = 10m/s^2 (hint: T=hrdg/2 cosθ) (ANS: height h = 9cm)
2) A capillary tube whose inside radius is 0.5mm is dipped in water of surface tension 7.5 X 10^{-3}N/m. To what height is the water raised by the capillary action above the water level? What is the weight of water raised? Angle of contact of water with glass is 0^0 and g = 9.8m/s^2. (hint: T=hrdg/2 cosθ)
(ANS: 0.02404gm)
3) Water rises to a height 30mm in a capillary tube. If the radius of the tube is $\frac{3}{4}^{th}$ of its previous value, what is the height to which the water will rise now? (hint: T=hrdg/2 cosθ) (ANS: $h_2 = 40mm$)
4) When a capillary tube is dipped in pure water the rise of water level in its is 40mm. When the same tube is dipped vertically in a trough of mercury, the level inside the tube was depressed by 12.2mm. Compare the surface tension of water and mercury (Angles of contact of water and mercury are 0^0 and 130^0 and density 10^3kg/m^3 and 13.6 X 10^3kg/m^{3}respectively) (hint: T=hrdg/2 cosθ) (ANS: $T_1 : T_2 = 1 : 6.45$)
5) A liquid rises to a height of 50mm in a capillary tube of diameter 0.04mm. If the density of the liquid is 0.8 X 10^3kg/m^3 and the angle of contact is 20^0, find the surface tension of the liquid.
(hint: T=hrdg/2 cosθ) (ANS: T = 4.17 X 10^{-3}N/m)
6) A capillary tube of bore diameter 0.4mm is dipped vertically in a beaker of mercury. The angle of contact is 130^0 and density of mercury is 13.6 X 10^3Kg/m^3. If the surface tension of mercury is 0.49Nm^{-1}, find the depression of mercury in the tube (hint: T=hrdg/2 cosθ) (ANS: depression of mercury is 2.363cm)
7) Calculate the surface tension of water assuming that the density of water is 10^3 kg m^{-3},angle of contact is 0^0,radius of capillary tube is 0.2 mm and the rise of water in the capillary tube is 6.6 cm.
(hint: T=hrdg/2 cosθ) (Ans:64.68x10^{-3} N/m)
8) A capillary tube of 0.5 mm bore stands vertically in a vessel containing liquid of surface tension 30x10^{-3} nm^{-1}. The liqud wets the tube and has a density of 800 kgm^{-3}.Calculate the rise of the liquid in the tube by neglecting the volume of the liquid in the meniscus.(hint: T=hrdg/2 cosθ) (Ans:3.061 cm)
9) A capillary tube of bore diameter 0.4 mm is dipped vertically in a beaker of mercury. The angle of contact is 130^0 and density of mercury is 13.6x10^3 kgm^{-3}. If the surface tension of mercury is 0.49 Nm^{-1}.Find the depression of mercury in the tube. (hint: T=hrdg/2 cosθ) (Ans:2.363 cm)
10) What should be the radius of a capillary tube, if the water has to rise to a height of 6 cm in it? Surface tension of water is 7.2x10^{-2} Nm^{-1}. (hint: T=hrdg/2 cosθ) (Ans:0.245 mm)

11) Water rises to a height of 58 mm in a certain capillary tube .What will be the depression if the same capillary tube is dipped in mercury.The angle of contact between mercury and glass is 128^0. Surface tension of water and mercury are $72x10^{-3}$ Nm^{-1} and $470x10^{-3}$ Nm^{-1} respectively.

(hint: T=hrdg/2 cosθ) (Ans: r=$2.53x10^{-4}$ m, d=1.72 cm)

12) Capillary rise in water is 10 cm.When the same capillary tube is dipped in mercury it depressed by 3.42 cm. Compare the surface tension of water and mercury if the angles of contact the water and mercury are 0^0 and 135^0 and the densities are $1x10^3$ kgm^{-3} and $13.6x10^3$ kgm^{-3} respectively.

