PLUS ONE: PHYSICS – PREVIOUS YEAR QUESTIONS

CHAPTER - 1, UNITS AND MEASUREMENTS

1. The displacement (S) of a body in a time 't' is given by $S = at^2 + bt$. Find the dimensions of a and b **[MODEL 2018]**

2. The side of a cube is measured as 3.405 cm. How many significant figures are there in the measurement? **[MODEL 2018]**

3. What is dimensions of a Physical quantity? Write any two uses of dimensional analysis. **[MODEL 2019]**

4. "Velocity cannot be added to temperature".
   a) This is in accordance with which law of physics?
   b) Check the dimensional correctness of the equation PV = Fx where P is the pressure, V is volume, F is force and *x* is displacement

[MARCH 2019]

5. Find the number of significant figures in the following
(1) 0.042 **(2)** 42.000 **[MODEL 2020]**

6. The centripetal force on a body of mass 'm' and velocity 'v' moving in circular orbit of radius 'r' is given by $F = \frac{mv^2}{r}$
   a) Write the dimensional formula of force.
   b) Using the formula of centripetal force write an equation to find percentage error in centripetal force.

[MARCH 2020]

7. The volume of water flowing out through a pipe in a given time is $\mathbf{V = KA^2ut}$, where A is the area of cross-section of the pipe, u is the speed of flow, t is the time and K is a dimensionless constant.
   a) Name the principle that can be used to check the dimensional correctness of this equation.
   b) Check the correctness of the equation.

[MARCH 2020]

8. Write the SI units of the following fundamental quantities:
(a) electric current
(b) plane angle **[MODEL 2021]**

9. The distance travelled by a freely falling body is given by the equation, $y = v_0t - \frac{1}{2}gt^2$. Using principles of dimensions, check the correctness of the equation.

[MODEL 2021]

10.
   a) State principle of homogeneity of dimensions.
   b) The kinetic energy (K) of a body depends on its mass (m) and its velocity (v). Using the above principle derive an equation for kinetic energy. **[MODEL 2021]**

11. Define plane angle. **[MARCH 2021]**

12. Write the SI unit and dimensional formula of energy. **[MARCH 2021]**

13. Fill in the blanks.

Name of base quantity	Name of SI unit
Length	metre
Mass	……
……	second
Electric current	…….
Thermodynamic temperature	…….
…….	mole
…….	candela

[MARCH 2021]

14.

a) State the principle of Homogeneity of dimensions.

b) A planet moves around the Sun in nearly circular orbits. Its period depends on radius (r) of the orbit, mass of the Sun (M) and gravitation constant (G). Derive the expression for its time period of the planet using method of dimensions.

[MARCH 2021]

15. 1 Angstrom $[1Å]$ =…….

a) 10^{-15} m

b) 10^{-10} m

c) 10^{-12} m **[MODEL 2022]**

16. The correctness of equations can be checked by the principle of homogeneity of dimensions.

a) State the principle of homogeneity of dimensions.

b) Using this principle, check whether the following equation is dimensionally correct.

$\frac{1}{2}mv^2 = mgh$ **[MODEL 2022]**

17. The restoring force developed in a spring extended by a length *x* is, F = –k*x*. The dimensional formula of k is? **[MARCH 2022]**

18. Check the dimensional correctness of the relation:

$v = \sqrt{\frac{GM}{R}}$

where v is orbital velocity, G is gravitational constant and R is radius of Eart **[MARCH 2022]**

19. $1A^0 =$ ... ... **[MARCH 2023]**

20.

a) What do you mean by principle of homogeneity of dimensions?

b) Using the principle, check whether the following equation is dimensionally, correct?

$\frac{1}{2}mv^2 = mgh$

c) State the significant figure in the following

i) $0.060607m^2$

ii) $6.0320Nm^{-2}$ **[MARCH 2023]**

21. The dimensional formula for a physical quantity is ML^2T^{-2}. Pick out the correct physical quantity.

a) Force c) Work

b) Momentum d) Power **[2024]**

22.

a) Write the number of significant figures of the following

i) 0.0072

ii) 1.6×10^{-19}

b) Check whether the equation $\frac{1}{2}mv^2 = mgh$ is a dimensionally correct by the method of dimensions **[2024]**

23. Write the use of dimensional analysis **[2024]**

24. Number of significant figures in 0.0024500 is ……

a) 3 b) 5 c) 8 d) 7 **[MODEL 2025]**

25.

a) State the principle of homogeneity of dimension

b) Which of the following has unit but no dimension?

i. Strain
ii. Relative velocity
iii. Angle
iv. Relative density

c) Kinetic energy of a body depends on its mass 'M' and velocity 'v'. Using principle of dimension derive an expression for kinetic energy.

[MODEL 2025]

26. Find out the fundamental quantity from among the physical quantities given below:

a) Velocity
b) Temperature
c) Force
d) Density **[MARCH 2025]**

27.

a) State the principle of homogeneity of dimensions.

b) Consider a simple pendulum, having a bob attached to a string, that oscillates under the action of the force of gravity. Suppose that the period of oscillation of the simple pendulum depends on its length (ℓ), mass of the bob (m) and acceleration due to gravity (g). derive the expression for its time period using method of dimensions.

[MARCH 2025]

CHAPTER – 2, MOTION IN A STRAIGHT LINE

1.

a) Define uniform motion

b) Draw the velocity – time graph of an uniformly accelerated motion.

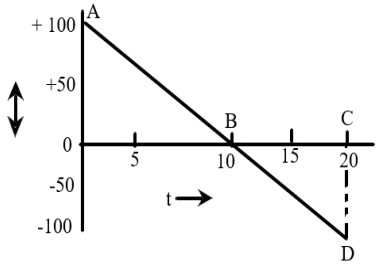
c) Using the graph obtain the equation

$x = vt + \frac{1}{2}at^2$

2. The slope of the position – time graph of uniform motion gives.

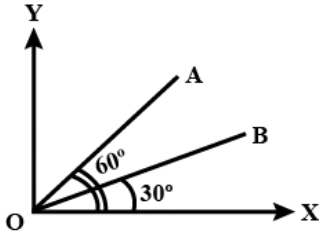
a) Acceleration
b) Velocity
c) Displacement
d) Force

3. Velocity time graph of a ball thrown vertically upwards with an initial velocity is shown in figure.



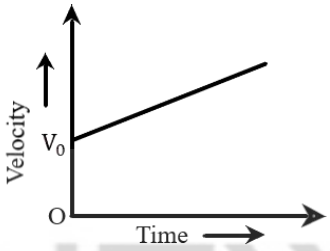
a) What is the magnitude of initial velocity of the ball?
b) Calculate the distance travelled by the ball during 20s, from the graph
c) Calculate the acceleration of the ball from the graph.

4. The position – time graph of two objects A and B are shown below.



a) Which body has greater velocity?
b) Find the ratio of velocities of A and B

5. The velocity – time graph of an object is given below.
a) The area under this graph gives.
b) Derive the relation $x = V_0t + \frac{1}{2}at^2$



6. A car travelling at a speed 54km/hr is brought to rest in the 90s. Find the distance travelled by before coming to rest.

7. An object moving along a straight line covers equal distances in equal intervals of time, it is said to be in uniform motion along a straight line.
a) The position – time graph of an object in uniform motion is ……
   i) A straight line parallel to the time axis.
   ii) A straight line parallel to the position axis.
   iii) A straight line inclined to the time axis.
   iv) A parabola
b) Derive the relation $x = V_0t + \frac{1}{2}at^2$ for uniformly accelerated motion with the help of velocity – time graph.
c) Which of the following statements are True?
   i) An object with constant velocity has always constant speed.
   ii) An object with constant speed has always constant velocity.
   iii) An object with zero velocity has always zero acceleration.
   iv) An object with zero acceleration has always zero velocity.

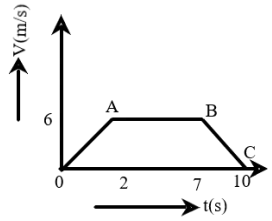
8. An object released near the surface of the earth is said to be in free fall. (Neglect the air resistance).
a) Choose the correct alternative from the clues given at the end of the statement.
"Free fall is an example of …….. accelerated motion"
(Uniformly / non – uniformly)

b) The incomplete table shown the velocity (v) of a freely falling object in a time interval of 1s. (Take $g = 10\ m/s^2$) Complete the table and draw the velocity time graph.

Time (t) s	Velocity (v) m/s
0	0
1	
2	
3	30
4	40
5	50

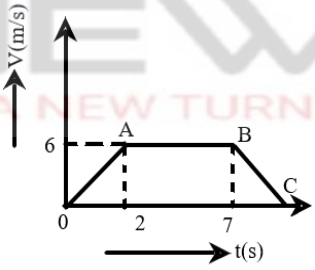
(c) Are under velocity time gives …….

9. Velocity – time graph of a body is given below.



a) Which portion of the graph represents uniform retardation?
   i) OA
   ii) AB
   iii) BC
   iv) OC

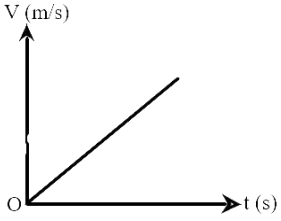
b) Find the displacement in time 2s to 7s.



c) A stone is dropped from height h. Arrive at an expression for the time taken to reach the ground.

10. Velocity – time graph of an object is given below.

a) What type of motion is indicated by the above graph?



b) Derive a relation connecting the displacement and time for this type of motion.

c) The ratio of velocity to speed of an object is ……..
   i) One
   ii) Greater than one
   iii) Less than one
   iv) Either less than one or equal to one.

NEW10'S
A NEW TURN IN EDIFICATION

11. Figure 1 shows displacement – time graph of runner A. Figure 2 shows velocity – time graph of runner B.

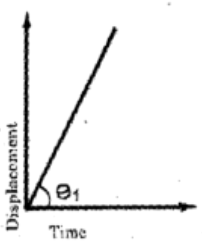


Figure 1

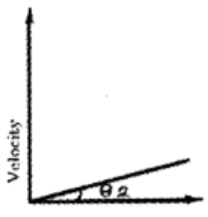


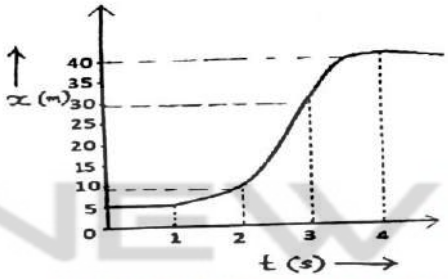
Figure 2

a) Identify the type of motion the runner A has
   i) Uniform motion
   ii) Non – uniform motion
   iii) Accelerated motion
   iv) Jerking motion

b) Derive a mathematical relation that connects displacement, velocity and time for runner A.

c) Analysing the above two graphs, find which runner will win the race. Why?

12. Position – time of a body is given.



NEW10'S
A NEW TURN IN EDIFICATION

a) Estimate the velocity during the time interval t → 2s to 3s.

b) Displacement of an object is proportional to t^3 . Show that its acceleration is increasing with time.

13. Velocity is defined as the rate of change of displacement

a) Distinguish between average velocity and instantaneous velocity.

b) When does the average velocity becomes equal to the instantaneous velocity?

c) A car travels from A to B at 60 km/hr and returns to A at 90 Km/ hr. What is its average velocity and Average speed?

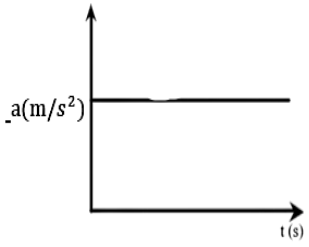
14. Acceleration is defined as the rate of change of velocity.

a) Is it possible for a body to have acceleration without velocity? Explain.

b) Draw the velocity – time graph of a body moving with uniform acceleration 'a' and initial velocity v_0 .

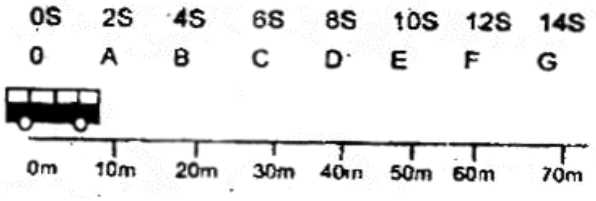
c) Using the above graph, obtain the equation for displacement in time 't'

15. Acceleration – time graph of a body is shown below.



a) Draw the corresponding velocity – time graph.
b) What does the area under the velocity – time graph represent?
c) Arrive at a relation connecting velocity (v) and time (t) for a uniformly accelerated body.

16. Figure given below shown the motion of a school bus starting from the point O and travels along a straight line.



a) Complete the following table

Time taken	Displacement from 0	Velocity
2s	10 – 0 = 10m	…….
10s	……	5 m/s

b) Is the motion of the bus uniform or non – uniform? Justify your answer.
c) Draw the position- time graph of the above motion.
d) A student in the school bus notices the speedometer of the bus. Which type of speed is shown by the speedometer?

17. State in the following cases whether the motion is one, two or three dimensions.
i) A butterfly flying around a flower
ii) A bus moving along a long and straight road.
a) Derive the equation of motion for non – uniform motion in one dimension.
b) Look at the graph in fig (a) and fig (b) carefully and state which of these can't possible represent one – dimensional motion with reasons.

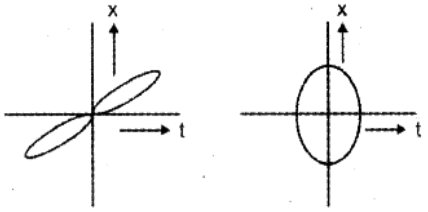
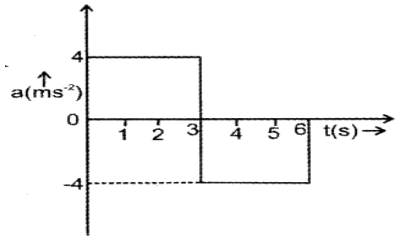


fig. (a) fig. (b)

18. A car is moving along the circumference of a circle of radius r.
a) What is the distance travelled in one revolution?
b) What is the displacement in one revolution?
c) What is the speedometer of the car measure?
d) Can body have acceleration without velocity. Explain?

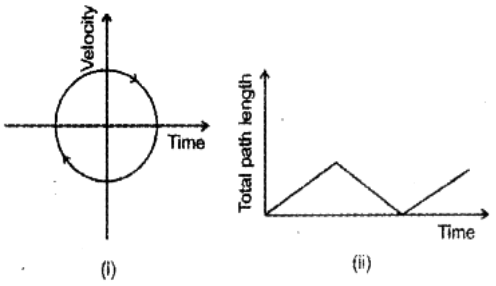
19. Acceleration – time graph of a body starts from rest as shown below.



a) What is the use of the acceleration – time graph?
b) Draw the velocity – time graph using the above graph.
c) Find the displacement in the interval if time from 0 to 3 seconds.

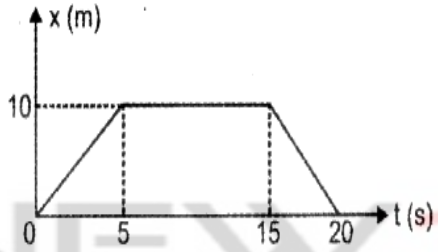
20. Acceleration is the time rate of change of velocity. Give an example of a body possessing zero velocity and still accelerating.

