11

11 physics

11th Standard

Physics

168 x 1 = 168

1) One of the combinations from the fundamental physical constants is $\frac{hc}{G}$, The unit of this expression is

(a) Kg^2 (b) m^3 (c) S^{-1} (d) m

2) If the error in the measurement of radius is 2%, then the error in the determination of volume of the sphere will be

(a) 8% (b) 2% (c) 4% (d) 6%

3) If the length and time period of an oscillating pendulum have errors of 1% and 3% respectively then the error in measurement of acceleration due to gravity is

(a) 4% (b) 5% (c) 6% (d) 7%

4) The length of a body is measured as 3.51 m, if the accuracy is 0.01 mm, then the percentage error in the measurement is

(a) 35.1% (b) 1% (c) 0.28% (d) 0.035%

5) Which of the following has the highest number of significant figures?

(a) 0.007 m^2 (b) 2.64×10^{24}kg (c) 0.0006032 m^2 (d) 6.3200 J

6) If $\pi = 3.14$, then the value of π^2 is

(a) 9.8596 (b) 9.860 (c) 9.86 (d) 9.9

7) Which of the following pairs of physical quantities have same dimension?

(a) force and power (b) torque and energy (c) torque and power (d) force and torque

8) The dimensional formula of Planck's constant h is

(a) $[ML^2T^{-1}]$ (b) $[ML^2T^3]$ (c) $[MLT^{-1}]$ (d) $[ML^3T^{-3}]$

9) The velocity of a particle v at an instant t is given by $v = at + br^2$. The dimensions of b is

(a) [L] (b) $[LT^{-1}]$ (c) $[LT^{-2}]$ (d) $[LT^{-3}]$

10) The dimensional formula for gravitational constant G is

(a) $[ML^3T^{-2}]$ (b) $[M^{-1}L^3T^{-2}]$ (c) $[M^{-1}L^{-3}T^{-2}]$ (d) $[ML^{-3}T^2]$

11) The density of a material in CGS system of units is 4 g cm^{-3}. In a system of units in which unit of length is 10 cm and unit of mass is 100 g, then the value of density of material will be

(a) 0.04 (b) 0.4 (c) 40 (d) 400

12) If the force is proportional to square of velocity, then the dimension of proportionality constant is

(a) $[MLT^0]$ (b) $[MLT^{-1}]$ (c) $[MLT^{-2}T]$ (d) $[MLT^{-1}T^0]$

13) The dimension of $\left(\mu_0 \epsilon_0\right)^{\frac{1}{2}}$ is

(a) length (b) time (c) velocity (d) force

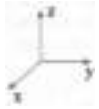
14) Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are taken as three fundamental constants. Which of the following combinations of these has the dimension of length?

(a) $\frac{\sqrt{hG}}{c^{\frac{3}{2}}}$ (b) $\frac{\sqrt{hG}}{c^{\frac{5}{2}}}$ (c) $\sqrt{\frac{hc}{G}}$ (d) $\sqrt{\frac{Gc}{h^{\frac{3}{2}}}}$

15) A length-scale (I) depends on the permittivity (e) of a dielectric material, Boltzmann constant (kB), the absolute temperature (T), the number per unit volume (n) of certain charged particles, and the charge (q) carried by each of the particles. Which of the following expression for I is dimensionally correct?

(a) $l = \sqrt{\frac{nq^2}{\epsilon k_B T}}$ (b) $l = \sqrt{\frac{\epsilon k_B T}{nq^2}}$ (c) $l = \sqrt{\frac{q^2}{en^{\frac{2}{3}} k_B T}}$ (d) $l = \sqrt{\frac{q^2}{\epsilon n k_B T}}$

16) Which one of the following Cartesian coordinate systems is not followed in physics?

(a)  (b)  (c)  (d) 

17) Identify the unit vector in the following?

(a) $\hat{i} + \hat{j}$ (b) $\frac{\hat{i}}{\sqrt{2}}$ (c) $\hat{k} - \frac{\hat{j}}{\sqrt{2}}$ (d) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

18) Which one of the following physical quantities cannot be represented by a scalar?

(a) Mass (b) length (c) momentum (d) magnitude of acceleration

19) Two objects of masses m_1 and m_2 fall from the heights h_1 and h_2 respectively. The ratio of the magnitude of their momenta when they hit the ground is

(a) $\sqrt{\frac{h_1}{h_2}}$ (b) $\sqrt{\frac{m_1 h_1}{m_2 h_2}}$ (c) $\frac{m_1}{m_2}\sqrt{\frac{h_1}{h_2}}$ (d) $\frac{m_1}{m_2}$

20) If a particle has negative velocity and negative acceleration, its speed

(a) increases (b) decreases (c) remains same (d) zero

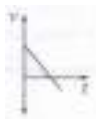
21) If the velocity is $\vec{v} = 2\hat{i} + t^2\hat{j} - 9\vec{k}$, then the magnitude of acceleration at t = 0.5s is

(a) 1 ms^{-2} (b) 2 ms^{-2} (c) zero (d) -1 ms^{-2}

22) If an object is dropped from the top of a building and it reaches the ground at t = 4 s, then the height of the building is (ignoring air resistance) (g = 9.8 ms^{-2})

(a) 77.3 m (b) 78.4 m (c) 80.5 m (d) 79.2 m

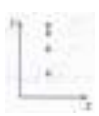
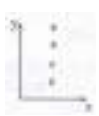
23) A ball is projected vertically upwards with a velocity v. It comes back to ground in time t. Which v-t graph shows the motion correctly?

(a)  (b)  (c)  (d) 

24) If one object is dropped vertically downward and another object is thrown horizontally from the same height, then the ratio of vertical distance covered by both objects at any instant t is

(a) 1 (b) 2 (c) 4 (d) 0.5

25) A ball is dropped from some height towards the ground. Which one of the following represents the correct motion of the ball?

(a)  (b)  (c)  (d) 

26) If a particle executes uniform circular motion in the xy plane in clock wise direction, then the angular velocity is in

(a) +y direction (b) +z direction (c) -z direction (d) -x direction

27) If a particle executes uniform circular motion, choose the correct statement

(a) The velocity and speed are constant (b) The acceleration and speed are constant.

(c) The velocity and acceleration are constant.

(d) The speed and magnitude of acceleration are constant.

28) If an object is thrown vertically up with the initial speed u from the ground, then the time taken by the object to return back to ground is

(a) $\frac{u^2}{2g}$ (b) $\frac{u^2}{g}$ (c) $\frac{u}{2g}$ (d) $\frac{2u}{g}$

29) Two objects are projected at angles 30° and 60° respectively with respect to the horizontal direction. The range of two objects are denoted as R_{30° and R_{30°. Choose the correct relation from the following

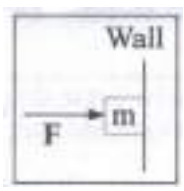
(a) $R_{30^\circ} = R_{60^\circ}$ (b) $R_{30^\circ} = 4R_{60^\circ}$ (c) $R_{30^\circ} = \frac{R_{60^\circ}}{2}$ (d) $R_{30^\circ} = 2R_{60^\circ}$

30) An object is dropped in an unknown planet from height 50 m, it reaches the ground in 2 s. The acceleration due to gravity in this unknown planet is

(a) $g = 20\ ms^{-2}$ (b) $g = 25\ ms^{-2}$ (c) $g = 15\ ms^{-2}$ (d) $g = 30\ ms^{-2}$

31) When a car takes a sudden left turn in the curved road, passengers are pushed towards the right due to

(a) inertia of direction (b) inertia of motion (c) inertia of rest (d) absence of inertia

32) 

An object of mass m held against a vertical wall by applying horizontal force F as shown in the figure.The minimum value of the force F is

(a) Less than mg (b) Equal to mg (c) Greater than mg (d) Cannot determine

33) A vehicle is moving along the positive x direction, if sudden brake is applied, then

(a) frictional force acting on the vehicle is along negative x direction

(b) frictional force acting on the vehicle is along positive x direction

(c) no frictional force acts on the vehicle

(d) frictional force acts in downward direction

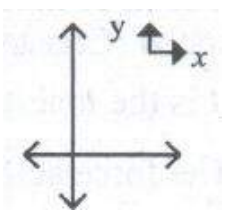
34) A book is at rest on the table which exerts a normal force on the book. If this force is considered as reaction force, what is the action force according to Newton's third law?

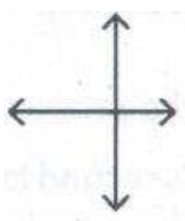
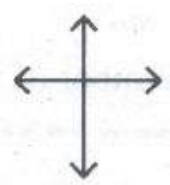
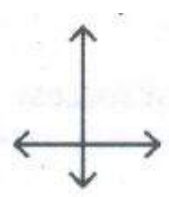
(a) Gravitational force exerted by Earth on the book

(b) Gravitational force exerted by the book on Earth

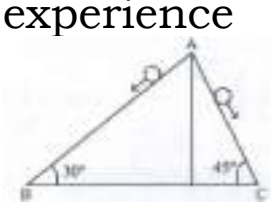
(c) Normal force exerted by the book on the table (d) None of the above

35) Choose appropriate free body diagram for the particle experiencing net acceleration along negative y direction. (Each arrow mark represents the force acting on the system).

(a) 

(b) 
(c) 
(d) 

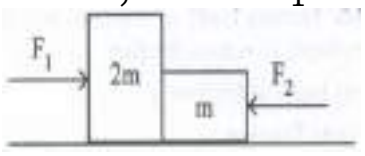
36) A particle of mass m sliding on the smooth double inclined plane (shown in figure) will experience



(a) greater acceleration along the path AB (b) greater acceleration along the path AC

(c) same acceleration in both the paths (d) no acceleration in both the paths

37) Two blocks of masses m and 2m are placed on a smooth horizontal surface as shown. In the first case only a force F_1 is applied from the left. Later only a force F_2 is applied from the right. If the force acting at the interface of the two blocks in the two cases is same, then $F_1 : F_2$ is



(a) 1:1 (b) 1:2 (c) 2:1 (d) 1:3

38) Force acting on the particle moving with constant speed is

(a) always zero (b) need not be zero (c) always non zero (d) cannot be concluded

39) An object of mass m begins to move on the plane inclined at an angle θ. The coefficient of static friction of inclined surface is μ_s. The maximum static friction experienced by the mass is

(a) mg (b) μ_s mg (c) μ_s mg sin θ (d) μ_s mg cos θ

40) When the object is moving at constant velocity on the rough surface

(a) net force on the object is zero (b) no force acts on the object

(c) only external force acts on the object (d) only kinetic friction acts on the object

41) The centrifugal force appears to exist

(a) only in inertial frames (b) only in rotating frames (c) in any accelerated frame

(d) both in inertial and non-inertial frames

42) Choose the correct statement from the following

(a) Centrifugal and centripetal forces are action reaction pairs

(b) Centripetal forces is a natural force

(c) Centrifugal force arises from gravitational force

(d) Centripetal force acts towards the center and centrifugal force appears to act away from the center in a circular motion.