(hint: T=hrdg/2 cosθ) (Ans:1:6.58)

viscosity

1) A flat plate of area 30 X $10^{-4}m^2$ is separated from a large plate by a layer of glycerin 2mm thick. Calculate the force required to keep the plate moving with a velocity of 0.004m/s, if the coefficient of viscosity of glycerin is $2kgm^{-1}s^{-1}$ (hint:η=ΠPr^4/8vl) (ANS: External force = $-0.12N$)

2) Calculate the horizontal force required to move a metal plate of area $2m^2$ with a velocity of 4.5 m/s when it rests on a layer of oil 2 X 10^{-3}m thick. Coefficient of viscosity of oil is $2N\text{-}S/m^2$

(hint:η=ΠPr^4/8vl) (ANS: F = 9 X 10^3N)

3) Water flows through a horizontal capillary tube of length 20cm under a constant pressure head of 20cm. If 864c.c of water flows through the tube in 12 minutes, calculate the radius of the tube ($\eta = 0.01381 poise$, density of water = 1 gm/c.c and g = 981 cm/s^2) (hint:η=ΠPr^4/8vl)

(ANS: radius of the tube is 0.144cm)

4) Water is conveyed through a pipe of inner radius 5cm at a rate of 1000 liters per minute to a place 5Km far away. If the coefficient of viscosity of water is $0.001Nm^{-2}s$, find the required pressure difference

(hint:η=ΠPr^4/8vl) (ANS: Pressure difference = 3.3953 X 10^4Nm^{-2})

5) The coefficient of viscosity of water and a liquid are $0.001Nm^{-2}s$ and 0.003 $Nm^{-2}s$. If the density of the liquid is $500kgm^{-3}$, compare the rates of flow of the liquids. (hint:η=ΠPr^4/8vl)

6) A square plate of 0.1m side moves parallel to another plate with a velocity of 0.1m/s, both plates immersed in water. If the viscous force is 0.002N and coefficient of viscosity 0.01 poise, what is the distance apart? (hint:η=ΠPr^4/8vl)

7) Water at a level difference of 13 cm flows through a horizontal tube of radius 1 mm and length 20 cm. In 2 minutes 320 cc of water is collected. Find the coefficient of viscosity of water. (hint:η=ΠPr^4/8vl)

(Ans:$9.368x10^{-4}$ $Nm^{-2}s$)

8) Water flows through a horizontal capillary tube of length of 20 cm under a constant pressure head of 20 cm . If 864 cc of water flows through the tube in 12 minutes, calculate the radius of the tube. (η=0.01381 poise,density of water=1 g/cc and g=981 cm/s^2) (hint:η=ΠPr^4/8vl) (Ans:0.144 cm)

9) Water is conveyed through a pipe of inner radius 5 cm at a rate of 1000 liters pre minutes to a place 5 km far away. If the coefficient if viscosity of water is 0.001 $Nm^{-2}s$.Find the required pressure difference.

(hint:$\eta=\Pi Pr^4/8vl$) (Ans:$3.395x10^4$ N/m^2)

10) When olive oil is allowed to flow through a capillary tube under a pressure of 14 Nm^{-2}, some quantity of olive oil is collected. It was found that the same quantity of phenol was collected when it was allowed to flow through the same tube under a pressure of 2 Nm^{-2} in the same time. If the coefficient of viscosity of olive oil is 0.084 $Nm^{-2}s$, find that of phenol. (hint:$\eta=\Pi Pr^4/8vl$) (Ans:0.012 $Nm^{-2}s$)

11) When kerosene and coconut oil of coefficients of viscosity 0.002 $Nm^{-2}s$ and 0.0154 $Nm^{-2}s$ respectively are allowed to flow through the same pipe under the same pressure difference in the same time interval,1n lt of coconut oil is collected. Find the volume of the kerosene that flows. (hint:$\eta=\Pi Pr^4/8vl$) (Ans:7.7 liters)

12) The coefficients of viscosity of water and a liquid are 0.001 $Nm^{-2}s$ and 0.003 $Nm^{-2}s$. If the density of the liquid is 500 kgm^{-3}, compare the rates flow of the liquids. (hint:$v\alpha P/\eta$) (Ans:6:1)

ASSIGNMENT QUESTIONS

1) Define Elasticity?
2) Define the term stress and also define different types of stress?
3) Define the term strain and also define different types of strain?
4) Write the units and dimensional formulae for stress and strain
5) State and explain Hooke's law
6) Define surface tension and state examples?
7) Explain Surface tension with reference to molecular theory
8) Define angle of contact and capillarity?
9) Write the formula for surface tension based on capillarity and name the parameters?
10) Define Viscosity and give examples of Viscosity?
11) State and explain Newton's formula for viscous force?
12) Define co-efficient of viscosity and write its units and dimensional formula?
13) Explain the effect of temperature on viscosity of liquids and gases?
14) State Poiseulle's equation for Co-efficient of viscosity and name the physical quantities involved?