21. Graph representing the motion of two bodies are show below. State with reason whether it can represent one dimensional motion.



22.

a) The figure shown the position- time graph of a body moving along straight line.



i) Draw the velocity – time graph of the body.
ii) From the graph, find the displacement in 20 seconds.

b) From the velocity – time graph of a body moving with uniform acceleration. Deduce the velocity – time relation and the velocity – displacement relation.

23. When breaks are applied on a moving vehicle, it stops after travelling a distance. This distance is called stopping distance.

a) Write an expression for stopping distance in terms of initial velocity (u) and retardation (a).
b) If the initial speed is doubled keeping the retardation same, by how much will the stopping distance change?

24. If V is the velocity and a is the acceleration, give an example of a physical situation for each of the following cases.

a) $V \neq 0, \quad a = 0$
b) $V = 0, \quad a \neq 0$
c) $V > 0, \quad a < 0$
d) $V < 0, \quad a > 0$

25. Show that in the absence of air resistance, for a ball thrown upwards, the time of ascent is equal to time of descent.

26. Show that when air resistance is also taken into account, the time of descent is greater than the time of ascent.

27. Motion is common to everything in the Universe. It is the change of position of an object with time.

NEW 10'S
A NEW TURN IN EDIFICATION

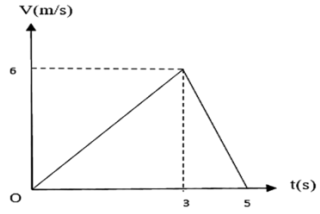
a) The slope of position – time graph of a particle gives:
   i) Acceleration
   ii) Displacement
   iii) Velocity
   iv) Momentum

b) Give an example of a body possessing zero velocity and that is still accelerating.

c) A car starts accelerating from rest for some time, moves with a uniform velocity for some time and comes to rest with a uniform retardation. Draw the velocity time graph of the car.

d) A car covers the first half of the distance between two places at a speed of 40kmph and the second half at 60kmph. Calculate the average speed of the car.

28. The x – t graph of an object is shown below. Draw the v –t graph and find total displacement.



29. A body is dropped from a height 'h'. Calculate.
   a) The time taken by it to reach the ground.
   b) The velocity on reaching the ground.

30. An athlete runs along a circular track of radius 50 cm. Find the distance travelled and displacement of the athlete. When he covers $\frac{3}{4}$ of the circular track.

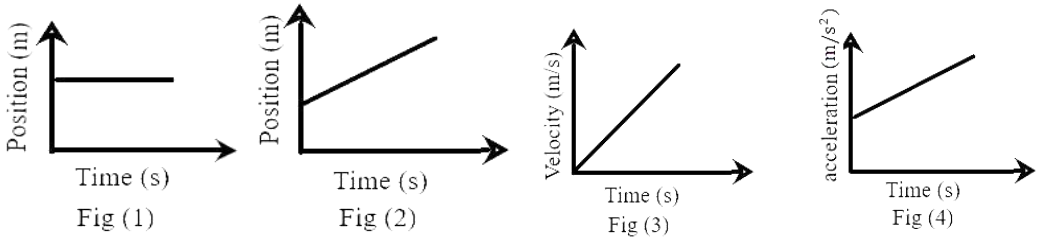
31. The position of an object moving along x axis is given by $x = 8.5 + 2.5\,t^2$ and t is measured in seconds. What is its velocity at t = 0s and t = 2 s? What is the average velocity between t = 2s and t = 4s?

32. The position of an object moving along x – axis is given by $x = 8t^3 - 3t^2 + 2t$, where x is in meter and t is seconds. Find the average velocity of the body in the time interval t = 0s to t = 2 s.

33. A body having an initial velocity 'v_0' has an acceleration 'a'.
   a) Using velocity - time graph, derive an equation for displacement of the above body.
   b) Draw the velocity - Time graph and speed-Time graph of a body thrown vertically in air. **[MODEL 2018]**

34. Using a suitable velocity-time graph, derive the relation $x = v_0t + \frac{1}{2}at^2$ **[MARCH 2018]**

35. A body falling under the effect of gravity is said to be in free fall.
   a) Draw the velocity-time graph for a freely falling object.
   b) Define uniform acceleration
   c) From the given figures, identify the figure which represents uniformly accelerated motion

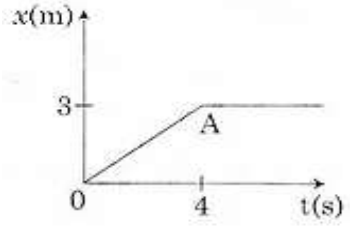


[MARCH 2018]

36. Draw the position-time graph for motion of a body moving along positive x axis with positive acceleration. What is the value of acceleration of a projected body at its highest point?

[MODEL 2019]

37. The position-time graph of a particle of mass 4 kg is shown. What is the force on the particle at $0 < t < 4$ s?

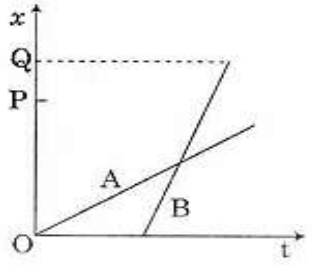


38. Choose the correct answer from below

a) (A/B) lives closer to the school than (B/A)

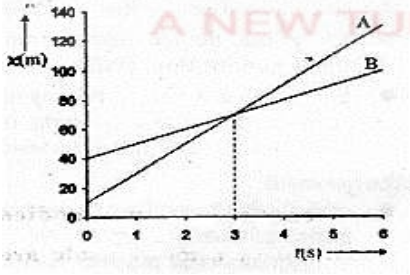
b) (A/B) starts from the school earlier than (B/A)

c) (A/B) walks faster than (B/A)



[MODEL 2019]

39. Position (x) - time (t) graphs of two objects A and B are shown below. At what time the objects meet?



[MARCH 2019]

40. Free fall is a uniformly accelerated motion.

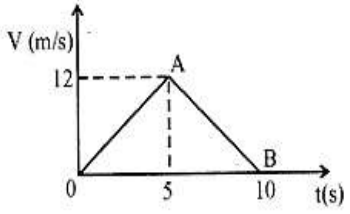
a) Draw the velocity – time graph of free fall.

b) A ball is thrown vertically upwards with a velocity of 20 ms^{-1} from the top of a building. The height of the point from where the ball is thrown is 25.0m from the ground.

i) How high will the ball rise?

ii) How long will it be before the ball hits the ground? **[MARCH 2019]**

41. The speed-time graph for a particle moving along a fixed direction is shown in figure below. Calculate the distance travelled by the particle between t = 0 to t = 10s.



[MODEL 2020]

42.

a) Can a body posses zero velocity and still accelerate? Explain with a suitable example.

b) A boy takes 5 minutes to ride a cycle on a horizontal circular track of radius 2 km. What is the distance, displacement, average speed of the boy in the following cases?

i. He reaches back to the starting point

ii. As he is at the diametrically opposite point on the track. **[MODEL 2020]**

43. Four pairs of initial and final positions of a body along an x axis are given. What pair gives a positive displacement of the body?

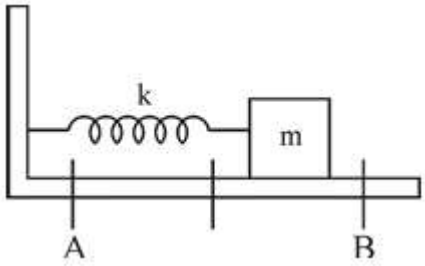
a) $-10\text{m}, \ +15\text{m}$

b) $-5\text{m}, \ -12\text{m}$

c) $2\text{m}, \ -5\text{m}$

d) $2\text{m}, \ 1\text{m}$ **[MARCH 2020]**

44. Simple harmonic motion of a block of mass m attached to a spring is shown in figure. The distance between extreme points A and B is 10 cm.

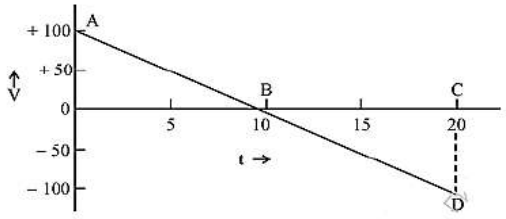


Take the direction from A to B as the positive. Redraw the given table and give the signs of velocity, acceleration and force.

	Point	Velocity	Acceleration	Force
a)	At the end B	0		
b)	At the mid-point of AB going towards A		0	0
c)	At 2cm away from B going towards A			

[MARCH 2020]

45. Velocity-time graph of a ball thrown vertically upwards with an initial velocity is shown in figure.

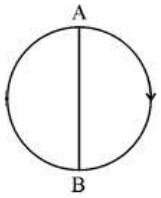


a) What is the magnitude of initial velocity of the ball?

b) Calculate the distance travelled by the ball during 20 s, from the graph.

c) Calculate the acceleration of the ball from the graph. **[MARCH 2020]**

46. A body is traveling along a circular path of radius 10 m as shown below. If it travels from A to B, find the distance and displacement of the body.



[MODEL 2021]

47.

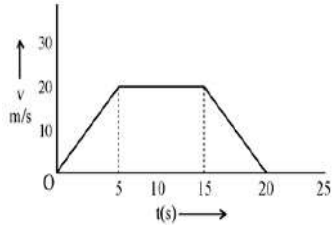
a) Define average velocity and average speed.

b) Draw the position-time graph of body having zero acceleration. **[MODEL 2021]**

48.

a) Derive position-time relation $x = v_0 t + \frac{1}{2} a t^2$ for a uniformly accelerated body.

b) The velocity-time graph of a body is given below. Find the displacement of the body during the time interval 5 s to 15 s.



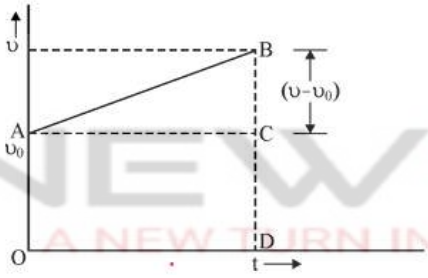
[MODEL 2021]

49. An astronaut in a space shuttle moves along a straight line. The data gives below give the measured velocity starting from t = 2s. Draw the velocity – time graph.

Time (S)	2	4	6	8	10	12	13	16
Velocity (m/s)	2	4	6	2	0	-2	-4	-2

[MARCH 2021]

50. v-t curve for an object with uniform acceleration is given below.



Using this graph derive the relation,

$x = v_0 t + \frac{1}{2} a t^2$ and $v^2 = v_0^2 + 2\,ax$ **[MARCH 2021]**

51.

a) Draw the velocity time graph of a uniformly accelerated object.

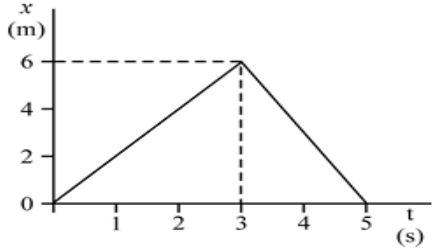
b) Using the graph derive an equation for displacement in terms of initial velocity V_0 and acceleration (a). **[MODEL 2022]**

52. An object released near the surface of earth is accelerated downward under the influence of gravity

a) Write down the equations of motion in this case.

b) Also plot a graph connecting acceleration and time in this case. **[MODEL 2022]**

53. The position – time graph of an object is shown below. Draw the velocity – time graph and find total displacement.



[MARCH 2022]

54. A particle is moving along X-axis with uniform positive acceleration.

a) Obtain an expression for displacement by drawing v-t graph.

b) A ball is thrown vertically upwards with a velocity of 20 m/s from the top of a tower of height 25 m from ground. How long does it remain in air? ($g = 10\ ms^{-2}$)

[MARCH 2022]

55.

a) Show that area under velocity – time graph gives displacement.

b) Give an example for a body possessing zero velocity which is accelerating topmost point of a body projecting vertically upwards. **[MARCH 2023]**

56. A ball is thrown vertically upwards with an initial velocity u. Calculate the time taken to reach maximum height?

[MARCH 2023]

57. The speedometer of a car shows 70 km/h. This represents ……. **[MODEL 2024]**

58. Derive the following equations for uniformly accelerated motion.

a) $x = v_0 t + \frac{1}{2}at^2$

b) $V^2 = v_0^2 + 2ax$

Where x → displacement, v_0 → initial velocity, v → final velocity, a → acceleration and t → time

[MODEL 2024]

59. The position of a body at different instances of time are given in the table. Draw the position – time graph and determine the velocity.

Position (m)	0	2	4	6
Time (s)	0	1	2	3

[MODEL 2024]

60.

a) Derive the relation $v = u + at$

b)

i) Draw velocity – time graph for uniformly accelerated motion.

ii) Write the significance of v –t graph

iii) Derive the equation $s = ut + \frac{1}{2}at^2$ from v – t graph. **[MARCH 2024]**

61. What is the relationship between the stopping distance and the initial velocity of a vehicle? **[MODEL 2025]**

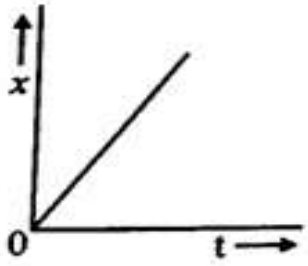
62.

a) Draw the velocity-time graph of a body in uniform accelerated motion.

b) From graph, derive the relation, $x = v_0 t + \frac{1}{2}at^2$

[MODEL 2025]

63. A graph of position-time of an object is given



Choose the correct answer related to this graph

a) Velocity of object increases
b) Object is stationary
c) Object has constant velocity **[MARCH 2025]**

64. A car moving along a straight highway with speed of 126 km h^{-1} is brought to a stop within a distance of 200m. what is the retardation of the car (assumed uniform)?

[MARCH 2025]

65. Draw the following graphs related to freely falling particle:

a) Position time graph
b) Velocity time graph
c) Acceleration time graph **[MARCH 2025]**

CHAPTER – 3, MOTION IN A PLANE

1. Rain is falling vertically at 10m/s and wind is blowing from east to west at 8m/s. In which direction should a girl waiting at the bus stop hold her umbrella?

2. What is the angular velocity of a second hand and minute hand of a clock?

3. Rain is falling vertically at 6m/s and a girl is riding a bicycle at a speed of 2 m/s from east to west. Find in which direction should she hold her umbrella.

4. Find the angle between $\vec{A} = 2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{B} = 4\hat{i} + 5\hat{j} - 2\hat{k}$?

5. If $\vec{A} \times \vec{B} = \vec{A}.\vec{B}$. Find angle between $\vec{A}$ and $\vec{B}$

6. Find the value of 'n' such that $\vec{A} = 4\hat{i} + 3\hat{j} - 7\hat{k}$ and $\vec{B} = 5\hat{i} + 2\hat{j} - n\hat{k}$ are orthogonal?

7. An object is acted upon by a force of 10 N at an angle 60^0 with horizontal. Find the horizontal and vertical components of force.

8. Find the unit vector in the direction of $\vec{A}$

9. If a body is acted upon the two perpendicular forces 5N and 6N. Find the magnitude and direction of resultant force?

10. Two vectors and their resultant have same magnitude. If so what is the angle between them?

11. If $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{B} = 5\hat{i} + 6\hat{j} + 7\hat{k}$ and angle between them is 60^0. Find $\vec{A}.\vec{B}$?