43) If a person moving from pole to equator, the centrifugal force acting on him

(a) increases (b) decreases (c) remains the same (d) increases and then decreases

44) Two masses m_1 and m_2 are experiencing the same force where $m_1 < m_2$. The ratio of their acceleration $\frac{a_1}{a_2}$ is

(a) 1 (b) less than 1 (c) greater than 1 (d) all the three cases

45) When an object is at rest on the inclined rough surface,

(a) static and kinetic frictions acting on the object is zero

(b) static friction is zero but kinetic friction is not zero

(c) static friction is not zero and kinetic friction is zero

(d) static and kinetic frictions are not zero

46) A uniform force of $(2\hat{i}+\hat{j})$ N acts on a particle of mass 1 kg. The particle displaces from position $(3\hat{j}+\hat{k})$ m to $(5\hat{i}+3\hat{j})$ m. The work done by the force on the particle is

(a) 9 J (b) 6 J (c) 10 J (d) 12 J

47) A ball of mass 1 kg and another of mass 2 kg are dropped from a tall building whose height is 80 m. After, a fall of 40 m each towards Earth, their respective kinetic energies will be in the ratio of

(a) $\sqrt{2}:1$ (b) $1:\sqrt{2}$ (c) 2:1 (d) 1:2

48) A body of mass 1 kg is thrown upwards with a velocity 20 ms^{-1}. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction?(Take g = 10 ms^{-2})

(a) 20 J (b) 30 J (c) 40 J (d) 10 J

49) A body of mass 4 m is lying in xy-plane at rest. It suddenly explodes into three pieces. Two pieces each of mass m move perpendicular to each other with equal speed v. The total kinetic energy generated due to explosion is

(a) mv^2 (b) $\frac{3}{2}mv^2$ (c) $2mv^2$ (d) $4mv^2$

50) The potential energy of a system increases, if work is done

(a) by the system against a conservative force

(b) by the system against a non-conservative force

(c) upon the system by a conservative force

(d) upon the system by a non- conservative force

51) What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?

(a) $\sqrt{2gR}$ (b) $\sqrt{3gR}$ (c) $\sqrt{5gR}$ (d) $\sqrt{gR}$

52) The work done by the conservative force for a closed path is

(a) always negative (b) zero (c) always positive (d) not defined

53) If the linear momentum of the object is increased by 0.1% then the kinetic energy is Increased by

(a) 0.1 % (b) 0.2 % (c) 0.4 % (d) 0.01 %

54) If the potential energy of the particle is $\alpha - \frac{\beta}{2}x^2$, then force experienced by the particle is

(a) $F=\frac{\beta}{2}x^2$ (b) $F=\beta x$ (c) $F=-\beta x$ (d) $F=-\frac{\beta}{2}x^2$

55) A wind-powered generator converts wind energy into electric energy. Assume that the generator converts a fixed fraction of the wind energy intercepted by its blades into electrical energy. For wind speed v, the electrical power output will be proportional to

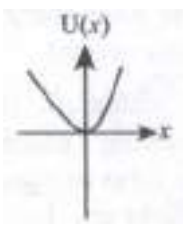
(a) v (b) v^2 (c) v^3 (d) v^4

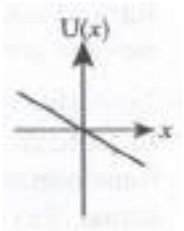
56) Two equal masses m_1 and m_2 are moving along the same straight line with velocities 5ms^{-1} and -9 ms^{-1} respectively. If the collision is elastic, then calculate the velocities after the collision of m_1 and m_2 respectively

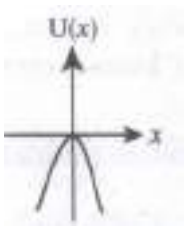
(a) -4 ms^{-1} and 10 ms^{-1} (b) 10 ms^{-1} and 0 ms^{-1} (c) -9 ms^{-1} and 5 ms^{-1}

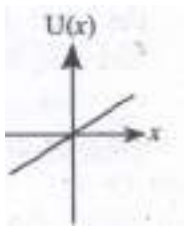
(d) 5 ms^{-1} and 1 ms^{-1}

57) A particle is placed at the origin and a force F = kx is acting on it (where k is a positive constant). If U (0) = 0, the graph of U(x) versus x will be (where U, is the potential , energy function)

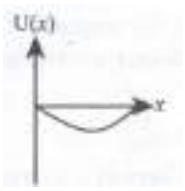
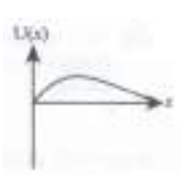
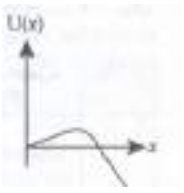
(a) 

(b) 

(c) 

(d) 

58) A particle which is constrained to move along x-axis, is subjected to a force in the same direction which varies with the distance x of the particle from the origin as $F(x) = kx + ax^3$. Here, k and a are positive constants. For $x \geq 0$, the functional form of the potential, energy U(x) of the particles

(a)  (b)  (c)  (d) 

59) A spring of force constant k is cut into two pieces such that one piece is double the length of the other. Then, the long piece will have a force constant of

(a) $\frac{2}{3}$k (b) $\frac{3}{2}$k (c) 3k (d) 6k

60) An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the water of the jet. What is the rate at which kinetic energy is imparted to water?

(a) $\frac{1}{2}mv^2$ (b) mv^3 (c) $\frac{1}{2}mv^3$ (d) $\frac{1}{2}mv^2$

61) The center of mass of a system of particles does not depend upon,

(a) position of particles (b) relative distance between particles (c) masses of particles (d) force acting on particle

62) A couple produces,

(a) pure rotation (b) pure translation (c) rotation and translation (d) no motion

63) A particle is moving with a constant velocity along a line parallel to positive X-axis. The magnitude of its angular momentum with respect to the origin is

(a) zero (b) increasing with x (c) decreasing with x (d) remaining constant

64) A rope is wound around a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force 30 N?

(a) 0.25 rad s^{-2} (b) 25 rad s^{-2} (c) 5 ms^{-2} (d) 25 ms^{-2}

65) A closed cylindrical container is partially filled with water. As the container rotates in a horizontal plane about a perpendicular bisector, its moment of inertia

(a) increases (b) decreases (c) remains constant

(d) depends on direction of rotation

66) A rigid body rotates with an angular momentum L. If its kinetic energy is halved, the angular momentum becomes,

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

67) A particle undergoes uniform circular motion. The angular momentum of the particle remain conserved about,

(a) the center point of the circle (b) the point on the circumference of the circle

(c) any point inside the circle (d) any point outside the circle

68) A disc of the moment of inertia I_a is rotating in a horizontal plane about its symmetry axis with a constant angular speed ω. Another disc initially at rest of moment of inertia I_b is dropped coaxially on to the rotating disc. Then, both the discs rotate with the same constant angular speed. The loss of kinetic energy due to friction in this process is,

(a) $\frac{1}{2}\frac{I_b^2}{2(I_a+I_b)}\omega^2$ (b) $\frac{I_b^2}{(I_a+I_b)}\omega^2$ (c) $\frac{(I_b-I_a)^2}{(I_a+I_b)}\omega^2$ (d) $\frac{1}{2}\frac{I_bI_b}{(I_a+I_b)}\omega^2$

69) From a disc of radius R a mass M, a circular hole of diameter R, whose rim passes through the center is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis passing through it

(a) $15MR^2/32$ (b) $13MR^2/32$ (c) $11MR^2/32$ (d) $9MR^2/32$

70) The ratio of the acceleration for a solid sphere (mass m and radius R) rolling down an incline of angle θ without slipping and slipping down the incline without rolling is,

(a) 5: 7 (b) 2: 3 (c) 2: 5 (d) 7: 5

71) The speed of a solid sphere after rolling down from rest without sliding on an inclined plane of vertical height h is,

(a) $\sqrt{\frac{4}{3}gh}$ (b) $\sqrt{\frac{10}{7}gh}$ (c) $\sqrt{2gh}$ (d) $\sqrt{\frac{1}{2}gh}$

72) The speed of the center of a wheel rolling on a horizontal surface is v_o. A point on the rim in level with the center will be moving at a speed of,

(a) zero (b) v_o (c) $\sqrt{2}v_o$ (d) $2v_o$

73) Two discs of same moment of inertia rotating about their regular axis passing through center and perpendicular to the plane of the disc with angular velocities ω_1 and ω_1. They are brought in to contact face to face coinciding with the axis of rotation. The expression for loss of energy during this process is

(a) $\frac{1}{4}I(\omega_1-\omega_2)^2$ (b) $I(\omega_1-\omega_2)^2$ (c) $\frac{1}{8}I(\omega_1-\omega_2)^2$ (d) $\frac{1}{2}I(\omega_1-\omega_2)^2$

74) When a mass is rotating in a plane about a fixed point, its angular momentum is directed along

(a) a line perpendicular to the plane of rotation

(b) the line making an angle of 45° to the plane of rotation (c) the radius

(d) tangent to the path

75) A round object of mass M and radius R rolls down without slipping along an inclined plane. The fractional force,

(a) dissipates kinetic energy as heat (b) decreases the rotational motion

(c) decreases the rotational and transnational motion

(d) converts transnational energy into rotational energy

76) The linear momentum and position vector of the planet is perpendicular to each other at

(a) perihelion and aphelion (b) at all points (c) only at perihelion (d) no point

77) If the masses of the Earth and Sun suddenly double, the gravitational force between them will

(a) remain the same (b) increase 2 times (c) increase 4 times (d) decrease 2 times

78) A planet moving along an elliptical orbit is closest to the Sun at distance r_1 and farthest away at a distance of r_2. If v_1 and v_2 are linear speeds at these points respectively. Then the ratio $\frac{v_1}{v_2}$ is

(a) $\frac{r_2}{r_1}$ (b) $(\frac{r_2}{r_1})^2$ (c) $\frac{r_1}{r_2}$ (d) $(\frac{r_1}{r_2})^2$

79) The time period of a satellite orbiting Earth in a cirular orbit is independent of

(a) Radius of the orbit (b) The mass of the satellite

(c) Both the mass and radius of the orbit

(d) Neither the mass nor the radius of its orbit

80) If the distance between the Earth and Sun were to be doubled from its present value, the number of days in a year would be

(a) 64.5 (b) 1032 (c) 182.5 (d) 730

81) According to Kepler's second law, the radial vector to a planet from the Sun sweeps out equal areas in equal intervals of time. This law is a consequence of

(a) conservation of linear momentum (b) conservation of angular momentum

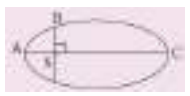
(c) conservation of energy (d) conservation of kinetic energy

82) The gravitational potential energy of the Moon with respect to Earth is

(a) always positive (b) always negative (c) can be positive or negative

(d) always zero

83) The kinetic energies of a planet in an elliptical orbit about the Sun, at positions A, B and C are K_A, K_B and K_C respectively. AC is the major axis and SB is perpendicular to AC at the position of the Sun S as shown in the figure. Then



(a) $K_A > K_B > K_C$ (b) $K_B < K_A < K_C$ (c) $K_A < K_B < K_C$ (d) $K_B > K_A > K_C$

84) The work done by the Sun's gravitational force on the Earth is

(a) always zero (b) always positive (c) can be positive or negative

(d) always negative

85) If the mass and radius of the Earth are both doubled, then the acceleration due to gravity g'

(a) remains same (b) $\frac{g}{2}$ (c) 2g (d) 4g

86) The magnitude of the Sun's gravitational field as experienced by Earth is

(a) same over the year

(b) decreases in the month of January and increases in the month of July

(c) decreases in the month of July and increases in the month of January

(d) increases during day time and decreases during night time

87) If a person moves from Chennai to Trichy, his weight

(a) increases (b) decreases (c) remains same (d) increases and then decreases

88) An object of mass 10 kg is hanging on a spring scale which is attached to the roof of a lift. If the lift is in free fall, the reading in the spring scale is

(a) 98 N (b) zero (c) 49 N (d) 9.8 N

89) If the acceleration due to gravity becomes 4 times its original value, then escape speed

(a) remains same (b) 2 times of original value (c) becomes halved

(d) 4 times of original value

90) The kinetic energy of the satellite orbiting around the Earth is

(a) equal to potential energy (b) less than potential energy

(c) greater than kinetic energy (d) zero

91) In the following, what are the quantities which that are conserved?