Ohm's Law

1) Calculate the potential difference to be applied across a conductor of resistance 16Ω so that a current of 15amperes may flow through it. (ANS: V = 240 volts)
2) Determine the current flowing through the filament of a lamp having a constant resistance of 440Ω and connected across 220V mains (ANS: i = 0.5 amperes)
3) Calculate the specific resistance of the material of a wire 1.1m long and 0.4mm in diameter and having a total resistance of 4.2Ω (ANS: S = 0.48 X 10^{-6}Ω-m)
4) The specific resistance of the material of a wire is 44 X 10^{-8}Ω-m. If the resistance of the wire is 14Ω and its diameter is 1mm, calculate the length of the wire (ANS:l = 25m)
5) The resistance of a wire is 15Ω. What is the resistance of another wire of same material having double length and half the radius? (ANS: R_2 = 120Ω)
6) Calculate the resistance of 500m of a cable, if its area of cross section and resistivity are 10mm^{2}and1.7 X 10^{-8}Ωm respectively? (ANS: R =0.85Ω)
7) A wire of resistance 4Ω is drawn outside so that its radius becomes half. What is the new resistance? (ANS:R_2 = 64Ω)
8) The resistance of a wire is 8Ω. What is the resistance of another wire of same material having same length but of double area of cross section (ANS: Resistance of second wire is 4Ω)
9) A wire is stretched by 1% calculate the percentage change in resistance of wire. (ANS: 2.01%)
10) The resistance of a wire is 8ohm. What is the resistance of another wire of same material having same length but of double area of cross section? (ANS: $R_2 = 4\Omega$)
11) If a wire of resistance R is stretched to 'n' times of its initial length then what is its new resistance?
12) A hollow cylinder (ρ=2.2×10^{-8} Ωm) of length 3 m has inner and outer diameter as 2mm and 4mm respectively. What is its resistance?
13) A wire of resistance R is bent in the form of a circle. What is the effective resistance across its diameter?
14) Calculate the resistance of a conductor when a current of 2 mA flows between its ends under a P.D of 20 V.
15) A wire of resistance 10 Ω is stretched so thet its radius becomes half. What is the new resistance?
16) A wire carries 20 mA steady current. Calculate the time required for 24×10^{19} electrons to pass through the wire.
17) Two wires of same material possess lengths in the ratio 2:5 and radii in the ratio 3:4. Calculate the ratio of their currents under same P.D.
18) Twowires made of same material and of same lengths have their resistances in the ratio 4:5. Calculate the ratio of their masses.

19) If the length of a conducting wire is increased 4 times and its area of cross-section is doubled, then find how its resistance changes.

20) Calculate the potential difference to be applied across a conductor of resistance 20 Ω, so that a current of 2 A may flow across through it.

21) The resistance of a wire is 8Ω. What is the resistance of another wire of same material having same length but of double area of cross section?

Meter Bridge and Wheatstone's bridge

22) If 10ohms and 30ohms are connected in left and right gaps in meter bridge experiment, find the balancing length. (ANS: Balancing length = 0.25m)

23) In the meter bridge experiment, if the resistances in the left and right gaps are in the ratio 3:4, find where the balancing point is obtained. (ANS: Balancing point obtained at 0.43m)

24) In an experiment with a meter bridge, a resistance of 10Ω is placed at in one gap and an unknown resistance in the other. The balance point is obtained at a distance of 40cm from that end of the wire which is connected directly to one terminal of the 10ohms. Find the value of unknown resistance. (ANS: X = 15Ω)

25) A wire of length 0.25m and diameter 3.286 X 10^{-5}m is connected in the left gap of a metre bridge. The other resistance at the balanced condition are Q = 10Ω, R = 33Ω and S = 66Ω. Find the specific resistance of the wire. (ANS: Specific resistance = 1.7 X 10^{-8}Ωm)

26) A balance point in a meter bridge experiment is obtained at 40 cm (from left). If the right gap has 10.5 Ωresistances, calculate the resistance in the left gap.

27) If 10 Ω and 30 Ω are used in a meter bridge experiment find the balancing length.

28) In the meter bridge experiment, if the resistances in the left and right gaps are in the ratio 3:4, find where the balancing point is obtained.

29) In the case of Wheatstone's bridge three resistors are 10 Ω, 12 Ω, 8 Ω. Find the value of fourth resistor.

30) Find the balance length of a meter bridge if the resistances in the left and right gaps are in the ratio of 3:5.

31) In meter bridge experiment, if the resistances of the 2 gaps (left and right) are in the ratio 4:5. Calculate the balancing length corresponding to left gap resistance.