12. Find the scalar product of $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{B} = 5\hat{i} + 6\hat{j} + 7\hat{k}$?

13. Find the cross product of $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$ and $\vec{B} = 5\hat{i} + 6\hat{j} + 7\hat{k}$?

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & 4 \\ 5 & 6 & 7 \end{vmatrix}$$

14. Pick out the scalar and vector quantities from the following list:
Work, velocity, coefficient of friction, linear momentum.

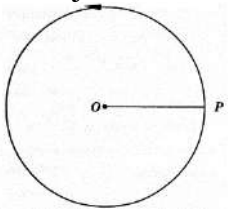
[MODEL 2019]

15. Find the magnitude of the resultant of two vectors A and B in terms of their magnitudes and angle θ between them.

[MARCH 2019]

16.

a) Figure shows the path of an object in uniform circular motion.



Redraw the figure and mark the directions of velocity and acceleration of the particle at P.

b) An object moving uniformly in a circular path of radius 12 cm completes 7 revolutions in 100s. What is the angular speed, and the linear speed of the motion?

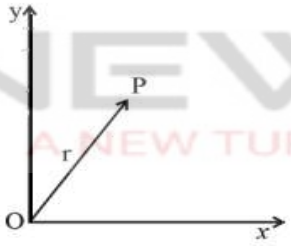
[MARCH 2019]

17. ln the uniform circular motion, which of the following physical quantities does not remain constant?

a) Speed
b) Linear momentum
c) Kinetic energy
d) Angular velocity

[MODEL 2020]

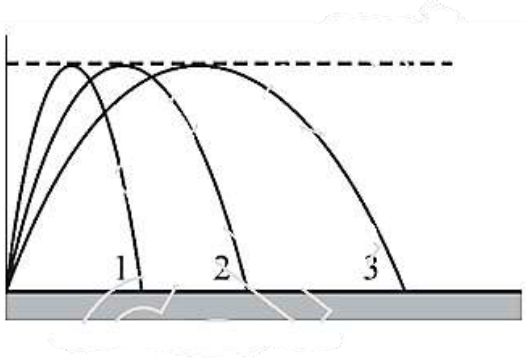
18. The position vector r of a particle P located in an x-y plane is shown in figure.



a) Redraw the figure by showing the rectangular components.
b) Write the position vector in terms of rectangular components.
c) Write an equation to find the magnitude of the resultant of two vectors A and B.

[MARCH 2020]

19. The figure shows three paths for a football kicked from ground level with same velocity. Ignore the effects of air resistance.

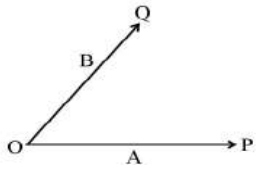


a) Derive an equation for the maximum height of this football.
b) In which path the horizontal component of velocity is maximum? **[MARCH 2020]**

20. A player throws a ball vertically upwards. What is the velocity and acceleration of the ball at the highest point of its motion?

[MARCH 2021]

21. Two vectors A and B are given below



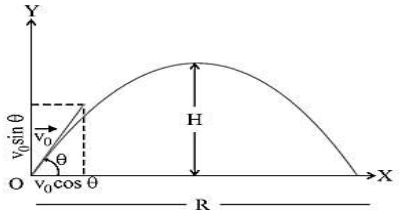
Redraw the figure and show the vector sum using parallelogram method. **[MARCH 2021]**

22. What are the conditions for equality of two vectors? **[MARCH 2021]**

23. Define angular velocity. Write the equation showing its relation with linear velocity.

[MARCH 2021]

24. Derive an expression for maximum height (H) and horizontal range(R) of a projectile using the given figure.



[MARCH 2021]

25. A stone tied to the end of a string 80 cm long is whirled in a horizontal circle with a constant speed. If the stone makes 14 revolutions in 25 s, what is the magnitude and direction of centripetal acceleration of the stone? **[MARCH 2021]**

26. Magnitude of a null vector is

a) 1
b) Zero
c) Unpredictable **[MODEL 2022]**

27. Find the magnitude of the resultant of two vectors $\vec{A}$ and $\vec{B}$ in terms of their magnitudes and angle θ between them. **[MODEL 2022]**

28. A ball is projected at an angle with the horizontal

a) What is the path followed by this ball?
   i. Circle
   ii. Ellipse
   iii. Parabola
b) Derive an equation for the path followed by the ball.
c) A cricket ball is thrown at a speed of 28 ms^{-1} at an angle $\theta = 30°$ with the horizontal.

Calculate the maximum height. (sin 30 = 0.5) **[MODEL 2022]**

29. $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$. The angle between vectors $\vec{A}$ and $\vec{B}$ is ……. **[MARCH 2022]**

30. A javelin is projected at an angle of 30º with an initial velocity of 5 ms^{-1} from the ground. What are its velocity and acceleration at highest point? **[MARCH 2022]**

31. Obtain an expression for centripetal acceleration of a body in uniform circular motion.

[MARCH 2022]

32. A child of mass 30 kg is standing inside a lift.

a) What happens to the apparent weight of the child if the lift is moving up with a uniform acceleration?

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b) Write an expression for the apparent weight of the child.
c) Find the apparent weight of the child, if the lift is moving down with constant acceleration of 5 ms^{-2}. **[MARCH 2022]**

33.
a) What is null vector?
b) Give any two properties? **[MARCH 2023]**

34. A boy throws a cricket ball with a velocity 'u' at an angle θ with the horizontal.
a) What is the trajectory of the ball?
b) Deduce an expression for maximum height reached by the ball?
c) If the boy can throw the ball to a maximum height 'h', what is the maximum horizontal distance to which he can throw? **[MARCH 2023]**

35. Two forces 10N, 8N are acting at a point. The angle between them is 60^0. Find the magnitude of the resultant force? **[MODEL 2024]**

36. An object is projected with velocity 'u' at an angle θ with the horizontal.
a) Derive the equation for time of flight and horizontal range.
b) Find the angle of projection for which the maximum height is equal to one forth the horizontal range? **[MODEL 2024]**

37. State and explain parallelogram law of vector addition? **[MARCH 2024]**

38. The figure shows the path of a projectile motion of a body.
a) Derive the expression for maximum height attained by the body
b) A ball is thrown at a speed of 28m/s in a direction 30^0 from the horizontal range. Calculate its horizontal range.
c) At what angle of projection is the horizontal range is maximum?

[MARCH 2024]

39. A player throws a ball upward with an initial speed of 29.4 m/s.
a) What is the direction of acceleration during the upward motion of the ball?
b) What are the velocity and acceleration of the ball at the highest point of its motion?

[MODEL 2025]

40.
a) If $\vec{A}$ and $\vec{B}$ are two vectors of different magnitude, can $\vec{A} + \vec{B} = \vec{A} - \vec{B}$?
b) Write two properties of null vector. **[MODEL 2025]**

41. A boy throws a cricket ball with velocity u at an angle θ with the horizontal
a) Draw the velocity time graph for the horizontal and vertical components of velocity.
b) Taking the vertical component of velocity, arrive at an equation to find the time of flight of the ball.
c) What is the kinetic energy of the ball at the highest point of projection?

[MODEL 2025]

42. State true or false:
a) The magnitude of displacement is either less or equal to the path length of an object between two points.
b) A null vector has no magnitude. **[MARCH 2025]**

43. It was Galileo who first stated the independency of the horizontal and the vertical components of projectile motion.
a) Write down the horizontal and the vertical components of initial velocity of a projectile.
b) Derive an equation of maximum height attained by a projectile.
c) A cricket ball is thrown at a speed of 28 ms^{-1} in a direction 30° above the horizontal. Calculate the maximum height.

[MARCH 2025]

CHAPTER – 4, LAWS OF MOTION

1. There are different types of forces in nature. We learnt their effects and applications. Give the exact reasons for the following.

a) Why can't a horse pull a cart in empty space?

b) Why are passengers thrown forwardwhen a speeding bus stops suddenly?

[MARCH 2010]

2. A passenger of mass 30kg is standing in a lift which is moving vertically downwards with an acceleration of $1.8 m/s^2$.

a) Will the passenger experience decrease or an increase in his weight? Explain?

b) What will be the effect if the cable is cut and the lift falls freely? **[MARCH 2010]**

3. A man is standing at the centre of a large flat slab of ice. He can get himself to the edge of the slab by spitting or blowing air in the forward direction (assuming the ice to be frictionless)

a) Name the principle/law involved in this.

b) A horse cannot pull a cart and run-in empty space. Why?

c) With the help of a free body diagram represent the various forces acting on a vehicle moving on a banked road.
Neglecting frictional force obtain the expression for the maximum safe speed of the vehicle on the banked road. **[IMP 2010]**

4. A machine gun fires bullets of mass 40g each with a speed of 1200 ms^{-1}. The person can hold the gun with a maximum number of bullets that can be fired per second from the gun?

5. Banking of road helps to increase the centripetal force and there by increases the limit of maximum speed of a vehiclewith it can take the curve**.**

a) Sketch the schematic diagram of a vehicle on a banked road and mark the various forces acting on it.

b) Give the expression for the maximumallowed speed of a vehicle on a banked road with friction.

[IMP 2011]

6. A stone breaks the window glass into pieces while a bullet almost pierces through the same. Give reason.

[IMP 2011]

7. Friction is a force acting between two surfaces in contact; when there is a relative motion between them. Consider a car moving over a horizontal road. What will be the direction of frictional force acting between the road and tyre?

[IMP 2011]

8. When a short is fired from a gun, the gun is moved in the backward direction.

a) State the principle behind it.

b) Prove the principle using Newton'ssecond law of motion.

[IMP 2011]

9. A thief jumps from the top of a house with a box of weight 25kg.wt. on his head. What will be the weight of the box experienced by the thief during his downward fall? Justify your answer.

[IMP 2011]

10. According to Newton's law of motion, the force depends on the rate of change of momentum.

a) State whether the force is external or internal? Justify your answer.

b) What happens to the linear momentum when the force is absent?

c) The motion of a particle of mass m is described $y = Ut + \frac{1}{2} gt^2$. find the force acting on the particle.

d) Why is it more difficult to rotate a stone by tying it to a longer string than a shorter string?

[MARCH 2012]

11. Write the reason for the following:

a) Action and reaction are equal and opposite. Yet they do not cancel each other.

b) A cricketer moves his handsbackwards while holding a catch.

[IMP 2012]

12. The outer side of a circular track of radius 200m is raised to make an angle of 15^0 with the horizontal.

a) Which force provides the necessary centripetal force for a car taking the circular track?

b) Name the process by which the outer side of a curved track is raised a little above the inner side.

c) Using the data provided in this case, determine the maximum permissiblespeed to avoid skidding (Given $\mu_s = 0.25$).

[MARCH 2013]

13. According to Newton's law of motion, the force depends on the rate of change of momentum.

a) Name the law that helps to measure force.

b) Using the above law, deduce an expression for force.

c) A man jumping out of a moving bus fall with his head on forward.

d) What should he do in order to land safely? **[MARCH 2013]**

14. Match the following.

Sl. No	A	B
1	Newton`s first law	Change inmomentum
2	Conservationof linear momentum	Action ↔Reaction
3	Newton`sthird law	Law of Inertia
4	Impulse	Momentum before collision = momentum after collision

15. A circular track of radius 400m is kept with outer edge to make 5 degrees with the horizontal.

a) What do you call this type of construction of tracks?

b) Obtain an expression for the maximum permissible speed considering the force of friction.

c) Calculate the permissible speed of the car if the coefficient of friction is 0.2.

[IMP 2013]

16. We are familiar with Newton's laws of motion.

a) State Newton's second law of motion.

b) Using the above law, explain.

(i) Impulse – momentum principle

(ii) Law of conservation of linear momentum

c) A circular race track of radius 300m is banked at an angle of 15^0. The coefficient of friction between the wheels of race car and the road is 0.2. Find:

(i) The optimum speed of the race car to avoid wear and tear on its tyres.

(ii) Maximum permissible speed to avoid slipping.

[MARCH 2014]

17. Friction is defined as the force which opposes the relative motion between two surfaces in contact.

a) Friction is necessary evil. Explain.

b) What is meant by banking of roads?
c) Obtain an expression for maximum speed on a banked road without considering friction.

[IMP 2014]

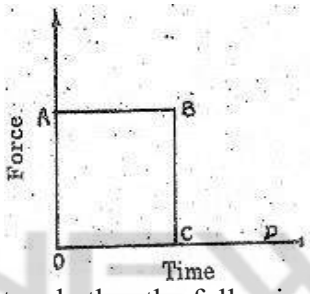
18. Newton formulated the famous laws of motion.
a) Give the significance of Newton's first law.
b) Action and reaction are equal and opposite, yet they do not cancel each other. Why?

[IMP 2014]

19.
a) State the following statements are True or False. Correct the statements if false.
   i. A spring balance gives the mass of a body while a common balance gives its weight.
   ii. If the same force is applied on two bodies of different masses for the same time, then the change in momentum of two bodies is the same.
b) State Newton's second law and arrive at the equation of force.
c) A motorcycle and a bus are moving with same momentum. Which of them has greater kinetic energy? Justify.

[MARCH 2015]

20. The given graph ABCD shows variation of force with time for a bodyplaced on a smooth horizontal surface.



a) Using the given graph, state whether the following statements are true or false.
   i. The force acting on a body along **AB is** constant.
   ii. The force acting on a body along **CD** is zero.
b)
   i. State the law of conservation of linear momentum.
   ii. Find the region on the graph at which the body moves with constant momentum.
   iii. Draw a momentum time graph for the given graph.

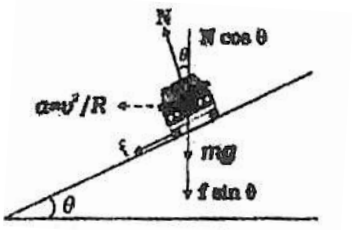
[IMP 2015]

21. When a horse suddenly starts moving,the rider falls backward.
a) Name and state the law used to explain the above situation.
b) State the law of conservation of linear momentum and prove it on the basis of second law of motion.
c) State true or false.
An iron ball and a wooden ball of the same radius are released from a height in vacuum; the iron ball will reach the ground first.

22. A person drives a car along a circular track on a level ground.
a) Derive an expression for the maximum safe speed of the car.
b) Why do we give banking to curved roads?

[IMP 2016]

23. The schematic diagram of the circular motion of a car on a banked road is shown in the figure.

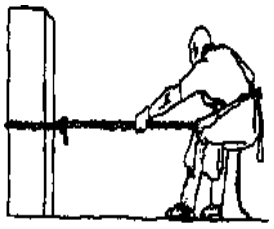


a) If the centripetal force is provided by the horizontal components of 'N' and 'F' arrive at an expression for maximum safe speed.

b) The optimum speed of a car on a banked road to avoid wear and tear on its tyres is given by .....

[MARCH 2017]

24. A man pulls a rope of negligible mass attached to a block. The man wear shoes that does not slip on the floor. The block moves towards the stationary man.



a) The law which relates the forces that two different bodies exert on each other is .....

i. Newton's firs law
ii. Newton's second law
iii. Newton's third law
iv. Newton's law of cooling.