(a) Linear momentum of planet (b) Angular momentum of planet

(c) Total energy of planet (d) Potential energy of a planet

92) The work done by Sun on Earth in one year will be

(a) zero (b) non-zero (c) positive (d) negative

93) The work done by Sun on Earth at any finite interval of time is

(a) Positive, negative or zero (b) Strictly positive (c) Strictly negative

(d) It is always zero

94) Consider two wires X and Y. The radius of wire X is 3 times the radius of Y. If they are stretched by the same load then the stress on Y is

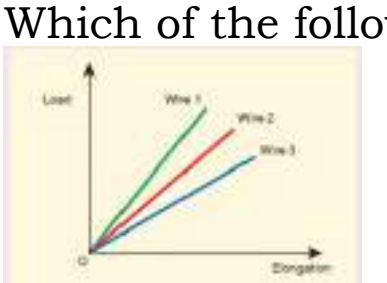
(a) equal to that on X (b) thrice that on X (c) nine times that on X

(d) Half that on X

95) If a wire is stretched to double of its original length, then the strain in the wire is

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

96) The load – elongation graph of three wires of the same material are shown in figure. Which of the following wire is the thickest?



(a) wire 1 (b) wire 2 (c) wire 3 (d) all of them have same thickness

97) For a given material, the rigidity modulus is $\left(\frac{1}{3}\right)^{rd}$ of Young's modulus. Its Poisson's ratio is

(a) 0 (b) 0.25 (c) 0.3 (d) 0.5

98) A small sphere of radius 2cm falls from rest in a viscous liquid. Heat is produced due to viscous force. The rate of production of heat when the sphere attains its terminal velocity is proportional to

(a) 2^2 (b) 2^3 (c) 2^4 (d) 2^5

99) Two wires are made of the same material and have the same volume. The area of cross sections of the first and the second wires are A and 2A respectively. If the length of the first wire is increased by Δl on applying a force F, how much force is needed to stretch the second wire by the same amount?

(a) 2 F (b) 4 F (c) 8 F (d) 16 F

100) With an increase in temperature, the viscosity of liquid and gas, respectively will

(a) increase and increase (b) increase and decrease (c) decrease and increase

(d) decrease and decrease

101) The young's modulus for a perfect rigid body is

(a) 0 (b) 1 (c) 0.5 (d) infinity

102) Which of the following is not a scalar?

(a) viscosity (b) surface tension (c) pressure (d) stress

103) If the temperature of the wire is increased, then the Young's modulus will

(a) remain the same (b) decrease (c) increase rapidly

(d) increase by very a small amount

104) Copper of fixed volume V is drawn into a wire of length l. When this wire is subjected to a constant force F, the extension produced in the wire is Δl. If Y represents the Young's modulus, then which of the following graphs is a straight line?

(a) Δl verses V (b) Δl verses Y (c) Δl verses F (d) Δl verses $\frac{1}{l}$

105) A certain number of spherical drops of a liquid of radius R coalesce to form a single drop of radius R and volume V. If T is the surface tension of the liquid, then

(a) energy = 4 V T $\left(\frac{1}{r}-\frac{1}{R}\right)$ is released (b) energy = 3 V T $\left(\frac{1}{r}+\frac{1}{R}\right)$ is absorbed

(c) energy = 3 V T $\left(\frac{1}{r}-\frac{1}{R}\right)$ is released (d) energy is neither released nor absorbed

106) The following four wires are made of the same material. Which of these will have the largest extension when the same tension is applied?

(a) length = 200 cm, diameter = 0.5 mm (b) length= 200 cm, diameter = 1 mm

(c) length = 200 cm, diameter = 2 mm (d) length= 200 cm, diameter = 3 m

107) The wettability of a surface by a liquid depends primarily on

(a) viscosity (b) surface tension (c) density

(d) angle of contact between the surface and the liquid

108) In a horizontal pipe of non-uniform cross section, water flows with a velocity of 1 ms^{-1} at a point where the diameter of the pipe is 20 cm. The velocity of water (1.5 m s^{-1}) at a point where the diameter of the pipe is (in cm)

(a) 8 (b) 16 (c) 24 (d) 32

109) In hot summer after a bath, the body's

(a) internal energy decreases (b) internal energy increases (c) heat decreases

(d) no change in internal energy and heat

110) The graph between volume and temperature in Charles' law is

(a) an ellipse (b) a circle (c) a straight line (d) a parabola

111) When a cycle tyre suddenly bursts, the air inside the tyre expands. This process is

(a) isothermal (b) adiabatic (c) isobaric (d) isochoric

112) An ideal gas passes from one equilibrium state (P_1, V_1, T_1, N) to another equilibrium state ($2P_1$, $3V_1$, T_2, N). Then

(a) $T_1 = T_2$ (b) $T_1 = \frac{T_2}{6}$ (c) $T_1 = 6T_2$ (d) $T_1 = 3T_2$

113) When a uniform rod is heated, which of the following quantity of the rod will increase

(a) mass (b) weight (c) center of mass (d) moment of inertia

114) When food is cooked in a vessel by keeping the lid closed, after some time the steam pushes the lid outward. By considering the steam as a thermodynamic system, then in the cooking process

(a) $Q > 0, W > 0,$ (b) $Q < 0, W > 0,$ (c) $Q > 0, W < 0,$ (d) $Q < 0, W < 0,$

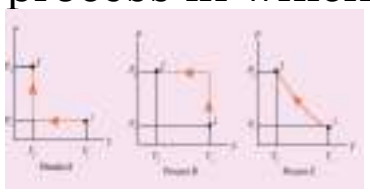
115) When you exercise in the morning, by considering your body as thermodynamic system, which of the following is true?

(a) $\Delta U > 0, W > 0,$ (b) $\Delta U < 0, W > 0,$ (c) $\Delta U < 0, W < 0,$ (d) $\Delta U = 0, W > 0,$

116) A hot cup of coffee is kept on the table. After some time it attains a thermal equilibrium with the surroundings. By considering the air molecules in the room as a thermodynamic system, which of the following is true

(a) $\Delta U > 0, Q = 0$ (b) $\Delta U > 0, W < 0$ (c) $\Delta U > 0, Q > 0$ (d) $\Delta U = 0, Q > 0$

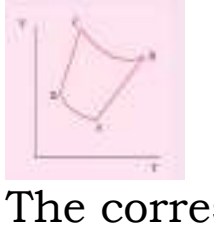
117) An ideal gas is taken from (P_i, V_i) to (P_ρ , V_f) in three different ways. Identify the process in which the work done on the gas the most.



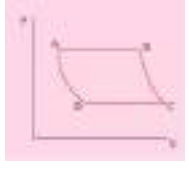
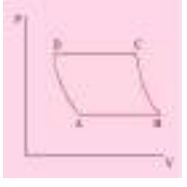
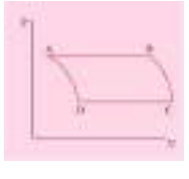
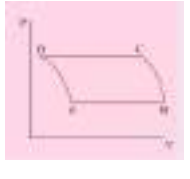
(a) Process A (b) Process B (c) Process C

(d) Equal work is done in Process A, B & C

118) The V-T diagram of an ideal gas which goes through a reversible cycle A→B→C→D is shown below. (Processes D→A and B→C are adiabatic)



The corresponding PV diagram for the process is (all figures are schematic)

(a)  (b)  (c)  (d) 

119) A distant star emits radiation with maximum intensity at 350 nm. The temperature of the star is

(a) 8280 K (b) 5000 K (c) 7260 K (d) 9044 K

120) Identify the state variables given here?

(a) Q, T, W (b) P, T, U (c) Q, W (d) P, T, Q

121) In an isochoric process, we have

(a) $W = 0$ (b) $Q = 0$ (c) $\Delta U = 0$ (d) $\Delta T = 0$

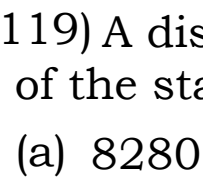
122) The efficiency of a heat engine working between the freezing point and boiling point of water is

(a) 6.25% (b) 20% (c) 26.8% (d) 12.5%

123) An ideal refrigerator has a freezer at temperature −12°C. The coefficient of performance of the engine is 5. The temperature of the air (to which the heat ejected) is

(a) 50°C (b) 45.2°C (c) 40.2°C (d) 37.5°C

124) A particle of mass m is moving with speed u in a direction which makes 60° with respect to x axis. It undergoes elastic collision with the wall. What is the change in momentum in x and y direction?



(a) $\Delta p_x = -mu, \Delta p_y = 0$ (b) $\Delta p_x = -2mu, \Delta p_y = 0$ (c) $\Delta p_x = 0, \Delta p_y = mu$

(d) $\Delta p_x = mu, \Delta p_y = 0$

125) A sample of ideal gas is at equilibrium. Which of the following quantity is zero?

(a) rms speed (b) average speed (c) average velocity (d) most probable speed

126) An ideal gas is maintained at constant pressure. If the temperature of an ideal gas increases from 100K to 1000K then the rms speed of the gas molecules

(a) increases by 5 times (b) increases by 10 times (c) remains same

(d) increases by 7 times

127) Two identically sized rooms A and B are connected by an open door. If the room A is air conditioned such that its temperature is 4°C lesser than room B, which room has more air in it?

(a) Room A (b) Room B (c) Both room has same air (d) Cannot be determined

128) The average translational kinetic energy of gas molecules depends on

(a) number of moles and T (b) only on T (c) P and T (d) P only

129) If the internal energy of an ideal gas U and volume V are doubled then the pressure

(a) doubles (b) remains same (c) halves (d) quadruples

130) The ratio $\gamma = \frac{C_p}{C_V}$ for a gas mixture consisting of 8 g of helium and 16 g of oxygen is

(a) 23/15 (b) 15/23 (c) 27/11 (d) 17/27

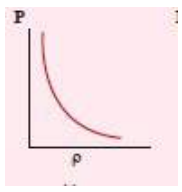
131) A container has one mole of monoatomic ideal gas. Each molecule has f degrees of freedom. What is the ratio of $\gamma = \frac{C_p}{C_V}$

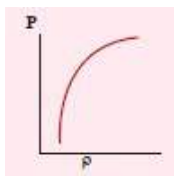
(a) f (b) $\frac{f}{2}$ (c) $\frac{f}{f+2}$ (d) $\frac{f+2}{f}$

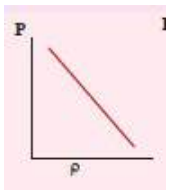
132) If the temperature and pressure of a gas is doubled the mean free path of the gas molecules

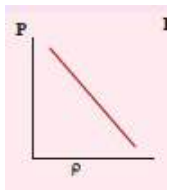
(a) remains same (b) doubled (c) tripled (d) quadrapoled

133) Which of the following shows the correct relationship between the pressure and density of an ideal gas at constant temperature?

(a) 

(b) 

(c) 

(d) 

134) A sample of gas consists of μ_1 moles of monoatomic molecules, μ_2 moles of diatomic molecules and μ_3 moles of linear triatomic molecules. The gas is kept at high temperature. What is the total number of degrees of freedom?

(a) $[3\mu_1 + 7(\mu_2 + \mu_3)]\ N_A$ (b) $[3\mu_1 + 7\mu_2 + 6\mu_3]\ N_A$ (c) $[7\mu_1 + 3(\mu_2 + \mu_3)]\ N_A$

(d) $[3\mu_1 + 6(\mu_2 + \mu_3)]\ N_A$

135) If s_P and s_V denote the specific heats of nitrogen gas per unit mass at constant pressure and constant volume respectively, then

(a) $s_P - s_V = 28R$ (b) $s_P - s_V = R/28$ (c) $s_P - s_V = R/14$ (d) $s_P - s_V = R$

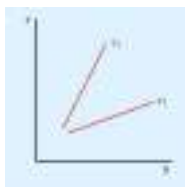
136) Which of the following gases will have least rms speed at a given temperature?