Magnetism

32) A north pole of strength 20 A-m and south pole of strength 50Am are separated by a distance of 10cm in air. Find the force between them. (ANS:Force = 0.01N)

33) The force of repulsion between two poles separated by a distance of 5cm is 10N. What is the repulsion between the same poles separated by a distance of 4cm? (ANS: Force = 15.62N)

34) Two magnetic poles of strength 30Am are separated by a distance of 10cm in air. What is the force between them? (ANS: Force = 9 X 10^{-3}N)

35) Two magnetic poles one of which is three times as strong as the other, exert on each other a force equal to 3 X 10^{-3}N when separated by a distance of 10cm. Find the strength of each pole.

(ANS: $m_1 = m = 10Am;\ m_2 = 3m = 30Am$)

36) A north pole of strength 20 Am and South Pole of strength 50 Am are separated by a distance 10 cm in air. Find the force between them.

37) Two magnetic poles each of strength 40 A-m are separated by distances of 20 cm in air. Find the force between them.

38) The magnetic force between two magnetic poles separated by a distance of 5 cm is 10 N. find the force if the distance between them is 4 cm.

39) If the distance between two magnetic poles is increased three times, what happens to the force between them?

Moment of couple and axial line, Equatorial line

40) A couple of 0.2 X 10^{-3}Nm is required to hold a bar magnet at right angles to a magnetic field of induction 0.5T. Find the magnitude of the moment of the magnet. (ANS:M = 0.4 X 10^{-3}A-m^2)

41) A bar magnet of length 20cm and pole strength 5Am is makes an angle of 30^0 with a uniform magnetic field of induction 100 tesla. Find the moment of couple on it. (ANS: couple $\tau = 50Nm$)

42) When a bar magnet is placed at 90^0 to a uniform magnetic field, it is acted upon by a couple which is maximum. For the couple to be half of the maximum value, at what angle should the magnet be inclined to the magnetic field (B)? (ANS: $\theta = 30°$)

43) Find the magnetic induction at a distance of 10cm on the equatorial line of a short bar magnet with a magnetic moment 60 Am^2 (ANS: B = 60 X 10^{-4}tesla.)

44) The magnetic moment of a short magnet is 27A-m^2. What is the magnetic induction at a point 30cm away on its equatorial line from its midpoint (ANS: B = 1 X 10^{-4}Wb-m^2(or)tesla).

45) The magnetic moment of a short magnet is 4 A-m^2. What is the magnetic induction at a point on the axial line at a point 40cm away from its mid-point? (ANS: B = $\frac{1}{8}X10^{-4}wb - m^2$)

46) The magnetic induction at a distance of 20cm on the axial line of a short bar magnet is 15Am^{-1}. Find the magnetic induction at a distance of 10cm. (ANS: $B_2 = 120Am^{-1}$)

47) Each pole of a bar magnet experiences a force of 4×10^{-4}N when placed in a uniform magnetic field of induction 2×10^{-5} N/A-m calculate the pole strength.

48) A bar magnet of pole strength 60 Am has a length 20 cm. what is the magnetic moment?

49) A short bar magnet of magnetic moment 20 Am^2 produces magnetic field around it. Calculate the ratio of induction field strength at 10 cm distance on both its axial line and equatorial line.

50) The ratio of magnetic induction field strength due to a very short bar magnet on its axial line in its magnetic field at 2 points is 1:8. Find the ratio of their distances.

ASSIGNMENT QUESTIONS

1. State and explain Ohm's law?
2. State and explain Kirchoff's laws?
3. Define resistance and specific resistance and write their units and dimensional formula?
4. Derive the balancing condition of Wheatstone's bridge?
5. Write the experimental determination of specific resistance of a wire using Meter Bridge?
6. Define magnetic induction field strength and write its unit and dimensional formula?
7. State and explain Coulomb's inverse square law of magnetism?
8. Derive the relation F = mB.
9. Derive an expression for the couple acting on a bar magnet?
10. Derive an expression for the magnetic induction field strength at a point on the axial line?
11. Derive an expression for the magnetic induction field strength at a point on the equatorial line?

UNIT- 11

MODERN PHYSICS

ASSIGNMENT QUESTIONS

1. Define photo electric effect?
2. Write Einstein equation for photo electric effect and state the laws of photo electric effect?
3. Explain the working of photo cell?
4. Write the applications of photo electric effect?
5. Define total internal reflection and critical angle. Write the examples of it?
6. Define optical fiber and write the different types of optical fiber?
7. Write the applications of optical fibers?
8. Define super conductivity and write their properties?
9. Write the applications of super conductors?

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