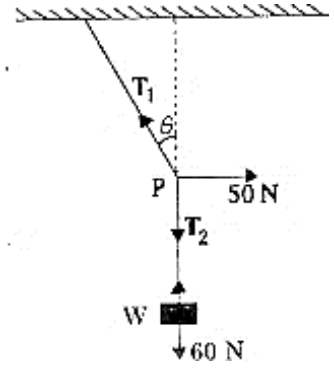
b) 'The man remains stationary'. Substantiate the statement based on the various forces acting on the man.

c) Explain, how the block moves even if the net force on the moving block is zero, though a new non zero force is initially required. **[IMP 2017]**

25.

a) What is the condition for the Equilibrium of concurrent forces?

b) A mass of 6 kg is suspended by a rope of length 2m from the ceiling. A force of 50 N in the horizontal direction is applied at the midpoint P of the rope, as shown. What is the angle, the rope makes with the vertical in equilibrium? (Take g =10 m/s^2) neglect the mass of the rope.



c) What will be the angle made by the rope with the vertical if its length is doubled?

[MARCH 2018]

26. A gun moves backward when a shot isfired from it.

a) Choose the correct statement.

i. The momentum of the gun is greater than that of the shot.

ii. The momentum acquired by the gun and shot have the same magnitude.

iii. Gun and shot acquire the same amount of kinetic energy.

b) A shell of mass 0.020 kg is fired by a gun of mass 100 kg. If the muzzle speed of the shell is 80 m/s. What is the recoil speed of the gun?

[MARCH 2018]

27. To reduce friction and accident by skidding the road are banked at curves.

a) What is meant by banking of roads?

b) Sketch the schematic diagram of a vehicle on a banked road with friction and mark the various forces

c) Derive an expression for the maximum safe speed of a vehicle on a banked road with friction. **[IMP 2018]**

28. A man jumping out of a slow-moving bus fall forward.

a) This is due to .....

b) Which Newton's law gives the above concept? State the law.

c) What is the net force acting on a book at rest on the table?

[IMP 2018]

29. The rate of change of total momentum of a system of many particle systems is proportional to the ..... on the system.

i. external force

ii. a sum of the internal forces **[IMP 2018]**

30. Static friction opposes impending motion.

a) Write the mathematical equation connecting the limiting value of static friction with normal reaction.

b) Choose the correct statement

i. Both kinetic friction and static friction are independent of the area of contact.

ii. Kinetic friction depends on area ofcontact, but static friction does not.

iii. Static friction depends on area ofcontact but kinetic friction does not.

iv. Both kinetic friction and static frictiondepend of the area of contact.

c) A mass rests on a horizontal plane. The plane is gradually inclined until at an angle θ with the horizontal, the mass just begins to slide. Show that the coefficient of static friction between the block and the surface is equal to tan θ **[MARCH 2019]**

31. A light bullet is fired from a heavy gun.

a) Choose the correct

i. Speed of the gun and the bullet are equal.

ii. Momenta of the bullet and gun are equal in magnitude and opposite in direction.

iii. Momenta of the gun and bullet are equal in magnitude and are in the same direction.

iv. Velocity of gun and bullet are equal.

b) By using a suitable conservation law in physics, prove your above answer.

[MARCH 2019]

32. A large force acting for a short interval of time is called impulsive force.

a) What is the SI unit of impulse?

b) Two billiard balls each of mass 0.05g moving in opposite direction with speed 6 m/s collide and rebound with the same speed. What is the impulse imparted to each ball due to the other? **[IMP 2019]**

33. The static friction comes into play at the moment the force is applied.

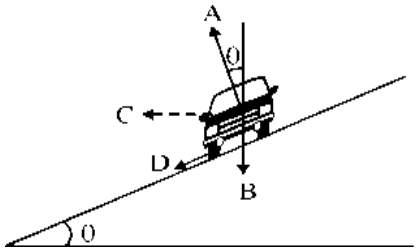
a) Write the relation between static friction and normal reaction.

b) Determine the maximum acceleration of the train in which a box lying on its floor will remain stationary, given that the coefficient of static friction between the box and the train's floor is 0.15.

c) State the laws of limiting friction **[IMP 2019]**

34. State the law of conservation of linear momentum. **[MARCH 2020]**

35. Circular motion of a car on banked road is shown in figure.



a) Write the name of forces A, B, C, D in the figure.

b) Write the equation which equate forces on the car along horizontal and vertical direction.

c) State the law of static friction. **[MARCH 2020]**

36. Newton's first law of motion describes the .....

a) Energy

b) Work

c) Inertia

d) Momentum **[MARCH 2020]**

37. When a moving bus suddenly stops passengers tends to fall forward. This is due to ..... **[IMP 2020]**

38. A vehicle of mas s is moving on a bankedroad of radius r.

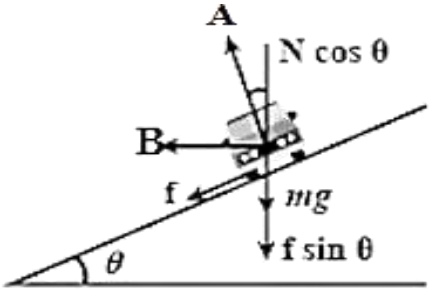
a) What are various forces acting on the vehicle?

b) Obtain an expression for maximum safe speed of the vehicle on a banked road.

c) A circular road of radius 300 m is banked at an angle of 15^0. If the coefficient of friction between the wheels of a car and the road is 0.2, what is the optimum speedof the car? (g = 9.8 m/s^2) **[IMP 2020]**

39. Using Newton's second law of motion,derive the equation $\vec{F} = m\vec{a}$ **[IMP 2020]**

40. Various forces acting on a car in circular motion through a banked road is shown.



a) Write the name of forces A and B.

b) A cyclist travelling on a level road takes a sharp circular turn of radius3 m without reducing the speed. The co-efficient of static friction between the tyres and the roads is 0.1. Calculate the maximum permissible speed to avoid slipping.

[SEP 2021]

41. A person firing a bullet from a gun experiences a backward jerk:

a) Write the principle behind this.

b) A bullet of mass 15 g fired with a velocity of 100 ms^{-1} from a gun of mass 2kg. Find the recoil speed of gun. **[JUNE 2022]**

42. A child of mass 30 kg is standing insidea lift.

a) What happens to the apparent weight ofthe child if the lift is moving up witha uniform acceleration?

b) Write an expression for the apparent weight of the child.

c) Find the apparent weight of the child, if acceleration of 5 $ms^{-2.}$

[JUNE 2022]

43. Banking of roads helps to increase thelimit of maximum safe speed of avehicle at a curve.

a) Draw the schematic diagram of a vehicle on a banked road and mark the various forces acting on it.

b) Obtain an expression for the maximum safe speed of a vehicle at a banked road with friction force. **[JUNE 2022]**

44. While firing a bullet the gun recoils

a) Which law helps you to explain the phenomenon?

b) In the firing process, the speed of the gun is very low compared to the speed of bullet. Substantiable the above statement mathematically? **[MARCH 2023]**

45.

a) Sketch the schematic diagram of a vehicle on a banked road and mark various forces acting on it.

b) Obtain an expression for maximum safe speed for a vehicle in the banked road.

[MARCH 2023]

46.

a) State the law of conservation of momentum?

b) Prove the law of conservation of momentum using Newton's third law of motion.

[MODEL 2024]

47. A vehicle of mass m moving with a velocity v along banked road with radius r.

a) Draw the diagram showing various forces acting on it.

b) Derive the expression for maximum permissible speed at the banked road with friction.

[MODEL 2024]

48.

a) State Newton's 2nd law of motion and show F = ma.

b) State & prove law of conservation of linear momentum.

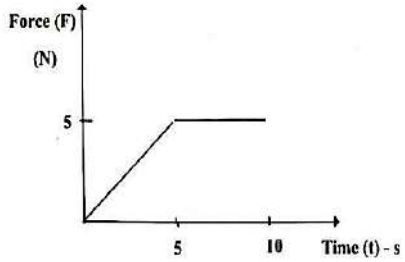
c) What is friction? Mention its different types.

d) At equilibrium the net force acting on a body is ……. **[MARCH 2024]**

49.

a) State Newton's second law of motion.

b) The force F acting on a particle of mass m is indicated by force - time graph shown below. Find the change in momentum of the particle over the time interval from zero to 10 s.



[MODEL 2025]

50. Vehicle of mass m is moving with a velocity v along a banked road with radius R.

a) Draw vector diagram showing the various forces acting on the vehicle.
b) Derive an expression for the maximum permissible speed at the banked road with friction.
c) A car speeding at 80 km/h on a level road takes a sharp turn without reducing the speed. If the coefficient of static friction between the tyre and road is 0.20. Will the car skid while taking the turn? (Radius of the circular path = 4 m)

[MODEL 2025]

51.

a) State Newton's second law of motion.
b) Derive the equation of force using the above law.

[MARCH 2025]

52. A car is moving in a circular level road with uniform speed.

a) Draw a diagram showing all forces acting on it.
b) Obtain the equation for maximum velocity of the car.
c) Comment on any method to increase the maximum safe velocity of car.

CHAPTER – 5, WORK, ENERGY AND POWER

1. Collision between two particles need not be the physical contact of two particles as in the case of scattering ofthe α particle by a nucleus.

a) What is the quantity that remains conserved in all types of collisions?

b) Suppose an electron and a proton are projected with equal kinetic energy, what will be the ratio of their linear momentumsif the proton is 1830 times heavier than an electron?

c) The bob of a pendulum released from 30^0 to the vertical hits on another bob ofequal mass at rest. How high does the first bob rise after the collision? (Assume that the collision is elastic and the sizes of the bobs are negligible.) **[MARCH 2010]**

2. A ball moves along a circular path under the influence of centripetal force.

a) What is the work done by the centripetal force on the ball?
b) An arrow shot from a bow has kinetic energy. How does it get this kinetic energy?
c) Show that the total mechanical energy of a freely falling body is conserved.

[IMP 2010]

3. According to the work- energy theorem, work done by a force on a body is equal to change in its kinetic energy.

a) A lorry and a car moving with a same kinetic energy are stopped by applying breaks which provides the same retardation. Which of them will come to a rest in a shorter distance? Explain.
b) If the kinetic energy of a body is doubled, what is the percentage change in its linear momentum? **[MARCH 2011]**

4. Consider a body falling freely throughthe atmosphere. Neglecting the air resistance prove that the total mechanical energy of the body remains constant throughout the fall. **[IMP 2011]**

5. Ramesh lifts a body of mass 'm' to a height 'h' near the surface of the earth in a time 't'

a) Draw the force-displacement
b) If 'A' is the area of the graph, what quantity does A/t indicate? Graph?

6. Fill in the blanks:

Water stored in a dam	Potential energy	….. (a) …..
…… (b) …….	Kinetic energy	$E = \frac{1}{2} mv^2$
mass =10kg	Acceleration a =…...(c) ……	Force = 10N
lift falls freely	a = g	R= ……(d) …..

[MARCH 2012]

7. Work is required to lift a body through a height from the ground.

a) Calculate the work done in lifting a body of mass 10kg to a height of 10m above the ground.
b) State and prove the law of conservation of energy of a freely falling body.
c) Draw the variation of KE and PE with the height of the body. **[MARCH 2012]**

8. A force is required to do work. The work done by a force is the product of displacement and the component of force in the direction of displacement. Prove this statement.

[MARCH 2012]

9. Work is related to force and displacement over which it acts.

a) A man tries to pull a rigid wall for a long time but fails to displace it. What is the external work done by him?
b) Suggest two conditions for the workdone by a force to be zero.
c) A body of mass 1kg travels in a straight line with a velocity $v = kx^{3/2}$ where k = 5 SI units. Calculate the workdone by the net force to displace from x = 0 to x = 2m. **[MARCH 2012]**

10. Fill in the blanks

A	----------	$\rightarrow\rightarrow$ F.S	Scalar quantity
B	Mass, m	Momentum m	K.E = ----
C	----------Collision	Momentum conserved	Energy conserved
D	Unit of power	----------	746 watt
E	Body of mass m	At a height, h	PE= ------
F	Power, P	P = --------	Scalar product

[MARCH 2013]

11.

a) State and explain the work done inthe following situations:
   i. A person carrying a heavy load walks on a level road.
   ii. A man spending his energy by pushingon a concrete wall.

b) A constant force of 200 N displaces a body through 5m in the direction of the force. Find the work done on the body. **[MARCH 2013]**

12.

a) State and prove that the law of conservation of energy for a freely falling body.

b) Draw graphically the variation of kinetic energy and potential energy with the height of the body in the above case.

13. A car is moving with a constant speed on straight line

a) What is the net work done by theexternal force on the car?
b) State work energy theorem.

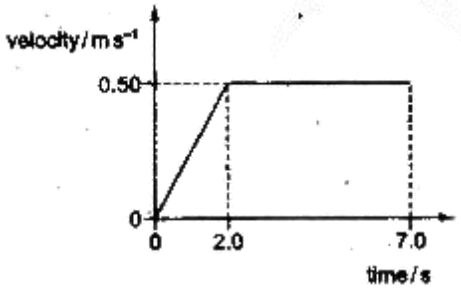
c) A bullet of mass 10g and velocity 800 m/s is passed through a mud wall of thickness 1 m. Its velocity reduces to 100m/s. Find the average resistance offered by the mud wall.

[IMP 2013]

14. From the table given below:

Force(N)	2	4	6	8	10
Displacement(m)	1	2	3	4	5

a) Draw the force – displacement graph.
b) How can you find the work done from the above graph?
c) Suggest any two situations in which the work done by a force is zero.
d) A ball is pushed with a force of 3N for 2s along a frictionless track. The graph shows the force on the body against time.



How much work is done by the force? **[MARCH 2014]**

15. Below figure represents two point masses, m_1 and m_2 approaching each other with speeds u_1 and u_2. Let them undergo one-dimensional collision and retrieve each other with velocities v_1 and v_2.

Show that $(u_1 - u_2) = -(v_1 - v_2)$
i.e., before and after collision, their relative velocities are equal. **[IMP 2014]**

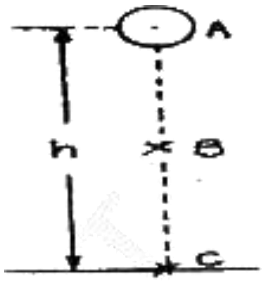
16. Several such a billiards, marbles, or caroms involve collisions.

a) When two object collide, after collision they could move together, the collision is .....
(Elastic, completely elastic, inelastic, completely inelastic)
b) Show that in a perfectly elastic collisionin one-dimension, relative velocity after collision is equal to relative velocity before collision.
c) A ball at rest is dropped from a height of12 m. It loses 25% of its kinetic energy on striking the ground. Find the height at which it bounces.

[MARCH 2015]

17. The figure shows a body of mass m placed at a height h. A, B and C are the three points on the trajectory of this body.

a) Which is the type of energy possessed by this body at a height h?
b) Prove that total mechanical energy is conserved at B and C.
c) A body of mass 5 kg is thrown vertically up with a kinetic energy of 490J.
Find the height at which the kinetic energy of the body becomes half of the original value.



[IMP 2015]

18. The scalar product of force and displacement gives work. It can be negative, zero or positive.

a) The work done in sliding a load is .... with respect to frictional force (Zero, positive, negative, infinity)

b) State and prove the work energy theorem for constant force.

c) A pump on the ground floor of a building can pump water to fill a tank of volume 30 m^3 in 15 minutes. If the tank is 40 m above the ground and the efficiency of the pump is 30%, how much electric power is consumed by the pump?