(a) Hydrogen (b) Nitrogen (c) Oxygen (d) Carbon dioxide

137) For a given gas molecule at a fixed temperature, the area under the Maxwell-Boltzmann distribution curve is equal to

(a) $\frac{PV}{KT}$ (b) $\frac{KT}{PV}$ (c) $\frac{P}{NKT}$ (d) PV

138) The following graph represents the pressure versus number density for ideal gas at two different temperatures T_1 and T_2. The graph implies



(a) $T_1 = T_2$ (b) $T_1 > T_2$ (c) $T_1 < T_2$ (d) Cannot be determined

139) In a simple harmonic oscillation, the acceleration against displacement for one complete oscillation will be

(a) an ellipse (b) a circle (c) a parabola (d) a straight line

140) A particle executing SHM crosses points A and B with the same velocity. Having taken 3 s in passing from A to B, it returns to B after another 3 s. The time period is

(a) 15 s (b) 6 s (c) 12 s (d) 9 s

141) The length of a second's pendulum on the surface of the Earth is 0.9 m. The length of the same pendulum on surface of planet X such that the acceleration of the planet X is n times greater than the Earth is

(a) 0.9n (b) $\frac{0.9}{n}$m (c) $0.9n^2$m (d) $\frac{0.9}{n^2}$

142) A simple pendulum is suspended from the roof of a school bus which moves in a horizontal direction with an acceleration a, then the time period is

(a) $T \propto \frac{1}{g^2+a^2}$ (b) $T \propto \frac{1}{\sqrt{g^2+a^2}}$ (c) $T \propto \sqrt{g^2+a^2}$ (d) $T \propto \left(g^2+a^2\right)$

143) Two bodies A and B whose masses are in the ratio 1:2 are suspended from two separate massless springs of force constants k_A and k_B respectively. If the two bodies oscillate vertically such that their maximum velocities are in the ratio 1:2, the ratio of the amplitude A to that of B is

(a) $\sqrt{\frac{K_B}{2K_A}}$ (b) $\sqrt{\frac{K_B}{8K_A}}$ (c) $\sqrt{\frac{2K_B}{K_A}}$ (d) $\sqrt{\frac{8K_B}{K_A}}$

144) A spring is connected to a mass m suspended from it and its time period for vertical oscillation is T. The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillation is

(a) T'= $\sqrt{2}$T (b) $T' = \frac{T}{\sqrt{2}}$ (c) T'=$\sqrt{2T}$ (d) $T' = \sqrt{\frac{T}{2}}$

145) The time period for small vertical oscillations of block of mass m when the masses of the pulleys are negligible and spring constant k_1 and k_2 is

(a) $T = 4\pi\sqrt{m\left(\frac{1}{k_1}+\frac{1}{k_2}\right)}$ (b) $T = 2\pi\sqrt{m\left(\frac{1}{k_1}+\frac{1}{k_2}\right)}$ (c) $T = 4\pi\sqrt{m\left(k_1+k_2\right)}$

(d) $T = 2\pi\sqrt{m\left(k_1+k_2\right)}$

146) A simple pendulum has a time period T_1. When its point of suspension is moved vertically upwards according as $y = k t^2$, where y is vertical distance covered and k = 1 ms^{-2}, its time period becomes T_2. Then, $\frac{T_1^2}{T_2^2}$ is (g = 10 m s^{-2}).

(a) $\frac{5}{6}$ (b) $\frac{11}{10}$ (c) $\frac{6}{5}$ (d) $\frac{5}{4}$

147) An ideal spring of spring constant k, is suspended from the ceiling of a room and a block of mass M is fastened to its lower end. If the block is released when the spring is un-stretched, then the maximum extension in the spring is

(a) $4\frac{Mg}{k}$ (b) $\frac{Mg}{k}$ (c) $2\frac{Mg}{k}$ (d) $\frac{Mg}{2k}$

148) A pendulum is hung in a very high building oscillates to and fro motion freely like a simple harmonic oscillator. If the acceleration of the bob is 16 ms^{-2} at a distance of 4 m from the mean position, then the time period is

(a) 2 s (b) 1 s (c) 2πs (d) πs

149) A hollow sphere is filled with water. It is hung by a long thread. As the water flows out of a hole at the bottom, the period of oscillation will

(a) first increase and then decrease (b) first decrease and then increase

(c) increase continuously (d) decrease continuously

150) The damping force on an oscillator is directly proportional to the velocity. The units of the constant of proportionality are

(a) $kgms^{-1}$ (b) $kgms^{-2}$ (c) kgs^{-1} (d) kgs

151) When a damped harmonic oscillator completes 100 oscillations, its amplitude is reduced to $\frac{1}{3}$ of its initial value. What will be its amplitude when it completes 200 oscillations?

(a) $\frac{1}{5}$ (b) $\frac{2}{3}$ (c) $\frac{1}{6}$ (d) $\frac{1}{9}$

152) Which of the following differential equations represents a damped harmonic oscillator?

(a) $\frac{d^2y}{dt^2} + y = 0$ (b) $\frac{d^2y}{dt^2} + \gamma\frac{dy}{d} + y = 0$ (c) $\frac{d^2y}{dt^2} + k^2 + y = 0$ (d) $\frac{dy}{d} + y = 0$

153) If the inertial mass and gravitational mass of the simple pendulum of length l are not equal, then the time period of the simple pendulum is

(a) $T = 2\pi\sqrt{\frac{m_i l}{m_g g}}$ (b) $T = 2\pi\sqrt{\frac{m_g l}{m_i g}}$ (c) $T = 2\pi\frac{m_g}{m_i}\sqrt{\frac{l}{g}}$ (d) $T = 2\pi\frac{m_i}{m_g}\sqrt{\frac{l}{g}}$

154) A student tunes his guitar by striking a 120 Hertz with a tuning fork, and simultaneously plays the 4^{th} string on his guitar. By keen observation, he hears the amplitude of the combined sound oscillating thrice per second. Which of the following frequencies is the most likely the frequency of the 4^{th} string on his guitar?

(a) 130 (b) 117 (c) 110 (d) 120

155) A transverse wave moves from a medium A to a medium B. In medium A, the velocity of the transverse wave is 500 ms^{-1} and the wavelength is 5 m. The frequency and the wavelength of the wave in medium B when its velocity is 600 ms^{-1}, respectively are

(a) 120 Hz and 5 m (b) 100 Hz and 5 m (c) 120 Hz and 6 m (d) 100 Hz and 6 m

156) For a particular tube, among six harmonic frequencies below 1000 Hz, only four harmonic frequencies are given: 300 Hz, 600 Hz, 750 Hz and 900 Hz. What are the two other frequencies missing from this list?

(a) 100 Hz, 150 Hz (b) 150 Hz, 450 Hz (c) 450 Hz, 700 Hz (d) 700 Hz, 800 Hz

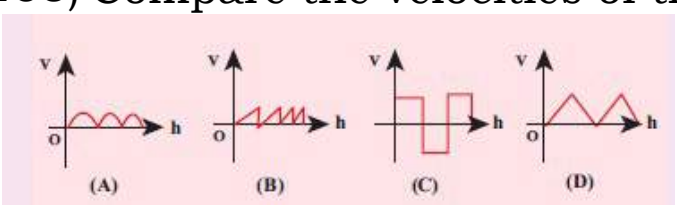
157) Which of the following options is correct?.

A	B
(1) Quality	(A) Intensity
(2) Pitch	(B) Waveform
(3) Loudness	(C) Frequency

Options for (1), (2) and (3), respectively are

(a) (B), (C) and (A) (b) (C), (A) and (B) (c) (A), (B) and (C) (d) (B), (A) and (C)

158) Compare the velocities of the wave forms given below, and choose the correct option.



where, v_A, v_B, v_C and v_D are velocities given in (A), (B), (C) and (D), respectively.

(a) $v_A > v_B > v_D > v_C$ (b) $v_A < v_B < v_D < v_C$ (c) $v_A = v_B = v_D = v_C$ (d) $v_A > v_B = v_D > v_C$

159) A sound wave whose frequency is 5000 Hz travels in air and then hits the water surface. The ratio of its wavelengths in water and air is

(a) 4.30 (b) 0.23 (c) 5.30 (d) 1.23

160) A person standing between two parallel hills fires a gun and hears the first echo after t_1 sec and the second echo after t_2 sec. The distance between the two hills is

(a) $\frac{v(t_1-t_2)}{2}$ (b) $\frac{v\left(t_1t_2\right)}{2(t_1+t_2)}$ (c) $v\,(t_1 + t_2)$ (d) $\frac{v(t_1+t_2)}{2}$

161) An air column in a pipe which is closed at one end, will be in resonance with the vibrating body of frequency 83Hz. Then the length of the air column is

(a) 1.5 m (b) 0.5 m (c) 1.0 m (d) 2.0 m

162) The displacement y of a wave travelling in the x direction is given by $y = (2 \times 10^{-3})$ sin $(300t - 2x + \frac{\pi}{4})$, where x and y are measured in metres and t in second. The speed of the wave is

(a) 150 ms^{-1} (b) 300 ms^{-1} (c) 450 ms^{-1} (d) 600 ms^{-1}

163) Consider two uniform wires vibrating simultaneously in their fundamental notes. The tensions, densities, lengths and diameter of the two wires are in the ratio 8 : 1, 1 : 2, x : y and 4 : 1 respectively. If the note of the higher pitch has a frequency of 360 Hz and the number of beats produced per second is 10, then the value of x : y is

(a) 36 : 35 (b) 35 : 36 (c) 1 : 1 (d) 1 : 2

164) Which of the following represents a wave

(a) $(x - vt)^3$ (b) $x(x+vt)$ (c) $\frac{1}{x+vt}$ (d) $\sin(x+vt)$

165) A man sitting on a swing which is moving to an angle of 60° from the vertical is blowing a whistle which has a frequency of 2.0 k Hz. The whistle is 2.0 m from the fixed support point of the swing. A sound detector which detects the whistle sound is kept in front of the swing. The maximum frequency the sound detector detected is

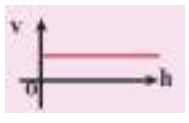
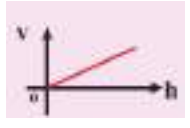
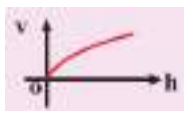
(a) 2.027 kHz (b) 1.974 kHz (c) 9.74 kHz (d) 1.011 kHz

166) Let $y = \frac{1}{1+x^2}$ at t = 0 s be the amplitude of the wave propagating in the positive x-direction. At t = 2 s, the amplitude of the wave propagating becomes $y = \frac{1}{1+(x-2)^2}$.

Assume that the shape of the wave does not change during propagation. The velocity of the wave is

(a) 0.5m s^{-1} (b) 1.0m s^{-1} (c) 1.5m s^{-1} (d) 2.0m s^{-1}

167) A uniform rope having mass m hangs vertically from a rigid support. A transverse wave pulse is produced at the lower end. Which of the following plots shows the correct variation of speed v with height h from the lower end?

(a)  (b)  (c)  (d) 

168) An organ pipe A closed at one end is allowed to vibrate in its first harmonic and another pipe B open at both ends is allowed to vibrate in its third harmonic. Both A and B are in resonance with a given tuning fork. The ratio of the length of A and B is

(a) $\frac{8}{3}$ (b) $\frac{3}{8}$ (c) $\frac{1}{6}$ (d) $\frac{1}{3}$

225 x 2 = 450

169) How will you measure the diameter of the Moon using parallax method?

170) Write the rules for determining significant figures.

171) Define precision and accuracy. Explain with one example.

172) Write short notes on the following.
(a) Unit

173) The radius of the circle is 3.12 m. Calculate the area of the circle with regard to significant figures.

174) A RADAR signal is beamed towards a planet and its echo is received 7 minutes later. If the distance between the planet and the Earth is 6.3×10^{10} m. Calculate the speed of the signal?

175) Check the correctness of the equation $\frac{1}{2}mv^2 = mgh$ using dimensional analysis method.