19.

a) State the work energy theorem.

b) Show that the potential energy of a body is completely converted into kinetic energy during its free fall under the gravity.

c) A man carefully brings down a glass sheet from a height 2 m to the ground. The work done by him is....

i. Negative
ii. Zero
iii. Positive
iv. Unpredictable

[IMP 2016]

20. Force is required to lift a body from the ground to a height h and work is measured as the product of force and magnitude of displacement.

a) Name the energy possessed by the body at maximum height. Write an equation for it.

b) **A** man of mass 60 kg carries a stone of mass 20 kg to the top of a multi- storeyed building of height 50m. Calculate the total energy spent by him? (9.8m/s^2)

21. "Energy of a body is defined as its capacity of doing work".

a) The energy possessed by a body by virtue of motion is known as .....

b) A body of mass 5 kg initially at rest is subjected to a horizontal force of 20 N. What is the kinetic energy acquired by the body at the end of 10 s?

c) State whether the following statement is TRUE or FALSE. "The change in kinetic energy of a particle is equal to the work done on it by the net force".

[MARCH 2017]

22. The total mechanical energy of the system is conserved, if the forces doing work on it are conservative.

a) Derive a mathematical expression to explain work-energy theorem.

b) A particle of mass 4 kg which is at rest explodes into three fragments. Two of the fragments each of mass m kg arefound to move in mutually perpendicular directions with speed v m/s each. Find the energy released in the process of explosion.

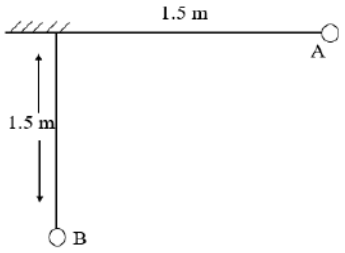
[IMP 2017]

23. "A heavy and a light body have the same kinetic energy". which one has greater momentum? why? **[MODEL 2018]**

24. According to conservation of energy: energy can neither be created nor be destroyed"

a) Prove law of conservation of mechanical energy in the case of a freely falling body.

b) the bob of a pendulum of length 1.5 m is released from the position 'A' shown in figure. what is the speed with which the bob arrives at the lower most point B, given that 5% of its initial energy is dissipated against air resistance?



[MODEL 2018]

25. Write the work done in each of the following case as zero, positive or negative.

a) Work was done by centripetal force in circular motion.

b) Work was done by friction.

c) Work was done by the gravitationalforce on a freely falling object.

d) Work was done by the applied force in lifting an object.

[MARCH 2018]

26. Find the angle between the force $\vec{F} = (3\hat{i} + 4\hat{j} - 5\hat{k})$N and displacement $\vec{d} = (5\hat{i} + 4\hat{j} + 3\hat{k})$m. **[MARCH 2018]**

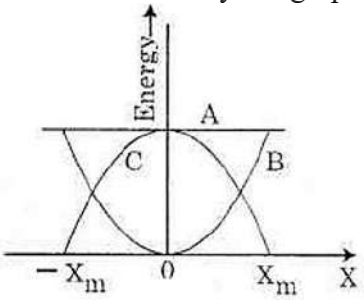
27. A car and a truck have the same kinetic energies at a certain instant while they are moving along two parallel roads.

a) Which one will have greater momentum?

b) If the mass of truck is 100 times greater than that of the car, find the ratio of velocity of the truck to that of the car.

[IMP 2018]

28. The given graph shows potential energy kinetic energy and total energy of a block attached to a spring obeying Hooke's law. identify the graph.



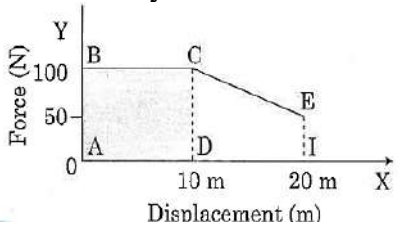
[MODEL 2019]

29. Identify the sign of work done by the force given are whether positive or negative

a) Work done by the force applied by a man and gravitational force in lifting a bucket out of a well by means of a rope tied to the bucket.

b) Work done by an applied force and frictional force on a body moving on a rough horizontal plane with uniform velocity.

c) calculate the work done by the force from the given force displacement graph.



[MODEL 2019]

30. Power is the rate at which work is done.
   a) Express power in terms of force and velocity.
   b) An elevator carrying the maximum load of 1800 kg is moving up with a constant speed of 2m/s. The frictional force opposing the motion is4000 N. Determine the minimum power delivered by the motor to theelevator.
   c) Express your above answer in horsepower?

[MARCH 2019]

31. Write any two properties of conservative force. **[MARCH 2019]**

32. Select the CORRECT alternative.
   a) When a conservative force does positive work on a body, the potential energy of the body .....
      1. Increase
      2. Decrease
      3. Remain unaltered
   b) Work was done by a body against friction always results in a loss of it's.....
      1. Kinetic energy
      2. Potential energy
   c) The quantity which is conserved in an elastic collision of two bodies is .....
      1. Total kinetic energy
      2. Total linear momentum

33. Several such as billiards, marbles,carroms involve collision.
   a) What is meant by completely inelastic collision?
   b) Show that in a perfectly elastic collision in one dimension, the relative velocity after collision is numericallyequal to relative velocity before collision. **[IMP 2019]**

34. A light body and a heavy body have equalkinetic energies, which one has greater momentum? **[IMP 2019]**

35. kilowatt hour is the unit of
   a) Energy
   b) Power
   c) Time
   d) Mass **[MODEL 2020]**

36. consider a spring applied with a force within the elastic limit.
   a) Draw the variation of restoring force F with displacement X from the mean position.
   b) what does the area of the graph represent?

[MODEL 2020]

37. A stone is dropped from the top of tower of height h.
   a) State work – energy theorem.
   b) Prove law of conservation of energy in this case
   c) Draw the variation of P.E and K.E. with the height of the stone.

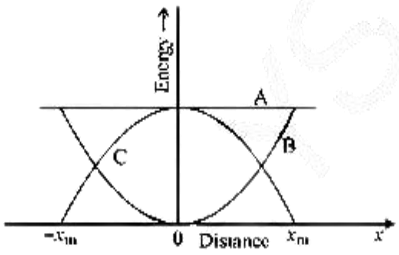
[MODEL 2020]

38. Find out the sign of work done in the following cases:
   a) Work done by a man in lifting a bucket out of a well.
   b) Work done by friction on a body slidingdown an inclined plane.
   c) Work done by an applied force on abody moving on a rough horizontal plane.
   d) Work done by the resistive force of air on a vibrating pendulum.

[MARCH 2020]

39. Graphs of the potential energy, kinetic energy and total energy of an oscillating spring is shown in figure:

NEW10 A NEW TURN IN EDIFICATION

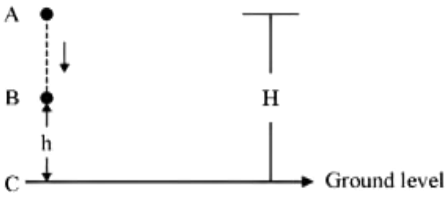


a) Find out the potential energy, kinetic energy and total energy from the graph.

b) Derive an expression to find thepotential energy of a spring.

[MARCH 2020]

40. An object is dropped from a height H as shown below:



Show that total energy is conserved at the points A, B and C**.** **[IMP 2020]**

41. Two bodies of masses m_1 and m_2 have the same linear momentum. What is the ratio of their kinetic energies?

[IMP 2020]

42. What is the difference between elastic and inelastic collision? Derive an expression for loss in kinetic energy on completely inelastic collision of two bodies in one dimensional motion.

[SEP 2021]

43. Write whether the work done in the following cases are positive, negative or zero.

a) Work done by frictional force.

b) Work done by centripetal force on a body moving in a circular path.

c) work done by gravitational force in a freely falling body.

d) work done by person carrying a load on his head and walks along a horizontal level road.

[MODEL 2021]

44. The magnitude of Kinetic energy of a body is 'K'. What is its kinetic energy if its velocity is doubled? **[MODEL 2021]**

45.

a) State the principle of conservation of mechanical energy.

b) Prove the principle of conservation of mechanical energy in the case of a freely falling body.

[MODEL 2021]

46.

a) Derive an equation for the potential energy of a stretched spring.

b) Draw a graph showing the variation of kinetic energy and potential energy with displacement in the case of spring obeying Hooke's law.

[MODEL 2021]

47. Find the angle between force $\vec{F} = (3\hat{i} + 4\hat{j} - 5\hat{k})$unit and displacement $\vec{d} = (5\hat{i} + 4\hat{j} + 3\hat{k})$ unit.

[MODEL 2022]

48.

a) What is meant by work done by a force?
b) Write down any two conditions in which work done is zero.
c) Write any one example for negative work.

[MODEL 2022]

49. Draw the variation of kinetic energy and potential energy of a freely falling body, with height **[MARCH 2022]**

50. Show that the total mechanical energy of a freely falling body is constant. **[MARCH 2022]**

51. Choose the correct option

a) The spring force is a conservation /non-conservation force
b) Draw the variation of potential and kinetic energies of a spring which its displacement from the equilibrium position **[MARCH 2023]**

52.

a) A car and a lorry have equal kinetic energy, which one will have greater momentum? Explain.
b) State and prove work. Energy theorem **[MARCH 2024]**

53.

a) Classify the following into conservation and non-conservation forces
(Electrostatic force, frictional force, magnetic force, viscous force)
b) Power = Force × ……. **[MARCH 2024]**

54. Define power write its unit and dimension? **[MARCH 2024]**

55.

a) State work – Energy theorem
b) What is a collision? Explain its different types **[MARCH 2024]**

56.

a) Work done in the motion of a body over a closed loop is zero for conservative forces in nature. Say true or false. Give reason for your answer.
b) Classify the following into conservative and non-conservative forces. Electrostatic force, frictional force, viscous force, magnetic force. **[MODEL 2025]**

57.

a) State and prove work energy theorem.
b) State whether the potential energy in the following cases increases or decreases.
   i. A spring is stretched
   ii. A spring is compressed **[MODEL 2025]**

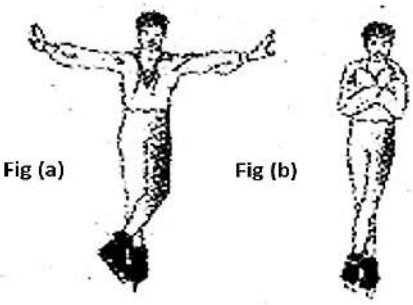
58. Differentiate between elastic and inelastic collision. **[MARCH 2025]**

CHAPTER – 6, SYSTEM OF PARTICLES AND ROTATIONAL MOTION

1. Remya stands at the centre of a turn- table with her two arms outstretched. The table with an angular speed of 40 revolutions / minute. **[MARCH 2010]**

2. Rotational inertia is the tendency of a rotating body to resist any change in its state of rotational motion.

a) What you mean by the radius of gyration of a rolling body?
b) The figure shows two different spinning poses of a ballet dancer.



In which spinning pose does the ballet dancer have less angular velocity? Justify your answer. **[MARCH 2012]**

3.

a) Derive the mathematical relation between angular momentum and torque. State the law of conservation of angular momentum.

b) A solid sphere is rotating about a diameter at an angular velocity ω. If it cools so that the radius reduces to 1/n of its original value, its angular velocity becomes .....

i. ω/n
ii. ω/n^2
iii. nω
iv. $n^2\omega$

[IMP 2015]

4. The rotational analogue of force is moment of force, also called torque.

a) The turning effect of force is maximum when the angle between $\vec{r}$ and $\vec{F}$ is .....

b) A wheel starting from rest acquires an angular velocity of 10 rad/s in two seconds. The moment of inertia of the wheel is $0.4 kgm^2$. Calculate the torque acting on it.

c) The possibility of falling backward with the ladder is more when you are high up on the ladder than when you just begin to climb. Explain why.

[MARCH 2016]

5.

a) Classical dancers bring their hands closer to their body to rotate faster. Name the principle employed by them.

b) A wheel rolls along a straight line. Derive an expression for its total kinetic energy.

c) The rotational analogue of force is.....

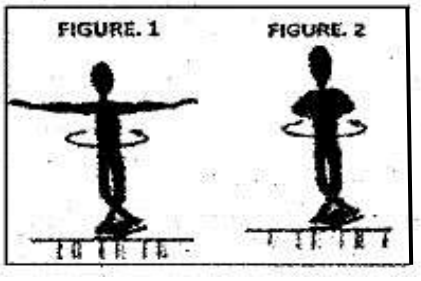
[IMP 2016]

6. The angular momentum of a particle the rotational analogue of its linear momentum.

a) The equation connecting angular momentum and linear momentum are .....

b) Starting from the equation connecting angular momentum and linear momentum, deduce the relation between torque and angular momentum. **[MARCH 2017]**

7. The demonstration of conservation of angular momentum is schematically shown in the figures. Identify the figure which has more angular velocity.



[MARCH 2017]

8. The moment of inertial of a thin rod of mass M and length / about an axis perpendicular to the rod at its mid-point is $\frac{MI^2}{12}$.

What is the radius of gyration in the above case? **[MODEL 2018]**

9.

a) Write the equation connecting torque with force.

b) A meter stick is balanced at its centre 50cm. When two coins, each of mass 5kg, are put one on the top of the other at the 12cm mark, it is found to be balanced at 45cm. What is the mass of the stick?

c) Derive the relation connecting torque with angular momentum. **[MARCH 2018]**

10. A girl rotates on a swivel chair as shown below.

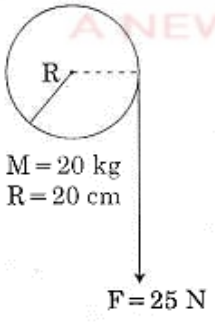
a) What happens to her angular speed when she stretches her arms?

b) Name and state the conservation law applied for your justification. **[IMP 2018]**

11. A cord of negligible mass is wound round the rim of a fly wheel (moment of inertia about a perpendicular axis passing through the centre is $\frac{MR^2}{2}$) of mass 20kg and radius 20 cm. A steady pulling force of 25 N is applied on the cord as shown.

a) Calculate the angular acceleration of the wheel.

b) Find the work done by the pull, when 2 m of the cord is unwound.