176) A physical quantity x is given by $x = \frac{a^2b^3}{c\sqrt{d}}$. If the percentage errors of measurement in a,b, c and d are 4%, 2%, 3% and 1% respectively, then calculate the percentage error in the calculation of x.

177) State the number of significant figures in the following 600800

178) State the number of significant figures in the following 400

179) State the number of significant figures in the following 2.65×10^{24}m

180) State the number of significant figures in the following 0.0006032

181) Round off the following numbers as indicated 12.653 up to 3 digits.

182) Write short notes on the following.
(c) Dimensionless quantities

183) Explain what is meant by Cartesian coordinate system?

184) Define a vector. Give examples.

185) Define a scalar. Give examples

186) Define acceleration.

187) Define a radian?

188) What is non uniform circular motion?

189) The position vectors particle has length 1m and makes 30° with the x-axis. What are the lengths of the x and y components of the position vector?

190) An object at an angle such that the horizontal range is 4 times of the maximum height. What is the angle of projection of the object?

191) A water fountain on the ground sprinkles water all around it. If the speed of the water coming out of the fountain is v, calculate the total area around the fountain that gets wet.

192) If an object is thrown horizontally with an initial speed $10ms^{-1}$ from the top of a building of height 100 m. What is the horizontal distance covered by the particle?

193) Two vectors $\vec{A}$ and $\vec{B}$ of magnitude 5 units and 7 units make an angle 60° with each other. Find the magnitude of the difference vector $\vec{A}$ - $\vec{B}$ and its direction with respect to the vector $\vec{A}$.

194) What are the unit vectors along the negative x-direction, negative y-direction, and negative z-direction?

195) Two vectors are given as $\vec{r} = 2\hat{i} + 3\hat{j} + 5\hat{k}$ and $\vec{F} = 3\hat{i} - 2\hat{j} + 4\hat{k}$. Find the resultant vector $\vec{\tau} = \vec{r} \times \vec{F}$.

196) Determine the value of the T from the given vector equation $5\hat{j} - T\hat{j} = 6\hat{j} + 3T\hat{j}$

197) A person initially at rest starts to walk 2 m towards north, then 1 m towards east, then 5 m towards south and then 3 m towards west. What is the position vector of the person at the end of the trip?

198) Assume your school is located 2 km away from your home. In the morning you are going to school and in the evening you come back home. In this entire trip what is the distance travelled and the displacement covered?

199) An athlete covers 3 rounds on a circular track of radius 50 m. Calculate the total distance and displacement travelled by him.

200) A train was moving at the rate of 54 km h^{-1} when brakes were applied. It came to rest within a distance of 225 m. Calculate the retardation produced in the train.

201) A particle moves along the x-axis in such a way that its coordinates x varies with time 't' according to the equation $x = 2 - 5t + 6t^2$. What is the initial velocity of the particle?

202) Suppose two trains A and B are moving with uniform velocities along parallel tracks but in opposite directions. Let the velocity of train A be 40 km h^{-1} due east and that of train B be 40 km h^{-1} due west. Calculate the relative velocities of the trains.

203) Consider two trains A and B moving along parallel tracks with the same velocity in the same direction. Let the velocity of each train be 50 km h^{-1} due east. Calculate the relative velocities of the trains.

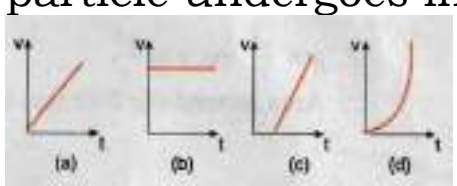
204) How long will a boy sitting near the window of a train travelling at 36 km h^{-1} see a train passing by in the opposite direction with a speed of 18 km h^{-1}. The length of the slow moving train is 90 m.

205) A particle is in circular motion with an acceleration $\alpha = 0.2$ rad s^{-2}.
(a) What is the angular displacement made by the particle after 5 s?
(b) What is the angular velocity at t = 5 s?. Assume the initial angular velocity is zero.

206) An object is thrown vertically downward. What is the acceleration experienced by the object?

207) An iron ball and a feather are both falling from a height of 10m
(a) What are the time taken by the iron ball and feather to reach the ground?
(b) What are the velocities of iron ball and feather when they reach the ground?
(Ignore air resistance and take g = 10 m s^{-2})

208) The following graphs represent velocity – time graph. Identify what kind of motion a particle undergoes in each graph.



209) Calculate the area of the triangle for which two of its sides are given by the vectors

$\vec{A} = 5\hat{i} - 3\hat{j}, \vec{B} = 4\hat{i} + 6\hat{j}$

210) A object is thrown with initial speed 5 ms^{-1} with an angle of projection 30°. What is the height and range reached by the particle?

211) Consider the x-axis as representing east, the y-axis as north and z-axis as vertically upwards. Give the vector representing each of the following points.

212) 8. Define scalar and vector. Give examples.

213) State Newton's second law.

214) Define one newton.

215) Show that impulse is the change of momentum.

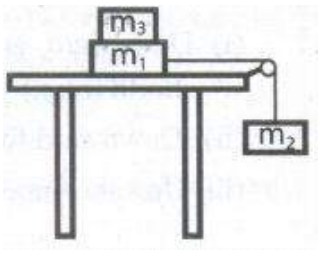
216) What is the meaning by 'pseudo force'?

217) State the empirical laws of static and kinetic friction.

218) What are inertial frames?

219) Under what condition will a car skid on a leveled circular road?

220) Apply Newton's second law for an object at rest on Earth and analyse the result.

221) 

Two masses m_1 and m_2 are connected with a string passing over a frictionless pulley fixed at the corner of the table as shown in the figure. The coefficient of static friction of mass m_1 with the table is μ_s, Calculate the minimum mass m_3 that may be placed on m1 to prevent it from sliding. Check if m_1=15 kg, m_2=10 kg,m_3= 25 and μ_s = 0.2.

222) A football player kicks a 0.8 kg ball and imparts it a velocity 12 ms^{-1} The contact between the foot and ball is only for one sixtieth of a second. Find the average kicking force.

223) People often say "For every action there is an equivalent opposite reaction". Here they meant 'action of a human'. Is it correct to apply Newton's third law to human actions? What is mean by 'action' in Newton third law? Give your arguments based on Newton's laws.

224) A long stick rests on the surface. A person standing 10 m away from the stick. With what minimum speed an object of mass 0.5 kg should he thrown so that it hits the stick. (Assume the coefficient of kinetic friction is 0.7).

225) A person rides a bike with a constant velocity $\vec{v}$ with respect to ground and another biker accelerates with acceleration $\vec{a}$ with respect to ground. Who can apply Newton's second law with respect to a stationary observer on the ground?

226) A book of mass m is at rest on the table.
(1) What are the forces acting on the book?
(2) What are the forces exerted by the book?
(3) Draw the free body diagram for the book.

227) If two objects of masses 2.5 kg and 100 kg experience the same force 5 N, what is the acceleration experienced by each of them?

228) The position vector of a particle is given by $\vec{r} = 3t\hat{i} + 5t^2\hat{j} + 7\hat{k}$. Find the direction in which the particle experiences net force?

229) The velocity of a particle moving in a plane is given by the following diagram. Find out the direction of force acting on the particle?

230) A particle of mass 2 kg experiences two forces, $\vec{F_1} = 5\hat{i} + 8\hat{j} + 7\hat{k}$ and $\vec{F_2} = 3\hat{i} - 4\hat{j} + 3\hat{k}$. What is the acceleration of the particle?

231) Consider a horse attached to the cart which is initially at rest. If the horse starts walking forward, the cart also accelerates in the forward direction. If the horse pulls the cart with force F_h in forward direction, then according to Newton's third law, the cart also pulls the horse by equivalent opposite force $F_c = F_h$ in backward direction. Then total force on 'cart+horse' is zero. Why is it then the 'cart+horse' accelerates and moves forward?

232) The position of the particle is represented by $y = ut - \frac{1}{2} gt^2$
(a) What is the force acting on the particle?
(b) What is the momentum of the particle?

233) Consider an object of mass 2 kg resting on the floor. The coefficient of static friction between the object and the floor is $\mu_s = 0.8$. What force must be applied on the object to move it?

234) Consider an object of mass 50 kg at rest on the floor. A Force of 5 N is applied on the object but it does not move. What is the frictional force that acts on the object?

235) Consider a circular road of radius 20 meter banked at an angle of 15 degree. With what speed a car has to move on the turn so that it will have safe turn?

236) If a stone of mass 0.25 kg tied to a string executes uniform circular motion with a speed of 2 m s^{-1} of radius 3 m, what is the magnitude of tensional force acting on the stone?

237) State Newton's third law.

238) Explain how the definition of work in physics is different from general perception.

239) Explain the characteristics of elastic and inelastic collision.

240) Two different unknown masses A and B collide. A is initially at rest when B has a speed v. After collision B has a speed v/2 and moves at right angles to its original direction of motion. Find the direction in which A moves after collision?

241) A bullet of mass 20 g strikes a pendulum of mass 5 kg. The centre of mass of pendulum rises a vertical distance of 10 cm. If the bullet gets embedded into the pendulum, calculate its initial speed?

242) A weight lifter lifts a mass of 250 kg with a force 5000 N to the height of 5m
(a) What is the work done by the weight lifter?
(b) What is the work done by the gravity?
(c) What is the net work done on the object?

243) Consider an object of mass 2 kg moved by an external force 20 N in a surface having coefficient of kinetic friction 0.9 to a distance 10 m. What is the work done by the external force and kinetic friction? Comment on the result. (Assume g = 10 ms^{-2})

244) Water in a bucket tied with rope is whirled around in a vertical circle of radius 0.5 m. Calculate the minimum velocity at the lowest point so that the water does not spill from it in the course of motion. (g = 10 ms^{-2})

245) A vehicle of mass 1250 kg is driven with an acceleration 0.2 along a straight level road against an external resistive force 500 N. Calculate the power delivered by the vehicle's engine if the velocity of the vehicle is 30 ms^{-1}.

246) Define centre of mass.

247) Define torque and mention its unit.

248) What are the conditions in which force can not produce torque?

249) What is equilibrium?

250) Define couple.

251) Define centre of gravity.

252) What is radius of gyration?

253) State the law of conservation of angular momentum.

254) What are the rotational equivalents for the physical quantities
(i) mass and
(ii) force?

255) What is the condition for pure rolling?

256) What is the difference between sliding and slipping?

257) Find the moment of inertia of a uniform rod about an axis which is perpendicular to the rod and touches anyone end of the rod.

258) Find the radius of gyration of a disc of mass M and radius R rotating about an axis passing through the center of mass and perpendicular to the plane of the disc.

259) A rolling wheel has velocity of its center of mass as 5 ms^{-1}. If its radius is 1.5 m and angular velocity is 3 rad s^{-1} then check whether it is in pure rolling or not.

260) Four round objects namely a ring, a disc, a hollow sphere and a solid sphere with same radius R start to roll down an incline at the same time. Find out which object will reach the bottom first.

261) State principle of moments.

262) A fly wheel rotates with a uniform angular acceleration. If its angular velocity increases from 20πrad/s *to* 40πrad/s in 10 seconds. Find the number of rotations in that period.

263) State Kepler's three laws.