[MODEL 2019]

12. Match the following

A		B	
a)	Torque ($\vec{r}$)	i)	Perpendicular to ($\vec{r}$) and ($\vec{p}$)
b)	Angular momentum ($\vec{L}$)	ii)	$\Sigma(\vec{F} = 0)$
c)	Rotational equilibrium	iii)	$\vec{\omega} \times \vec{r}$
d)	Linear velocity ($\vec{v}$)	iv)	$\vec{r} \times \vec{F}$
		v)	$\Sigma\vec{r} = 0$

[MARCH 2019]

13. A solid cylinder of mass 20 kg rotates about its axis with angular speed 100 rad. s^{-1}. The radius of the cylinder is 0.25 m. What is the kinetic energy associated with the rotation of the cylinder? What is the magnitude of angular momentum of the cylinder about its axis? **[IMP 2019]**

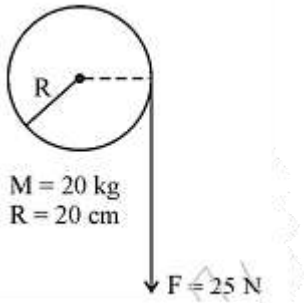
14. The rotational analogue of mass is called ……. **[IMP 2019]**

15.

a) State the law of conservation of angular momentum.

b) If a particle moves in a circular path with decreasing speed, how its angular momentum changes? **[MODEL 2020]**

16. A cord of negligible mass is wound round the rim of a flywheel mounted on a horizontal axle as shown in figure:



Calculate the angular acceleration of the wheel if steady pull of 25 N is applied on the cord. Moment of inertia of flywheel about its axis = $\frac{MR^2}{2}$. **[MARCH 2020]**

17. The rotational analogue of force is ……

a) energy

b) work

c) inertia

d) torque **[MARCH 2020]**

18. In pure rotational motion every particle of the body has the same angular velocity at any instant of time. State whether this statement is True or False. **[IMP 2020]**

19.

a) Show that, $\vec{\tau} = \frac{\overrightarrow{dL}}{dt}$ for rotational motion.

b) State the law of conservation of angular momentum.

c) Write an example for the motion in which angular momentum is conserved. **[IMP 2020]**

20. The moment of linear momentum is called …… **[MODEL 2021]**

21. State the law of conservation of angular momentum. **[MODEL 2021]**

22. Find the torque of a force $7\hat{\imath} + 3\hat{\jmath} - 5\hat{k}$ about the origin. The force acts on a particle whose position vector is $\hat{\imath} - \hat{\jmath} + \hat{k}$ **[MODEL 2021]**

23.

a) What is the rotational analogue of force in linear motion?

b) It is difficult to close or open a door by applying force at the hinges. Why? **[MODEL 2021]**

24. What is the analogue of mass in rotational motion? **[MARCH 2021]**

25. What are the factors on which the moment of inertia of a rigid body depends? **[MARCH 2021]**

26. Angular momentum of a rotating body is $\vec{l} = \vec{r} \times \vec{p}$. Using this relation arrive at the di equation, $\frac{\overrightarrow{dL}}{dt} = \tau$ **[MODEL 2022]**

27.

a) What are the analogues of mass and force in rotational motion?

b) Derive an expression for kinetic energy of a rotating body. **[MODEL 2022]**

28. The angular speed of a rotating body changes from ω_1 to ω_2 without applying an external torque but due to change in moment of inertia. Find the ratio of radii of gyration in the two cases. **[MARCH 2022]**

29.

a) 'τ' is the torque and 'L' is the angular momentum of rotating rigid body, show that $\tau = \frac{dL}{dt}$

b) Calculate the duration of a day when Earth shrinks to $\frac{1^{th}}{8}$ of its initial volume.

[MARCH 2022]

30. The point at which the whole mass of the body is supposed to be concentrated is called. **[MARCH 2023]**

31. What are the factors affecting moment of inertia of an object? **[MARCH 2023]**

32.

a) State law of conservation of angular momentum

b) Based on the law, how does the speed of a ballet dancer vary. When

i. Outstretching her arms and legs

ii. Folding her arms and legs

c) Derive the relation connecting torque and angular momentum. **[MARCH 2023]**

33.

a) Define moment of inertia of a body

b) Which physical quantity is represented by the product of moment of inertia and angular velocity? **[MODEL 2024]**

34.

a) The rotational analogue of mass in linear motion is ……

b) Angular momentum of a rotating body is $\vec{L} = \vec{r} \times \vec{p}$. Using this relation arrive at the equation $\frac{d\vec{L}}{dt} = \tau$ **[MODEL 2024]**

35.

a) State and explain

(i) Torque

(ii) Angular momentum

b) Write the relation between torque and angular momentum **[MARCH 2024]**

36. How will you distinguish hardboiled egg and a row egg spinning each on a table top?

37.

a) Define moment of inertia.

b) What are the factors on which moment of inertia of a body depends?

[MODEL 2025]

38.

a) State the law of conservation of angular momentum.

b) Angular momentum of a rotating body is $\vec{L} = \vec{r} \times \vec{p}$. Using this relation arrive at the equation $\frac{d\vec{L}}{dt} = \vec{\tau}$ (τ = Torque). **[MODEL 2025]**

39.

a) In rotation of a rigid body about a fixed axis, every particle of the body has same……

(Linear velocity / Angular velocity)

b) The quantity angular velocity is ……

(Scalar/ Vector) **[MARCH 2025]**

NEW TOPS
A NEW TURN IN EDIFICATION

40.

a) Write the expression for the kinetic energy of a rotating body.

b) A solid cylinder of mass 20 kg rotates about its axis with angular speed 100 rad s^{-1}. The radius of the cylinder is 0.25 m. What is the kinetic energy associated with the rotation of the cylinder? **[MARCH 2025]**

CHAPTER – 7, GRAVITATION

1. Acceleration due to gravity on earth changes with depth and height.

a) What is the weight of a body placed at the centre of earth? Why?

b) Find the height at which the acceleration due to gravity is $1/4^{th}$ that at the surface of earth.

[MODEL 2018]

2. A satellite moves in a circular orbit of radius 'r' with an orbital velocity.

a) Derive an equation for the orbital velocity of a satellite.

b) The time taken by Saturn to complete one orbit around the Sun is 29.5 times the earth year. If the distance of earth from the Sun is 1.5×10^{8}km, then what will be the distance of the Saturn from the Sun?

[MODEL 2018]

3. If the zero of potential energy is at infinity, the total energy of an orbiting satellite is negative of its ……. Energy.

[MARCH 2018]

4. Derive an expression for the escape's velocity of an object from the surface of Earth.

[MARCH 2018]

5. Acceleration due to gravity decreases with depth.

a) Prove the above statement by deriving the proper equation.

b) Using the equation, show that acceleration due to gravity is maximum at the surface and zero at the center of the earth.

6. Choose the correct Answer.

a) Acceleration due to gravity increases / decreases with increasing altitude.

b) Acceleration due to gravity

c) increases / decreases with increasing depth.

d) Acceleration due to gravity does not depend on mass of the earth / mass of the body.

e) If the zero of potential energy is at infinity, the total energy of an orbiting satellite is negative of its kinetic/ potential energy.

[MODEL 2019]

7. A satellite orbits the sun as shown. Does the following are constant in the motion?

a) Linear speed and angular momentum

b) Kinetic energy and total energy

c) State Kepler's law of areas and law of periods

d) **[MODEL 2019]**

8. Derive an expression for escape speed from a planet **[MARCH 2019]**

9. Earth satellites are objects which revolve around the earth.

a) Time period of a geostationary satellite is ……..

b) Derive an expression for the time period of a satellite.

c) By using the expression, you derived above, show that motion of satellite obeys Kepler's law of period **[MARCH 2019]**

10.

a) Obtain an expression for orbital velocity of a satellite at a height h from the surface of earth'

b) The orbital velocity of a satellite of mass m is V_0. What will be the orbital velocity of another satellite of mass 2 m in the same orbit?

[MODEL 2020]

11. The value of acceleration due to gravity (g) is same for all objects at a given place.

a) Does a body have the same weight at the equator and at the poles? Explain.

b) At what height above Earth's surface the value of 'g' is same as in a mine 80 km deep?

c) Draw a graph showing the variation of magnitude of the value of acceleration due to gravity(g) with distance from the centre of the earth

[MODEL 2020]

12. The escape speed of an object from the earth is 11.2 km/s.

a) Define escape speed of an object.

b) How escape speed is related to the mass of the object?

[MARCH 2020]

13.

a) Choose the correct alternative:

i. Acceleration due to gravity increases/decreases with increasing altitude.

ii. Acceleration due to gravity increases/decreases with increasing depth.

iii. The total energy of an orbiting satellite is negative of its kinetic/potential energy.

iv. The polar satellite go around the earth in a north-south direction/east-west direction.

b) State Kepler's law of time periods **[MARCH 2020]**

14. State Newton's law of gravitation. **[MODEL 2021]**

15.

a) Define orbital velocity of satellite.

b) Derive an expression for orbital velocity. **[MODEL 2021]**

16.

a) Write the equation connecting acceleration due to gravity (g) and universal gravitational constant (G).

b) Derive an equation for acceleration due to gravity at a depth 'd' from the surface of earth.

[MODEL 2021]

17.

a) Derive an equation for acceleration due to gravity at a height 'h' above the surface of earth.

b) Calculate the value of acceleration due to gravity at a height equal to half of the radius of earth from the surface of earth.

[MODEL 2021]

18. State Newton's Universal Law of Gravitation.

[MARCH 2021]

19. Derive an expression for acceleration due to gravity at any point above the surface of earth.

[MARCH 2021]

20. Derive an expression for escape velocity of an object from the surface of earth.

[MARCH 2021]

21.

a) Write the unit and dimensional formula of gravitational constant.

b) Derive an expression for acceleration due to gravity at a depth below the surface of earth.

[MARCH 2021]

NEW10'S
A NEW TURN IN EDIFICATION

22.

a) The value of acceleration due to gravity is maximum at the
   i. Poles
   ii. Centre of the earth
   iii. Equator

b) Find the height at which g is reduced to $\frac{g}{2}$
(Radius of earth - R_E) **[MODEL 2022]**

23.

a) Define orbital velocity of a satellite.
b) Obtain an equation for orbital velocity.
c) Write the relationship connecting orbital velocity and escape speed. **[MODEL 2022]**

24. Write the value of escape velocity of an object from the surface of moon. **[MARCH 2022]**

25. The value of acceleration due to gravity decreases with depth.

a) Derive an expression for acceleration due to gravity (g) at a depth 'd' below the surface of Earth.
b) What is the weight of a body at the centre of Earth? **[MARCH 2022]**

26. Assuming satellite orbits around a planet to be circular,
Obtain expressions for orbital velocity and time period of a satellite around earth.
[MARCH 2022]

27. Escape velocity from the earth for a body of mass m is 11km/s.

a) Derive an expression for escape velocity from the surface of earth.
b) The moon has no atmosphere why? **[MARCH 2023]**

28. The value of acceleration due to gravity 'g' will be maximum at poles.

a) State whether the velocity of escape speed for two bodies of masses 2 Kg and 200 Kg are same or different. Give
b) State Kepler's first law of planetary motion. **[MARCH 2023]**

29.

a) State Newton's law of gravitation
b) Derive an expression for acceleration due to gravity with height (h) above the surface of earth.
c) Why does earth impart same acceleration on all body? **[MARCH 2023]**

30. The dimensional formula for gravitational constant

a) MLT^{-2}
b) ML^2T^{-2}
c) $M^{-1}L^3T^{-2}$
d) $M^{-1}L^2T^{-2}$ **[MARCH 2024]**

31. State Kepler's laws of planetary motion. **[MARCH 2024]**

32.

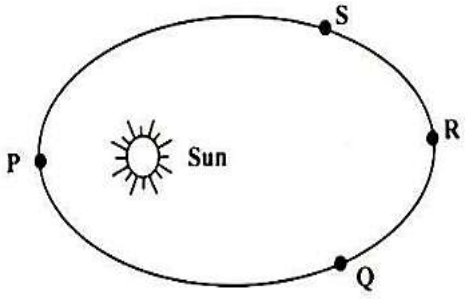
a) What do you mean by escape speed?
b) Derive the expression for escape speed of a body from the earth? **[MARCH 2024]**

33. Orbital velocity of a satellite of mass m is V_0. What will be the orbital velocity of another satellite of mass 2m in the same orbit? **[MODEL 2025]**

34.

a) State Kepler's second law (law of area) of planetary motion.
b) The figure shows different positions P, Q, R and S of a planet around the sun.
The planet has different velocities at these positions. Identify the position at which the kinetic energy of the planet is maximum.

NEW 10'S
A NEW TURN IN EDIFICATION



a) P ii) Q iii) R iv) S

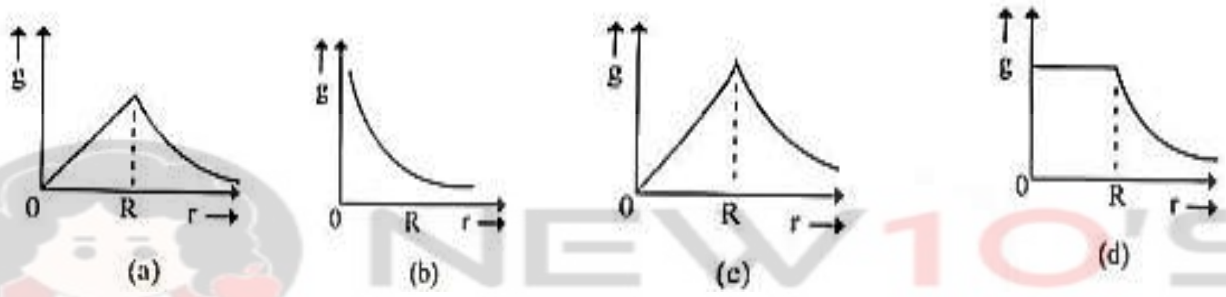
[MODEL 2025]

35. The value of g is same for all objects at a given place.

a) The acceleration due to gravity is maximum at ……...
(Poles, equator)

b) Derive an expression for the variation of 'g' with height 'h' above the surface of the earth, where h<<R

c) The variation of acceleration due to gravity (g) with distance (r) from the centre of the earth is correctly represented by (Given R = radius of earth)



[MODEL 2025]

36. Acceleration due to gravity is independent of ……
(Mass of earth /mass of body) **[MARCH 2025]**

37.

a) Define escape speed.

b) Moon has no atmosphere. Give reasons. **[MARCH 2025]**

38. Potential energy is an energy relative to conservative force.

a) Define gravitational Potential energy.

b) Derive the equation for gravitational Potential energy of a particle on earth surface.

c) Is Gravitational Potential energy positive or negative? Comment on it.

[MARCH 2025]

CHAPTER – 8, MECHANICAL PROPERTIES OF SOLIDS

1.

a) The ratio of shear stress to shear strain is .....
(i) Poisson's ratio
(ii) Young's modulus
(iii) Bulk modulus
(iv) Rigidity modulus

b) State Hooke's law **[IMP – 2016]**

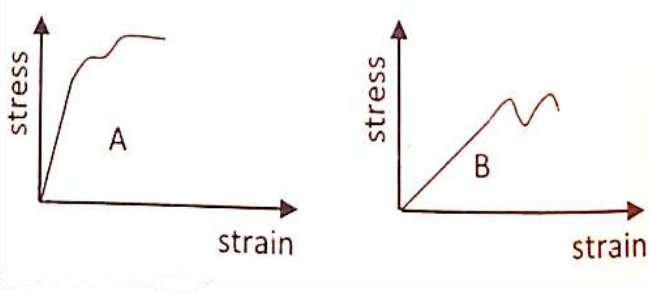
2. A steel rod has radius of 10mm and a length of 1m. A 100 kN force stretches it along its length. Calculate the elongation of the steel rod.
[Young's modulus of steel is $2.0\times 10^{11}\mathrm{N/m^2}$.

[MARCH 2017]

3. A metal cube of side 10cm is subjected to a shear stress $10^4\mathrm{N/m^2}$. Calculate the rigidity modulus, if the top of the cube is displaced by 0.05cm with respect to its bottom.

[MARCH 2017]

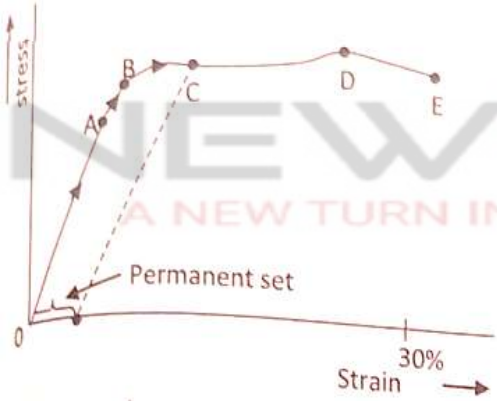
4. The stress strain curve of two bodies A and B are given in the figure



Which of the materials has greater Young's modulus? Which of the two materials is preferable to be used as a rope in a crane? Substantiate your answer.

[IMP- 2017]

5. A typical stress-strain graph of a metallic wire is shown below.



(a) Write the name of the point B labelled in the graph.
(b) For materials like copper, the points D and E are ..... (Close/far) apart.

[MARCH 2018]

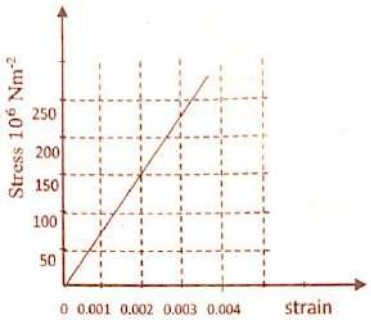
6. The stress required to double the length of a wire of Young's modulus Y is .....

(i) $\frac{Y}{2}$ (ii) 2Y
(iii) Y (iv) 4Y **[IMP – 2018]**

7. A steel wire of length 1.5m and diameter 0.25 cm is loaded with a force of 98N. The increase in length of the wire is 1.5×10^{-4}m. Calculate the tensile stress and the fractional change in length of the wire. **[IMP- 2018]**

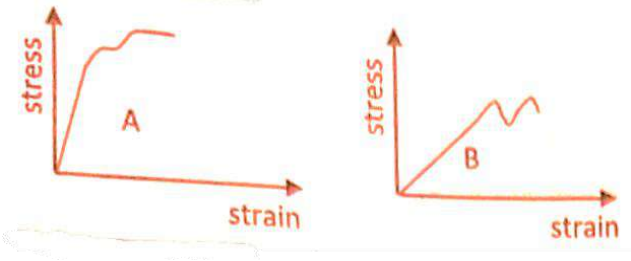
8.

a) Figure shows the strain-stress curve for a material. What is the Young's modulus of the material?



b) Young's modulus of aluminium is $70\times 10^9 N/m^2$ and that of copper is $120\times 10^9 N/m^2$. Same strain is to be produced on an aluminium wire and a copper wire of equal cross section. Which wire requires more force? **[MARCH 2019]**

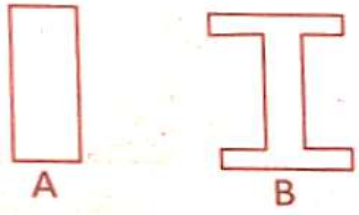
9. The stress-strain graph of two materials A and B are shown below.



a) State the law which relates stress with strain.
b) Which of the two materials has the greater Young's modulus?
c) Which of the two materials is more ductile? **[IMP – 2019]**

10. The Young's modulus of rubber is
a) Greater than that of steel
b) Less than that of steel
c) Equal to that of steel **[MARCH 2020]**

11. Beam of different cross-sectional shapes are shown in figure.



Why the beam B is using in the construction of bridges? **[MARCH 2020]**

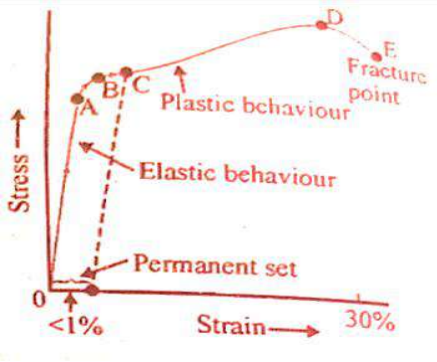
12. For small deformations the stress and strain are proportional to each other. This is the statement of .....
(Pascal's Law, Newton's Law, Hooke's Law, Stoke's Law) **[IMP – 2020]**

13. A steel wire has a radius of 10mm and a length of 1m. A 100kN force stretches it along its length. Calculate the stress and elongation on the wire. Young's modulus of steel is $2\times 10^{11} N/m^2$. **[IMP – 2020]**

14. State Hooke's Law. **[MARCH 2021]**

15. A typical stress- strain curve for a metal is given below. What is denoted by the points A and B?

NEW10'S
A NEW TURN IN EDIFICATION



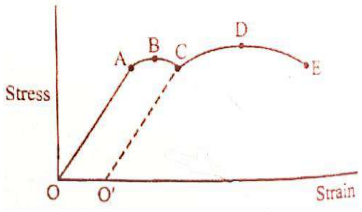
[MARCH 2021]

16. Define the terms:
(i) tensile stress
(ii) longitudinal strain **[IMP – 2021]**

17. Draw a typical stress-strain curve for a metal and mark the proportional limit. **[IMP – 2021]**

18. Stress-strain curve of steel wire is shown below. From the plot, identify the following.

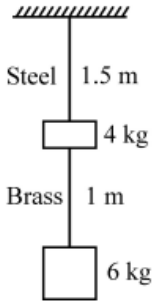
(a) A (b) B (c) E (d) OO′



[MARCH 2022]

19. State the Hooke's Law. **[IMP – 2022]**

20. Two wires of diameter 0.25 cm, one made of steel and the other made of brass are loaded as shown in figure. The unloaded length of steel wire is 1.5m and that of brass wire is 1m. Compute the elongations of steel and brass wire.
$y_s = 200 \times 10^9 N/m^2$
$y_b = 91 \times 10^9 N/m^2$



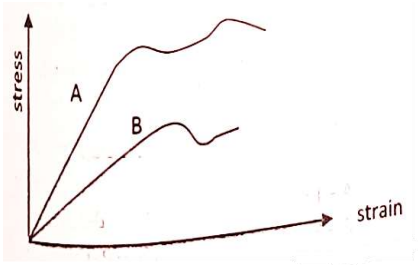
[IMP – 2022]

21. True or False;
Elastomers do not obey Hooke's law **[MARCH 2023]**

22.
a) Which type of elasticity is involved in stretching a wire?
b) Steel is more elastic than rubber. Why?
c) If the bulk modulus of water is $2 \times 10^9 Nm^{-2}$, find its compressibility. **[MARCH 2023]**

23. Reciprocal of Bulk modulus is ..... **[IMP – 2023]**

24. Stress-Strain graph for two materials is shown below:



a) State the law which relates stress with strain.
b) Which of the material has greater Young's Modulus, A or B? **[IMP – 2023]**

25. Explain Young's modulus, write its unit **[MARCH – 2024]**

26. Substance which can be stretched to cause large strains are called …… **[MODEL 2025]**

27.
a) State Hooke's law in elasticity.
b) Say true or false
   i. The Young's modulus of rubber is greater than that of steel.
   ii. The stretching of a coil is determined by its shear modulus. **[MODEL 2025]**

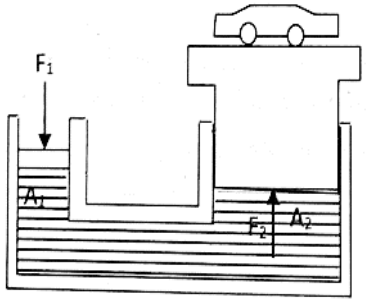
28.
a) Draw typical stress-strain graph.
b) Mark the following points on graph
   i. Proportional limit
   ii. Fracture point **[MARCH – 2025]**

29. State true or false:
'The stretching of a coil determined by its shear modulus.' **[MARCH – 2025]**

CHAPTER – 9, MECHANICAL PROPERTIES OF FLUIDS

1. The terminal velocity of a copper ball of radius 2.0mm falling through a tank of oil at 200c is 6.5cm/s. Calculate the viscosity of the oil at 200c. (Hints: Density of oil is $1.5 \times 10^3 kgm^{-3}$, density of copper is $8.9 \times 10^3 kgm^{-3}$) **[MARCH 2018]**

2. A device used to lift automobiles is shown in the figure.



a) Write the name of the device
b) In the situation shown in the figure, mass of the car is 3000kg and area of the piston carrying it is 425 cm^2. What pressure is to be applied to the smaller piston? **[MARCH 2018]**

3.
a) Water rises up in a narrow tube in spite of gravity. This phenomenon is called ……

b) Derive an expression for the height of water in the tube in terms of radius of the tube and surface tension of the liquid.

c) Water with detergent dissolved in it should have ……. angle of contact. (Small/ large). **[MARCH 2018]**

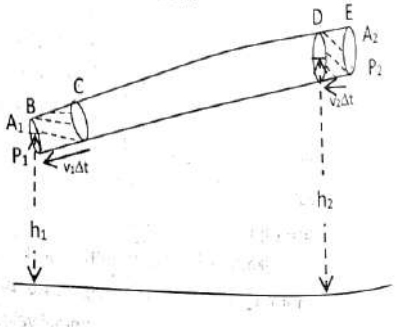
4. For a liquid gas interface, the convex side has a high pressure than the concave side.

a) Derive an expression for excess pressure inside a drop.

b) Which is better, washing of cloth in cool soap water or warm soap water? Why?

[IMP – 2018]

5. The flow of an ideal fluid in a pipe of varying cross section is shown below.



a) Write Bernoulli's equation.

b) Find the speed of efflux using Bernoulli's Principle.

c) State Torri celli's law

[IMP – 2018]

6.

a) Define angle of contact

b) Water proofing agents are added to create a ……. (large/ small) angle of contact between the water and fibres.

c) Calculate the excess of pressure inside an air bubble of radius 1mm formed just below the free surface of water. Given surface tension of water is 72×10^{-3}N/m.

[MARCH 2019]

7.

a) Derive Bernoulli's equation for the stream line flow of an incompressible liquid.

b) Figures (a) and (b) refer to the steady flow of a (non viscous) liquid. Which one of the following two figures is INCORRECT?

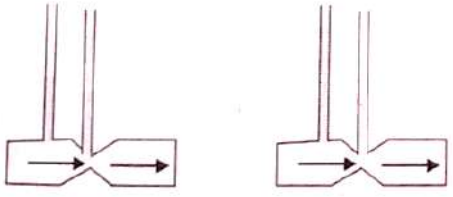


Figure (a) Figure (b)

[MARCH 2019]

8. When a metallic sphere falls through castor oils, its velocity becomes uniform. called terminal velocity.

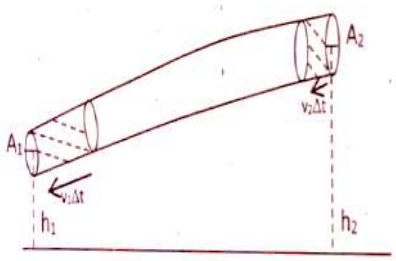
a) Write the expression for terminal velocity.

b) The terminal velocity of a copper ball of radius 2mm falling through a tank of oil at 20^0c is 6.5cm/s. Compute the velocity of the oil at 20^0c. Density of oil is 1.5×10^3kg/m^3. Density of copper is 8.9×10^3kg/m^3.

c) Rain drops falling under gravity do not acquire very high velocity. Why?

[IMP – 2019]

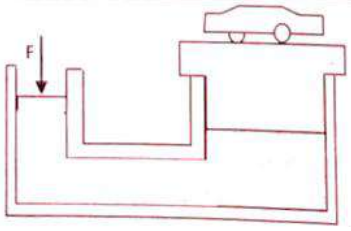
9. A fluid moving in a pipe of varying cross-sectional area is shown below.



a) What is the difference between streamline flow and turbulent flow?
b) State and prove Bernoulli's principle.

[IMP – 2019]

10. The given figure shows the principle behind the hydraulic lift.

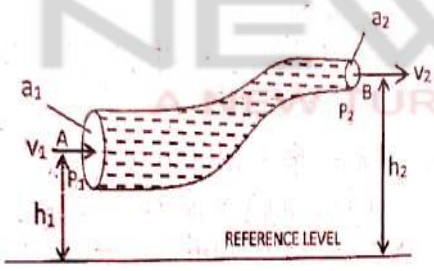


The radius of small piston is 5.0 cm and that of larger piston is 15 cm. Calculate the force F, if the mass of the car to be lifted is 1350 kg ($g = 9.8 m/s^2$). **[MARCH 2020]**

11. What do you mean by capillary rise? What is the phenomenon responsible for it?

[MARCH 2020]

12. Consider a fluid moving in a pipe of varying cross-sectional area as shown in figure a_1, a_2 are cross sectional areas of pipe and v_1, v_2 are the velocities of fluid.



a) State Bernoulli's principle.
b) Derive Bernoulli's equation.
c) Write the equation of Stoke's law. **[MARCH 2020]**

13. A car having mass 1350kg is placed in a hydraulic lift. If the radius of the small piston is 5cm and the radius of the large piston is 15 cm, calculate the amount of force to be exerted on the small piston to lift the car ($g = 9.8 m/s^2$) **[IMP – 2020]**

14. Define terminal velocity. Write the equation for terminal velocity. **[IMP-2020]**

15.

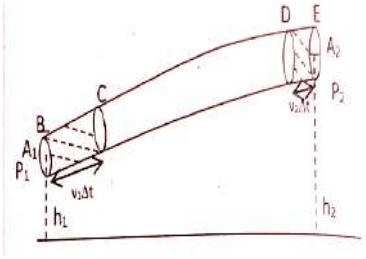
a) Derive an expression for capillary rise of a liquid in a capillary tube.
b) Explain the action of detergents.

[IMP – 2020]

16. State Pascal's law. Explain the working of a hydraulic lift by drawing figure.

[MARCH 2021]

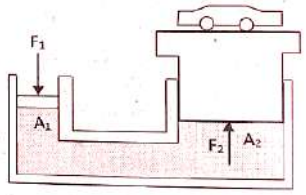
17. With the help of given figure state and prove Bernoulli's theorem.



[MARCH 2021]

18. Prove Bernoulli's principle. **[IMP -2021]**

19. The schematic diagram of machine is shown below.



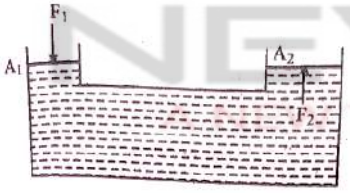
a) Write the name of the machine.

b) In the figure, mass of the car 3000 kg. The area of cross – section of the piston carrying the car is 425cm^2. What is the pressure on the smaller piston? (g = 9.8m/s^2) **[IMP – 2021]**

20. Pick the correct one:
When the temperature of a liquid increases, its surface tension ……

[MARCH 2022]

21.



a) State Pascal's law.

b) The schematic diagram of a hydraulic lift is shown in figure. Using Pascal's law, find the value of F_2 in terms of A_1 and A_2. (A_1 and A_2 are the areas of pistons).

[MARCH 2022]

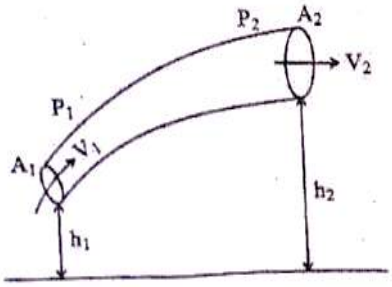
22. A solid sphere radius 'r' and density 'ρ' is falling through a viscous medium of density σ and coefficient of viscosity 'η'.

a) What are the different forces acting on the body?

b) Derive an expression for terminal velocity.