264) State Newton's Universal law of gravitation.
265) Will the angular momentum of a planet be conserved? Justify your answer.
266) Is potential energy the property of a single object? Justify.
267) Define gravitational potential.
268) What is meant by escape speed in the case of the Earth?
269) Define weight.
270) Why is there no lunar eclipse and solar eclipse every month?
271) If a comet suddenly hits the Moon and imparts energy which is more than the total energy of the Moon, what will happen?
272) If the Earth's pull on the Moon suddenly disappears, what will happen to the Moon?
273) If the Earth has no tilt, what happens to the seasons of the Earth?
274) If the masses and mutual distance between the two objects are doubled, what is the change in the gravitational force between them?
275) Two bodies of masses m and 4m are placed at a distance r. Calculate the gravitational potential at a point on the line joining them where the gravitational field is zero.
276) Calculate the change in g value in your district of Tamilnadu. (Hint: Get the latitude of your district of Tamilnadu from the Google). What is the difference in g values at Chennai and Kanyakumari?
277) Qualitatively indicate the gravitational field of Sun on Mercury, Earth, and Jupiter shown in figure.
278) Water falls from the top of a hill to the ground. Why? This is because the top of the hill is a point of higher gravitational potential than the surface of the Earth i.e. $V_{hill} > V_{ground}$
279) Find out the value of g' in your school laboratory?
280) Why is the energy of a satellite (or any other planet) negative?
281) A wire 10 m long has a cross-sectional area 1.25×10^{-4} m^2. It is subjected to a load of 5 kg. If Young's modulus of the material is 4×10^{10} N m^{-2}, calculate the elongation produced in the wire. Take g = 10 ms^{-2}.
282) A metallic cube of side 100 cm is subjected to a uniform force acting normal to the whole surface of the cube. The pressure is 10^6 pascal. If the volume changes by 1.5×10^{-5} m^3, calculate the bulk modulus of the material.
283) A metal cube of side 0.20 m is subjected to a shearing force of 4000 N. The top surface is displaced through 0.50 cm with respect to the bottom. Calculate the shear modulus of elasticity of the metal.
284) A wire of length 2 m with the area of crosssection $10^{-6}m^2$ is used to suspend a load of 980 N. Calculate
i) the stress developed in the wire
ii) the strain and
iii) the energy stored. Given: Y = 12 $\times$ 10^{10}N m^{-2}.
285) Water rises in a capillary tube to a height of 2.0cm. How much will the water rise through another capillary tube whose radius is one-third of the first tube?
286) Define stress and strain.
287) State Hooke's law of elasticity.
288) Define Poisson's ratio.
289) State Pascal's law in fluids.
290) State Archimedes principle.
291) State the law of floatation.
292) Define terminal velocity.
293) State Bernoulli's theorem.
294) Two streamlines cannot cross each other. Why?

295) Define surface tension of a liquid. Mention its S.I unit and dimension.
296) How is surface tension related to surface energy?
297) Define angle of contact for a given pair of solid and liquid.
298) What happens to the pressure inside a soap bubble when air is blown into it?
299) Why two holes are made to empty an oil tin?
300) Why the passengers are advised to remove the ink from their pens while going up in an aeroplane?
301) We use straw to suck soft drinks, why?
302) What do you mean by capillarity or capillary action?
303) a. 'A lake has more rain'.
b. 'A hot cup of coff ee has more heat'.
What is wrong in these two statements?
304) Calculate the volume of one mole of any gas at STP and at room temperature (300K) with the same pressure 1 atm.
305) If 5 L of water at 50°C is mixed with 4L of water at 30°C, what will be the final temperature of water? Take the specific heat capacity of water as 4184 J kg^{-1} K^{-1}.
306) Jogging every day is good for health. Assume that when you jog a work of 500 kJ is done and 230 kJ of heat is given off. What is the change in internal energy of your body?
307) Give an example of a quasi-static process.
308) Give some examples of irreversible processes.
309) Define one mole.
310) State Stefan-Boltzmann law.
311) What is Wien's law?
312) What are the different types of thermodynamic systems?
313) What is meant by 'thermal equilibrium'?
314) Define one calorie.
315) Did joule converted mechanical energy to heat energy? Explain.
316) State the first law of thermodynamics.
317) Can we measure the temperature of the object by touching it?
318) Define the quasi-static process.
319) What is PV diagram?
320) Give the equation of state for an adiabatic process.
321) Give an equation state for an isochoric process.
322) What is a cyclic process?
323) State Kelvin-Planck statement of second law of thermodynamics
324) What are processes involves in a Carnot engine?
325) State the second law of thermodynamics in terms of entropy.
326) Discuss the
a. thermal equilibrium
327) Draw the TP diagram (P-x axis, T-y axis), VT(T-x axis, V-y axis) diagram for
a. Isochoric process
b. Isothermal process
c. isobaric process
328) For a given ideal gas 6×10^5J heat energy is supplied and the volume of gas is increased from 4 m^3 to 6 m^3 at atmospheric pressure. Calculate
(a) the work done by the gas
(b) change in internal energy of the gas
(c) graph this process in P-V and T-V diagram.
329) Obtain an ideal gas law from Boyle's and Charles' law.
330) What is mean by state variable? Give example.

331) Give the sign convention for Q and W.

332) Give the expression for work done by the gas.

333) Explain why the specific heat capacity at constant pressure is greater than the specific heat capacity at constant volume.

334) Draw the PV diagram for
a. Isothermal process
b. Adiabatic process
c. isobaric process
d. Isochoric process

335) Discuss the
b. mechanical equilibrium

336) Discuss the
c. Chemical equilibrium

337) Calculate the rms speed, average speed and the most probable speed of 1 mole of hydrogen molecules at 300 K. Neglect the mass of electron.

338) What is the microscopic origin of pressure?

339) What is the microscopic origin of temperature?

340) Why moon has no atmosphere?

341) Define the term degrees of freedom.

342) State the law of equipartition of energy.

343) Define mean free path and write down its expression.

344) Calculate the temperature at which the rms velocity of a gas triples its value at S.T.P. (Standard temperature T_1 = 273K).

345) A gas made of a mixture of 2 moles of oxygen and 4 moles of argon at temperature T. Calculate the energy of the gas in terms of RT. Neglect the vibrational modes.

346) Classify the following motions as periodic and non-periodic motions?
a. Motion of Halley's comet.
b. Motion of clouds.
c. Moon revolving around the Earth

347) A nurse measured the average heart beats of a patient and reported to the doctor in terms of time period as 0.8 s. Express the heart beat of the patient in terms of number of beats measured per minute.

348) Consider two springs with force constants 1 N m^{-1} and 2 N m^{-1} connected in parallel. Calculate the effective spring constant (k_p) and comment on k_p.

349) A mass m moves with a speed v on a horizontal smooth surface and collides with a nearly massless spring whose spring constant is k. If the mass stops after collision, compute the maximum compression of the spring.

350) In simple pendulum experiment, we have used small angle approximation. Discuss the small angle approximation.

351) If the length of the simple pendulum is increased by 44% from its original length, calculate the percentage increase in time period of the pendulum.

352) Write down the kinetic energy and total energy expressions in terms of linear momentum, For one-dimensional case.

353) Compute the position of an oscillating particle when its kinetic energy and potential energy are equal.

354) What is meant by force constant of a spring?

355) Define time period of simple harmonic motion.

356) Define frequency of simple harmonic motion.

357) State the laws of simple pendulum?

358) Define forced oscillation. Give an example.

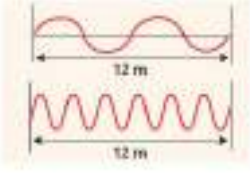
359) What is meant by maintained oscillation? Give an example.

360) Explain resonance. Give an example.

361) What is an epoch?

362) The average range of frequencies at which human beings can hear sound waves varies from 20 Hz to 20 kHz. Calculate the wavelength of the sound wave in these limits. (Assume the speed of sound to be 340 m s^{-1}.

363) Consider a string whose one end is attached to a wall. Then compute the following in both situations given in figure (assume waves crosses the distance in one second)



(a) Wavelength
(b) Frequency and
(c) Velocity

364) Calculate the speed of sound in a steel rod whose Young's modulus Y = 2×10^{11} N m^{-2} and ρ = 7800 kg m^{-3}.

365) An increase in pressure of 100 kPa causes a certain volume of water to decrease by 0.005% of its original volume.
(a) Calculate the bulk modulus of water?
(b) Compute the speed of sound (compressional waves) in water?

366) The wavelength of two sine waves are λ_1 = 1m and λ_2 = 6m. Calculate the corresponding wave numbers.

367) A mobile phone tower transmits a wave signal of frequency 900MHz. Calculate the length of the waves transmitted from the mobile phone tower.

368) Consider two sound waves with wavelengths 5 m and 6 m. If these two waves propagate in a gas with velocity 330 ms^{-1}. Calculate the number of beats per second.

369) Two vibrating tuning forks produce waves whose equation is given by $y_1 = 5 \sin(240\pi t)$ and $y_2 = 4 \sin(244\pi t)$. Compute the number of beats per second.

370) Compute the distance between anti-node and neighbouring node.

371) What is meant by waves?.

372) Write down the types of waves.

373) What are transverse waves? Give one example.

374) What are longitudinal waves? Give one example.

375) Define wavelength.

376) Write down the relation between frequency, wavelength and velocity of a wave.

377) What is meant by interference of waves?.

378) Explain the beat phenomenon.

379) Define intensity of sound and loudness of sound.

380) Explain Doppler Effect.

381) Explain red shift and blue shift in Doppler Effect.

382) What is meant by end correction in resonance air column apparatus?

383) Sketch the function y = x + a. Explain your sketch.

384) Write down the factors affecting velocity of sound in gases.

385) What is meant by an echo? Explain.

386) The speed of a wave in a certain medium is 900 m/s. If 3000 waves passes over a certain point of the medium in 2 minutes, then compute its wavelength?

387) A police in a siren car moving with a velocity 20 ms^{-1} chases a thief who is moving in a car with a velocity $v_0 ms^{-1}$. The police car sounds at frequency 300Hz, and both of them move towards a stationary siren of frequency 400Hz. Calculate the speed in which thief is moving. (Assume the thief does not observe any beat)

388) Why is it that transverse waves cannot be produced in a gas? Can the transverse waves can be produced insolids and liquids?

389) Why is the roar of our national animal different from the sound of a mosquito?

390) A sound source and listener are both stationary and a strong wind is blowing. Is there a Doppler effect?

391) In an empty room why is it that a tone sounds louder than in the room having things like furniture etc.

392) How do animals sense impending danger of hurricane?

393) Is it possible to realize whether a vessel kept under the tap is about to fill with water?

160 x 3 = 480

394) Briefly explain the types of physical quantities.

395) What are the limitations of dimensional analysis?

396) In a submarine equipped with sonar, the time delay between the generation of a pulse and its echo after reflection from an enemy submarine is observed to be 80 sec. If the speed of sound in water is 1460 ms^{-1}. What is the distance of enemy submarine?

397) Assuming that the frequency y of a vibrating string may depend upon
(i) applied force (F)
(ii) length (I)
(ill) mass per unit length (m), prove that $\gamma \alpha \frac{1}{l}\sqrt{\frac{F}{m}}$ using dimensional analysis.

398) From a point on the ground, the top of a tree is seen to have an angle of elevation 60^{o} . The distance between the tree and a point is 50m. calculate the height of the tree?

399) In a series of successive measurements in an experiment, the readings of the period of oscillation of a simple pendulum were found to be 2.63s, 2.56s, 2.42s, 2.71s, and 2.80s.
Calculate
(i) the mean value of the period of oscillation
(ii) the absolute error in each measurement
(iii) the mean absolute error
(iv) the relative error
(v) the percentage error.
(vi) Express the result in proper form.

400) Obtain an expression for the time period T of a simple pendulum. The time period T depend upon
(i) mass 'm' of the bob
(ii) length 'l' of the pendulum and
(iii) acceleration due to gravity g at the place where the pendulum is suspended.
(Constant k = 2π) i.e

401) If the value of universal gravitational constant in SI is 6.6 x 10^{-11} Nm^2 kg^{-2}, then find its value in CGS System?

402) Write a short note on the scalar product between two vectors.

403) Write a short note on vector product between two vectors.

404) How do you deduce that two vectors are perpendicular?

405) Define displacement and distance.

406) Define velocity and speed

407) What is the difference between velocity and average velocity

408) Define angular displacement and angular velocity.

409) A particle is projected at an angle of θ with respect to the horizontal direction. Match the following for the above motion.
(a) v_x - decreases and increases
(b) v_y - remains constant
(c) Acceleration - varies
(d) Position vector - remains downward

410) If Earth completes one revolution in 24 hours, what is the angular displacement made by Earth in one hour. Express your answer in both radian and degree.

411) An object is executing uniform circular motion with an angular speed of $\frac{\pi}{12}$ radian per second. At t = 0 the object starts at an angle $\theta = 0$ What is the angular displacement of the particle after 4s?

412) The Moon is orbiting the Earth approximately once in 27 days, what is the angle transversed by the Moon per day?

413) Consider the function $Y = x^2$. Calculate the derivative $\frac{dy}{dx}$ using the concept of limit. at the point x = 2.

414) A particle moves in a circle of radius 10 m. Its linear speed is given by v = 3t where t is in second and v is in ms^{-1}.
(a) Find the centripetal and tangential acceleration at t = 2 s.
(b) Calculate the angle between the resultant acceleration and the radius vector.

415) Is it possible to measure the depth of a well using kinematic equations?

416) An object of mass m has angular acceleration =0.2 α $rads^{-2}$. What is the angular displacement covered by the object after 3 second? (Assume that the object started with angle zero with zero angular velocity).

417) Explain the concept of inertia. Write two examples each for inertia of motion, inertia of rest and inertia of direction.

418) Using free body diagram, show that it is easy to pull an object than to push it.

419) Explain various types of friction. Suggest a few methods to reduce friction.

420) What are concurrent forces? State Lami's theorem.

421) Explain the similarities and differences of centripetal and centrifugal forces.

422) Explain the need for banking of tracks.

423) A bob attached to the string oscillates back and forth. Resolve the forces acting on the bob into components. What is the acceleration experience by the bob at an angle θ.

424) A car takes a turn with velocity 50 ms^{-1} on the circular road of radius of curvature 10m. calculate the centrifugal force experienced by a person of mass 60kg inside the car?

425) Apply Newton's second law to a mango hanging from a tree. (Mass of the mango is 400 gm).

426) Identify the internal and external forces acting on the following systems.
(a) Earth alone as a system
(b) Earth and Sun as a system
(c) Our body as a system while walking
(d) Our body + Earth as a system

427) An object of mass 10 kg moving with a speed of 15 ms^{-1} hits the wall and comes to rest within
(a) 0.03 second
(b) 10 second.
Calculate the impulse and average force acting on the object in both the cases.

428) Calculate the centrifugal force experienced by a man of 60 kg standing at Chennai? (Given: Latitude of Chennai is 13°)

429) A baby is playing in a swing which is hanging with the help of two identical chains is at rest. Identify the forces acting on the baby. Apply Lami's theorem and find out the tension acting on the chain.

430) Briefly explain 'centrifugal force' with suitable examples.

431) Arrive an expression for angle of friction.

432) Write the various types of potential energy. Explain the formulae.

433) Write the differences between conservative and Non-conservative forces. Give two examples each.

434) Define the following
a) Coefficient of restitution

435) Arrive at an expression for power and velocity. Give some examples for the same.

436) Two objects of masses 2 kg and 4 kg are moving with the same momentum of 20 kg m s^{-1}.
(a) Will they have same kinetic energy?
(b) Will they have same speed?

437) Let the two springs A and B be such that $k_A > k_B$, On which spring will more work has to be done if they are stretched by the same force?

438) An object of mass 1 kg is falling from the height h = 10m. Calculate
(a) The total energy of an object at h = 10 m.
(b) Potential energy ofthe object when it is at h = 4 m.
(c) Kinetic energy of the object when it is at h = 4 m.
(d) What will be the speed of the object when it hits the ground?
(Assume g = 10 m s^{-2})

439) An object of mass m is projected from the ground with initial speed v_0. Find the speed at height h.

440) An object of mass 2 kg attached to a spring is moved to a distance x = 10 m from its equilibrium position. The spring constant k = 1 N m^{-1} and assume that the surface is frictionless.
(a) When the mass crosses the equilibrium position, what is the speed of the mass?
(b) What is the force that acts on the object when the mass crosses the equilibrium position and extreme position x = ± 10m?

441) A lighter particle moving with a speed of 10 ms^{-1} collides with an object of double its mass moving in the same direction with half its speed. Assume that the collision is a one dimensional elastic collision. What will be the speed of both particles after the collision?

442) Show that the ratio of velocities of equal masses in an inelastic collision when one of the masses is stationary is $\frac{v_1}{v_2} = \frac{1-e}{1+e}$

443) Define the following
b) Power

444) Define the following
c) Law of conservation of energy

445) Define the following
d) loss of kinetic energy in inelastic collision

446) A ball with a velocity of 5 ms^{-1} impinges at angle of 60° with the vertical on a smooth horizontal plane. If the coefficient of restitution is 0.5, find the velocity and direction after the impact.

447) Find out the center of mass for the given geometrical structures.
(a) Equilateral triangle
(b) Cylinder
(c) Square

448) Give any two examples of torque in day-to-day life.

449) How do you distinguish between stable and unstable equilibrium?

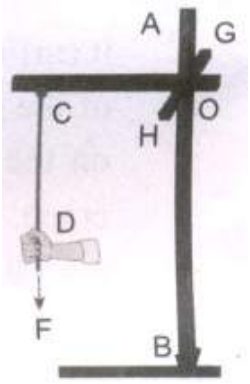
450) Mention any two physical significance of moment of inertia?

451) Two point masses 3 kg and 5 kg are at 4 m and 8 m from the origin on X-axis. Locate the position of center of mass of the two point masses
(i) from the origin and
(ii) from 3 kg mass.

452) Locate the center of mass of a uniform rod of mass M and length I.

453) A projectile of mass 5 kg, in its course of motion explodes on its own into two fragments. One fragment of mass 3 kg falls at three fourth of the range R of the projectile. Where will the other fragment fall?

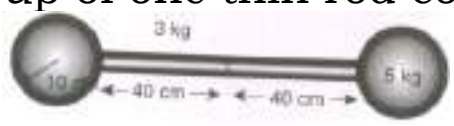
454) Three mutually perpendicular beams AB, OC, GH are fixed to form a structure which is fixed to the ground firmly as shown in the Figure. One string is tied to the point C and its free end D is pulled with a force F. Find the magnitude and direction of the torque produced by the force,
(i) about the points D, C, O and B
(ii) about the axis CD, OC, AB and GH.



455) A cyclist while negotiating a circular path with speed 20 m s^{-1} is found to bend an angle by 30° with vertical. What is the radius of the circular path? (given, g = 10 m s^{-2})

456) Find the moment of inertia of a disc of mass 3 kg and radius 50 cm about the following axes.
(i) axis passing through the center and perpendicular to the plane of the disc
(ii) axis touching the edge and perpendicular to the plane of the disc and
(iii) axis passing through the center and lying on the plane of the disc.

457) Find the moment of inertia about the geometric center of the given structure made up of one thin rod connecting two similar solid spheres as shown in Figure.



458) A jester in a circus is standing with his arms extended on a turn table rotating with angular velocity ω. He brings his arms closer to his body so that his moment of inertia is reduced to one third of the original value. Find his new angular velocity. [Given: There is no external torque on the turn table in the given situation.]

459) A solid sphere is undergoing pure rolling. What is the ratio of its translational kinetic energy to rotational kinetic energy?

460) What is the relation between torque and angular momentum?

461) A uniform rod of mass m and length l makes a constant angle θ with an axis of rotation which passes through one end of the rod. Find the moment of inertia about this axis.

462) Two particles P and Q of mass 1 kg and 3 kg respectively start moving towards each other from rest under mutual attraction. What is the velocity of their center of mass?

463) Define the gravitational field. Give its unit.

464) What is meant by superposition of gravitational field?

465) Define gravitational potential energy.

466) What is the difference between gravitational potential and gravitational potential energy?

467) What are geostationary and polar satellites?

468) How will you prove that Earth itself is spinning?

469) Explain the variation of g with lattitude.

470) Explain the variation of g with altitude.

471) Explain the variation of g with depth from the Earth's surface.

472) A student was asked a question 'why are there summer and winter for us? He replied as since Earth is orbiting in an elliptical orbit, when the Earth is very far away from the Sun(aphelion) there will be winter, when the Earth is nearer to the Sun(perihelion) there will be winter. Is this answer correct? If not, what is the correct explanation for the occurrence of summer and winter?

473) The following photographs are taken from the recent lunar eclipse which occurred on January 31, 2018. Is it possible to prove that Earth is a sphere from these photographs?

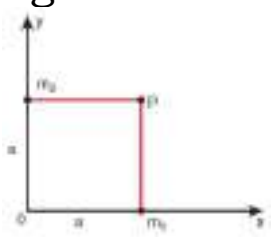
474) What is the gravitational potential energy of the Earth and Sun? The Earth to Sun distance is around 150 million km. The mass of the Earth is 5.9×10^{24} kg and mass of the Sun is 1.9×10^{30} kg.

475) Earth revolves around the Sun at 30 km s^{-1}. Calculate the kinetic energy of the Earth. In the previous example you calculated the potential energy of the Earth. What is the total energy of the Earth in that case? Is the total energy positive? Give reasons.

476) Suppose we go 200 km above and below the surface of the Earth, what are the g values at these two points? In which case, is the value of g small?

477) Moon and an apple are accelerated by the same gravitational force due to Earth. Compare the acceleration of the two.

478) Two particles of masses m_1 and m_2 are placed along the x and y axes respectively at a distance 'a' from the origin. Calculate the gravitational field at a point P shown in figure below.



479) Moon is the natural satellite of Earth and it takes 27 days to go once around its orbit. Calculate the distance of the Moon from the surface of the Earth assuming the orbit of the Moon as circular.

480) Calculate the energy of the
(i) Moon orbiting the Earth and
(ii) Earth orbiting the Sun.

481) Two pistons of a hydraulic lift have diameters of 60 cm and 5 cm. What is the force exerted by the larger piston when 50 N is placed on the smaller piston?

482) A cube of wood floating in water supports a 300 g mass at the centre of its top face. When the mass is removed, the cube rises by 3 cm. Determine the volume of the cube.

483) Explain elasticity using intermolecular forces.

484) Which one of these is more elastic, steel or rubber? Why?

485) What is the effect of temperature on elasticity?

486) Write down the expression for the elastic potential energy of a stretched wire.

487) Define coefficient of viscosity of a liquid.

488) Distinguish between streamlined flow and turbulent flow.

489) What is Reynold's number? Give its significance.

490) Write down the expression for the Stoke's force and explain the symbols involved in it.

491) What are the energies possessed by a liquid? Write down their equations.

492) Distinguish between cohesive and adhesive forces.

493) What are the factors affecting the surface tension of a liquid?

494) State the principle and usage of Venturimeter.

495) State and prove Pascal's law in fluids?

496) State and prove Archimedes principle.

497) A spherical soap bubble A of radius 2 cm is formed inside another bubble B of radius 4 cm. Show that the radius of a single soap bubble which maintains the same pressure difference as inside the smaller and outside the larger soap bubble is lesser than radius of both soap bubbles A and B.

498) A block of Ag of mass x kg hanging from a string is immersed in a liquid of relative density 0.72. If the relative density of Ag is 10 and tension in the string is 37.12 N then compute the mass of Ag block.

499) A spring balance shows wrong readings after using for a long time. Why?

500) What do you mean by upthrust or buoyancy?

501) A drop of oil placed on the surface of water spreads out. But a drop of water place on oil contracts to a spherical shape. Why?

502) When you mix a tumbler of hot water with one bucket of normal water, what will be the direction of heat flow? Justify.

503) A gas expands from volume $1m^3$ to $2m^3$ at constant atmospheric pressure.
(a) Calculate the work done by the gas.
(b) Represent the work done in PV diagram

504) During a cyclic process, a heat engine absorbs 500 J of heat from a hot reservoir, does work and ejects an amount of heat 300 J into the surroundings (cold reservoir). Calculate the efficiency of the heat engine?

505) Define specific heat capacity and give its unit.

506) What is a thermal expansion?

507) Give the expressions for linear, area and volume thermal expansions.

508) Define latent heat capacity. Give its unit.

509) Define thermal conductivity. Give its unit.

510) What is a black body?

511) What is a thermodynamic system? Give examples.

512) What are intensive and extensive variables? Give examples.

513) What is an equation of state? Give an example

514) Define the internal energy of the system.

515) Are internal energy and heat energy the same? Explain.

516) Give an expression for work done in an isothermal process.

517) Express the change in internal energy in terms of molar specific heat capacity.

518) Apply first law for
(a) an isothermal
(b) adiabatic
(c) isobaric processes.

519) What is meant by a reversible and irreversible processes?

520) State Clausius form of the second law of thermodynamics.

521) Define heat engine.

522) Can the given heat energy be completely converted to work in a cyclic process? If not, when can the heat can completely converted to work?

523) Why does heat flow from a hot object to a cold object?

524) Define the coefficient of performance.

525) Define molar specific heat capacity.

526) State Zeroth law of thermodynamics.

527) Give the equation of state for an isothermal process.

528) An oxygen molecule is travelling in air at 300 K and 1 atm, and the diameter of oxygen molecule is 1.2×10^{-10}m. Calculate the mean free path of oxygen molecule.

529) Write the expression for rms speed, average speed and most probable speed of a gas molecule.

530) What is the relation between the average kinetic energy and pressure?

531) Deduce Charles' law based on kinetic theory.

532) Deduce Boyle's law based on kinetic theory.

533) Deduce Avogadro's law based on kinetic theory.

534) List the factors affecting the mean free path.

535) What is the reason for Brownian motion?

536) Describe the Brownian motion.

537) During an adiabatic process, the pressure of a mixture of monatomic and diatomic gases is found to be proportional to the cube of the temperature. Find the value of $\gamma = (C_P/C_V)$

538) Estimate the total number of air molecules in a room of capacity 25 m^3 at a temperature of 27°C.

539) State the postulates of Kinetic theory of gases. (Any 6 points)

540) A spring balance has a scale which ranges from 0 to 25 kg and the length of the scale is 0.25m. It is taken to an unknown planet X where the acceleration due to gravity is 11.5 m s^{-1}. Suppose a body of mass M kg is suspended in this spring and made to oscillate with a period of 0.50 s. Compute the gravitational force acting on the body.

541) What is meant by periodic and nonperiodic motion? Give any two examples, for each motion.

542) Write short notes on two springs connected in series.

543) Write short notes on two springs connected in parallel.

544) Write down the time period of simple pendulum.

545) Write down the equation of time period for linear harmonic oscillator.

546) What is meant by free oscillation?

547) Consider a simple pendulum of length l = 0.9 m which is properly placed on a trolley rolling down on a inclined plane which is at θ = 45° with the horizontal. Assuming that the inclined plane is frictionless, calculate the time period of oscillation of the simple pendulum.

548) Explain damped oscillation. Give an example.

549) The ratio of the densities of oxygen and nitrogen is 16:14. Calculate the temperature when the speed of sound in nitrogen gas at 17°C is equal to the speed of sound in oxygen gas.

550) Check the dimensional of the wave y = sin(x−vt). If it is dimensionally wrong, write the above equation in the correct form

551) If the third harmonics of a closed organ pipe is equal to the fundamental frequency of an open organ pipe, compute the length of the open organ pipe if the length of the closed organ pipe is 30 cm.

552) Describe the formation of beats.

553) A ship in a sea sends SONAR waves straight down into the seawater from the bottom of the ship. The signal reflects from the deep bottom bed rock and returns to the ship after 3.5 s. After the ship moves to 100 km it sends another signal which returns back after 2s. Calculate the depth of the sea in each case and also compute the difference in height between two cases.

113 x 5 = 565

554) (i) Explain the use of screw gauge and vernier caliper in measuring smaller distances.
(ii) Write a note on triangulation method and radar method to measure larger distances

555) Explain in detail the various types of errors.

556) What do you mean by propagation of errors? Explain the propagation of errors in addition and multiplication.

557) Explain the principle of homogeniety of dimensions. What are its uses? Give example

558) Explain the principle of homogeneity of dimensions and derive an expression for the force F acting on a body moving in a circular path depends on mass of the body (m), velocity (v) and radius (r) of the circular path. Obtain the expression for the force by dimensional analysis method. (Take the value of k = 1)

559) Explain in detail the triangle law of addition.

560) Discuss the properties of scalar and vector products.

561) Derive the equation of motion, range and maximum height reached by the particle thrown at an oblique angle θ with respect to the horizontal direction.

562) Derive the expression for centripetal acceleration.

563) Derive the kinematic equations of motion for constant acceleration.

564) Derive the equations of motion for a particle (a) falling vertically (b) projected vertically.

565) Derive the expression for total acceleration in the non uniform circular motion.

566) Prove the law of conservation of linear momentum. Use it to find the recoil velocity of a gun when a bullet is fired from it.

567) Explain the motion of blocks connected by a string in
i) Vertical motion
ii) Horizontal motion.

568) Briefly explain the origin of friction. Show that in an inclined plane, angle of friction is equal to angle of repose

569) State Newton's three laws and discuss their significance.

570) Describe the method of measuring angle of repose.

571) Calculate the centripetal acceleration of Moon towards the Earth.

572) Briefly explain ‘rolling friction’.

573) Write down the expression for particle moving in an inclined plane.

574) Explain with graphs the difference between work done by a constant force and by a variable force.

575) State and explain work energy principle. Mention any three examples for it.

576) Arrive at an expression for elastic collision in one Dimension and discuss various cases.

577) What is inelastic collision? In which way it is different from elastic collision. Mention few examples in day to day life for inelastic collision.

578) Explain the types of equilibrium with suitable examples?

579) Explain the method to find the center of gravity of a irregularly shaped lamina?

580) Explain why a cyclist bends while negotiating a curve road? Arrive at the expression for angle of bending for a given velocity?

581) Derive the expression for moment of inertia of a rod about its center and perpendicular to the rod?

582) Derive the expression for moment of lnertia of a uniform ring about an axis passing through the center and perpendicular to the plane?

583) Derive the expression for moment of inertia of a uniform disc about an axis passing through the center and perpendicular to the plane.

584) State and prove parallel axis theorem.

585) Discuss rolling on inclined plane and arrive at the expression for the acceleration.

586) State and prove perpendicular axis theorem.

587) Discuss conservation of angular momentum with example?

588) Discuss the important features of the law of gravitation.

589) Explain how Newton arrived at his law of gravitation from Kepler’s third law.

590) Explain how Newton verified his law of gravitation.

591) Derive the expression for gravitational potential energy.

592) Prove that at points near the surface of the Earth, the gravitational potential energy of the object is U = mgh.
593) Explain in detail the idea of weightlessness using lift as an example.
594) Derive an expression for escape speed.
595) Derive the time period of satellite orbiting the Earth.
596) Derive an expression for energy of satellite.
597) Explain in detail the geostationary and polar satellites.
598) Explain how geocentric theory is replaced by heliocentric theory using the idea of retrograde motion of planets.
599) Describe the measurement of Earth's shadow (umbra) radius during total lunar eclipse.
600) Explain in detail the Eratosthenes method of finding the radius of Earth.
601) State Hooke's law and verify it with the help of an experiment?
602) Explain the different types of modulus of elasticity?
603) Derive an expression for the elastic energy stored per unit volume of a wire.
604) Derive an equation for the total pressure at a depth 'h' below the liquid surface.
605) Derive the expression for the terminal velocity of a sphere moving in a high viscous fluid using stokes force.
606) Derive Poiseuille's formula for the volume of a liquid flowing per second through a pipe under streamlined flow.
607) Obtain an expression for the excess of pressure inside a
i) liquid drop
ii) liquid bubble
iii) air bubble.
608) State and prove Bernoulli's theorem for a flow of incompressible, non-viscous, and streamlined flow of fluid.
609) Describe the construction and working of venturimeter and obtain an equation for the volume of liquid flowing per second through a wider entry of the tube.
610) What is capillarity? Obtain an expression for the surface tension of a liquid by capillary rise method.
611) Obtain an equation of continuity for a flow of fluid on the basis of conservation of mass.
612) Explain the meaning of heat and work with suitable examples.
613) Discuss the ideal gas laws.
614) Explain in detail the thermal expansion.
615) Describe the anomalous expansion of water. How is it helpful in our lives?
616) Explain Calorimetry and derive an expression for final temperature when two thermodynamic systems are mixed.
617) Discuss various modes of heat transfer.
618) Explain in detail Newton's law of cooling.
619) Explain Wien's law and why our eyes are sensitive only to visible rays?
620) Explain Joule's Experiment of the mechanical equivalent of heat.
621) Derive the expression for the work done in a volume change in a thermodynamic system.
622) Derive Mayer's relation for an ideal gas.
623) Explain in detail the isothermal process.
624) Derive the work done in an isothermal process.
625) Explain in detail an adiabatic process.
626) Derive the work done in an adiabatic process
627) Explain the isobaric process and derive the work done in this process.

628) Explain in detail the isochoric process.
629) What are the limitations of the first law of thermodynamics?
630) Explain the heat engine and obtain its efficiency.
631) Explain in detail carnot heat engine.
632) Explain in detail the working of a refrigerator.
633) Derive the expression for Carnot engine efficiency.
634) Explain the second law of thermodynamics in terms of entropy.
635) Find the adiabatic exponent γ for mixture of μ_1 moles of monoatomic gas and μ_2 moles of a diatomic gas at normal temperature (27°C).
636) Write down the postulates of kinetic theory of gases.
637) Derive the expression of pressure exerted by the gas on the walls of the container.
638) Explain in detail the kinetic interpretation of temperature.
639) Describe the total degrees of freedom for monoatomic molecule, diatomic molecule and triatomic molecule.
640) Derive the ratio of two specific heat capacities of monoatomic, diatomic and triatomic molecules.
641) Explain in detail the Maxwell Boltzmann distribution function.
642) Derive the expression for mean free path of the gas.
643) What is meant by simple harmonic oscillation? Give examples and explain why every simple harmonic motion is a periodic motion whereas the converse need not be true.
644) Describe Simple Harmonic Motion as a projection of uniform circular motion.
645) What is meant by angular harmonic oscillation? Compute the time period of angular harmonic oscillation.
646) Write down the difference between simple harmonic motion and angular simple harmonic motion.
647) Discuss the simple pendulum in detail.
648) Explain the horizontal oscillations of a spring.
649) Write short notes on the oscillations of liquid column in U-tube.
650) Explain in detail the four different types of oscillations.
651) Describe the vertical oscillations of a spring.
652) Discuss in detail the energy in simple harmonic motion.
653) Discuss how ripples are formed in still water.
654) Briefly explain the difference between travelling waves and standing waves.
655) Show that the velocity of a travelling wave produced in a string is $v\sqrt{\frac{T}{\mu}}$
656) Describe Newton's formula for velocity of sound waves in air and also discuss the Laplace's correction.
657) Write short notes on reflection of sound waves from plane and curved surfaces.
658) Briefly explain the concept of superposition principle.
659) Explain how the interference of waves is formed.
660) What are stationary waves? Explain the formation of stationary waves and also write down the characteristics of stationary waves.
661) Discuss the law of transverse vibrations in stretched strings.
662) Explain the concepts of fundamental frequency, harmonics and overtones in detail.
663) What is a sonometer? Give its construction and working. Explain how to determine the frequency of tuning fork using sonometer.
664) Write short notes on intensity and loudness.

665) Explain how overtones are produced in a
(a) Closed organ pipe
(b) Open organ pipe

666) How will you determine the velocity of sound using resonance air column apparatus?

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