[MARCH 2022]

23. The flow of an ideal fluid in a pipe of varying cross section is shown below.



a) State and prove Bernoulli's principle.
b) Write any two characteristics of a fluid that obey Bernoulli's principle. **[MARCH 2022]**

24. Principle of hydraulic lift is ..... **[IMP – 2022]**

25. Define angle of contact **[IMP – 2022]**

26. Derive the expression for capillary height. **[IMP – 2022]**

27. State and prove Bernoulli's principle. **[IMP – 2022]**

28.

a) A drop of liquid under no external force is always spherical in shape. Why?
b) When a painting brush dipped in water, its hairs cling together. Why? **[MARCH 2023]**

29.

a) "When water flowing in a broader pipe enters into a narrow pipe, its pressure decreases". Do you agree with this statement? Explain.
b) Define coefficient of viscosity. **[MARCH 2023]**

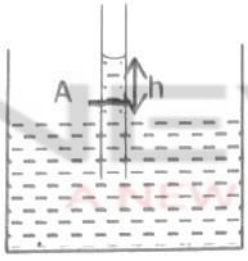
30. Due to capillary action, water will rise inside a glass tube.
a) The angle of contact in this case is (i) Acute (ii)Obtuse (iii) 90^0 (iv)Zero
b) Obtain an expression for the rise of liquid in the tube
c) Water rises to different heights in glass tubes of different radii. Give reason.

[MARCH 2023]

31. Excess pressure inside a liquid drop is ..... **[IMP – 2023]**

32. State Bernoulli's principle. **[IMP – 2023]**

33. When a narrow tube is dipped in water, water rises in the tube up to a height 'h'.



a) Name the phenomenon
b) Arrive at an expression for height of water rise (h) in the tube
c) Will water overflow, if the tube is cut at level A? Justify you answer **[IMP – 2023]**

34. The excess pressure inside a soap bubble is

(a) 0 (b) $\frac{S}{R}$ (c) $\frac{2S}{R}$ (d) $\frac{4S}{R}$ **[MARCH 2024]**

35. Explain the working of a hydraulic lift **[MARCH 2024]**

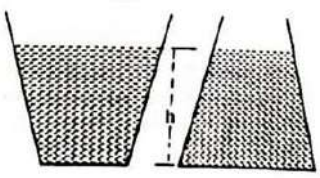
36.

a) What is stream line flow?
b) State Bernoulli's principle
c) What is viscous force and explain coefficient of viscosity. **[MARCH 2024]**

37. Equation of continuity deals with the law of conservation of ……. **[MODEL 2025]**

38.

a) It is easy and less painful to use thin needle than a thick needle for taking an injection. For the same applied force, which needle exerts more pressure? Why?
b) Two vessels of different shape are filled with water to the same height 'h' as shown in figure, is the pressure on the base of each vessel the same? Explain.



[MODEL 2025]

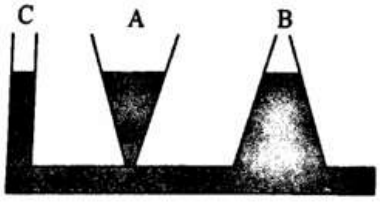
39.

a) Define angle of contact.

b) Due to capillary action, a liquid will rise in a tube.
The angle of contact in this case is
   a) Acute
   b) Obtuse
   c) 90^0
   d) Zero

c) Obtain an expression for rise of liquid in the tube. **[MODEL 2025]**

40. Three vessels A, B and C contain different amounts of liquids are shown. All up to the same height.



This phenomenon is an illustration of ……. **[MARCH 2025]**

41.

a) The pressure at depth below the surface of a liquid open to the atmosphere is greater than atmospheric pressure. Excess pressure at depth is called ……

b) Calculate the pressure on a swimmer 10m below the surface of a lake. **[MARCH 2025]**

42. Hydraulic lift and hydraulic brakes are application of a famous law.

a) Name and state the law.

b) Draw the Schematic diagram illustrating the principle behind the hydraulic lift and obtain the relation for mechanical advantage.

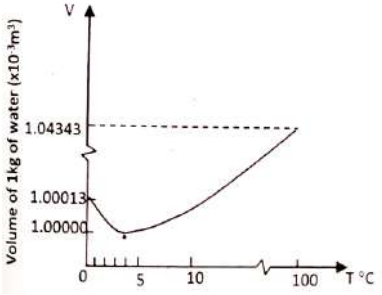
CHAPTER – 10, THERMAL PROPERTIES OF MATTER

1.

a) Triple point of water is 0.01^0 C. Express this temperature in Kelvin scale.

b) How does sea breeze occur? Explain. **[IMP – 2016]**

2. Graph below exhibits the anomalous expansion of water.



Based on the graph, explain how lakes freeze from the top to bottom rather than from bottom to top. **[MARCH 2017]**

3. The change in temperature of a substance, when a given quantity of heat is absorbed or rejected by it, is characterized by the heat capacity.

a) Define specific heat capacity, molar specific heat capacity at constant pressure and molar specific heat capacity at constant volume. Give the reason for using water as a coolant in automobile radiators.

b) At what temperature, water has minimum volume?

(i) 100^0C (ii) 0^0C

(iii) 4^0 C (iv) 10^0C **[IMP – 2017]**

4. When 0.15Kg of ice at 0^0C is mixed 0.30Kg of water at 50^0C in a container, the resulting temperature is 6.7^0C. Calculate the latent heat of fusion of ice. Given specific heat capacity of water $4186 jkg^{-1}K^{-1}$. **[MARCH 2018]**

5. Linear expansion is change in length of an object with temperature.

a) Write the equation for coefficient of linear expansion

b) Show that the coefficient of volume expansion is thrice its coefficient of linear expansion.

c) The absolute zero is .....

(i) -273.15^0C (ii) -273.15K

(iii) -273.15^0F (iv) 0^0C **[IMP-2018]**

6. Draw a graph showing the variation of volume of a given mass of water with temperature from 0^0C. In the graph mark the temperature at which water has maximum density. **[MARCH 2019]**

7. What is sublimation? Write an example for a sublime material. **[MARCH 2019]**

8. Which among the following possesses the highest specific heat capacity?

(i) Metals (ii) Ice (iii)Water (iv) Glass **[IMP – 2019]**

9. A body cools from 80^0C to 50^0C in 5 minutes. Calculate the time it taken to cool from 60^0C to 30^0C. The temperature of the surrounding is 20^0C. **[IMP – 2019]**

10. Temperature is the degree of hotness of a body.

a) Temperature of a normal human body is 98.6^0F. What is the corresponding temperature in the Celsius scale?

b) Define latent heat?

c) Why a brass tumbler feels much colder than a wooden tray on a chilly day? **[MARCH 2020]**

11. Heat energy is transferred from one body to another due to temperature difference.

a) What are the different modes of heat transfer?

b) Explain how sea breeze occurs

c) The bottoms of the cooking vessels are blackened. Give reasons. **[IMP – 2020]**

12.

a) What is the difference between latent heat of fusion and latent heat of vaporization?

b) Why burns from steam are usually more serious than those from boiling water? **[MARCH 2021]**

13. A transition of matter from any one state to another is called a change of state.

a) The temperature at which the solid and the liquid states of a substance are in thermal equilibrium is called its .....

b) "Value of latent heat of a substance depends on its pressure". State whether this statement is true or false.

c) 0.3Kg of ice melts completely by absorbing 10^5J of heat. Calculate heat of fusion of ice. **[IMP – 2021]**

14.

a) Among the various modes of heat transfer, which one is the fastest?

b) A pan filled with hot food cools from 94^0C to 86^0C in 2 minutes, when the room temperature is at 20^0C. How long will it take to cool from 71^0C to 69^0C?

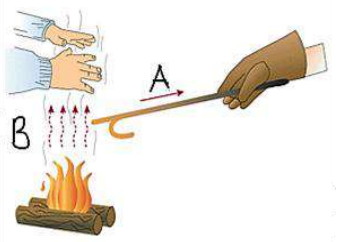
[MARCH 2022]

15. What is sublimation? **[IMP – 2022]**

16. Why do metal utensils have wooden handles? **[IMP – 2022]**

17. The change of state from liquid to solid is called ..... **[MARCH 2023]**

18. The modes of heat transfer is shown below. Identify A and B.



[MARCH 2023]

19. At what temperature does water have maximum density and minimum volume?

(a) 100^0C (b) 4^0C (c) 10^0C (d)0^0C **[IMP – 2023]**

20. Heat is transferred from one place to other due to temperature differences:

a) What is Convection?

b) How does sea breeze occur. Explain **[IMP – 2023]**

21. Explain anomalous behaviour of water related to thermal expansion **[MARCH 2024]**

22. State Newton's law of cooling. **[MARCH 2024]**

23. In which mode of heat transfer no medium is required?

a) Conduction

b) Radiation

c) Convection **[MODEL 2025]**

24.

a) Explain anomalous expansion of water.

b) Latent heat of vaporization of water is 22.6×10^5 J/kg. calculate the energy needed to change 0.5g of water into steam at 100^0C. **[MODEL 2025]**

25. Name the substance which has the highest specific heat capacity. **[MARCH 2025]**

26.

a) State Newton's law of cooling.

b) Draw the graph showing the cooling of hot water with time.

c) Specify one drawback of Newton's law of cooling.

[MARCH 2025]

CHAPTER – 11, THERMODYNAMICS

1. In an adiabatic process, the system is insulated from the surroundings and heat absorbed or released is zero.

(a) Derive an expression for the work done in an adiabatic change of an ideal gas from the state
(P_1, V_1, T_1) to the state (P_2, V_2, T_2)

(b) Two samples A and B of oxygen at the same initial temperature and pressure are compressed from volume V to $\frac{V}{2}$, A is compressed isothermally and B adiabatically. Find out the ratio of the final pressure of A and B, (y = 1.4). **[IMP – 2017]**

NEW10'S
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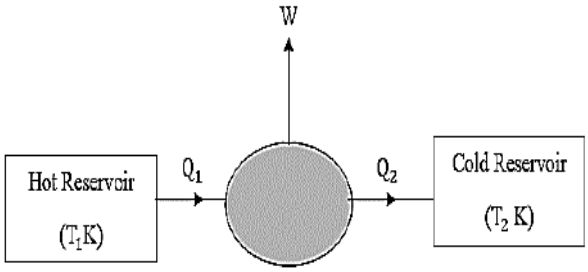
2. The branch of physics that was developed to understand and improve the working of heat engine is .....

(a) Optics (b) Thermodynamics

(c) Electronics (d) Electrodynamics **[MARCH 2018]**

3. Schematic diagram of a device is shown below.

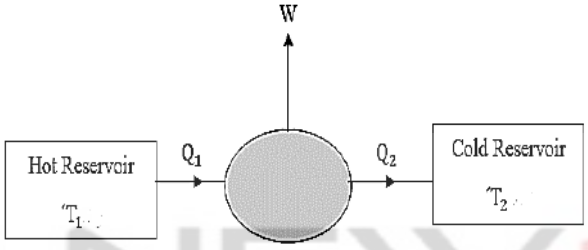


(a) Write the equation for the efficiency of the device.

(b) Write the name of the four process in the working cycle of the device.

(c) If $T_1 = 100^0$C; $T_2 = 0^0$C and Q_1=4200J, find the value of Q_2. **[MARCH 2018]**

4. The basic features of a device are schematically represented in the figure below.



(a) Which type of device is this, a heat engine or a refrigerator?

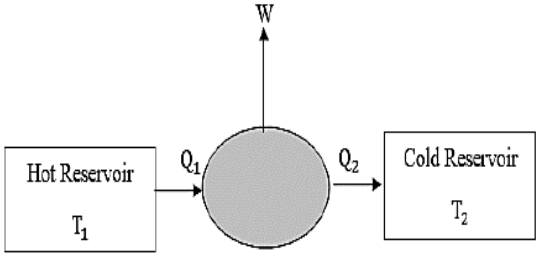
(b) Draw the indicator diagram and label the four processes in the Carnot cycle.

(c) A steam engine delivers 5.4×10^8J of work per minute and services 3.6×10^9J of heat per minute from its boiler. What is the efficiency of the engine? How much heat is wasted per minute?

[IMP – 2018]

5. State first law of the thermodynamics? **[MARCH 2019]**

6. Schematic diagram of a heat engine is shown below.



(a) Modify the given diagram for a refrigerator.

(b) Write the equation for the coefficient of performance of a refrigerator.

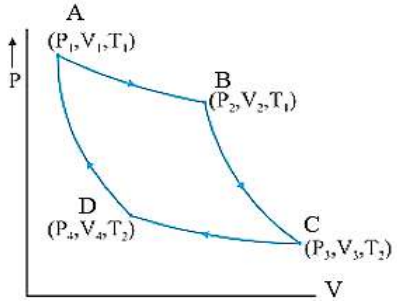
(c) In the given diagram, $T_1 = 900$K, $T_2 = 300$K, Q_1= 6400J/cycle. Calculate the value of Q_2.

[MARCH 2019]

7. Derive the relation $C_P - C_v = R$ where C_P and C_v are molar specific heat capacities of an ideal gas at constant pressure and volume respectively and R is the universal gas constant.

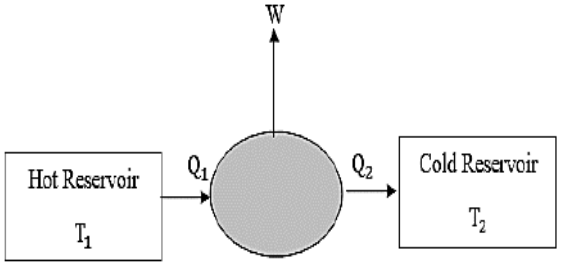
[IMP – 2019]

8. Carnot cycle for a heat engine with an ideal gas as the working substance is shown below.



(a) Name the four processes taking place in Carnot cycle.
(b) Can a Carnot engine work if its sink and source are interchanged? Explain **[IMP – 2019]**

9. Observe the given figure.



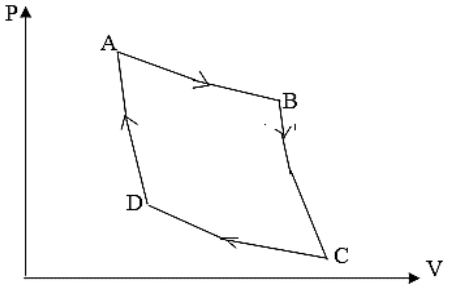
(a) Is this a heat engine or refrigerator?
(b) Write the four steps of operation in the Carnot cycle.

[MARCH 2020]

10. A refrigerator is to maintain eatables kept inside a 9^0C. If room temperature is 36^0C, Calculate the coefficient of performance.

[MARCH 2020]

11. The P-V diagram of a Carnot engine is given below.



(a) Which are the four thermodynamic processes represent in the above P-V diagram?
(b) Write an equation to calculate the efficiency of a Carnot engine.

[IMP – 2020]

12. (a) Derive an expression for work done in an isothermal process.
(b) What is the work done in an isochoric process

[IMP – 2020]

13. State first law of thermodynamics. **[MARCH 2021]**

14. What is the difference between isobaric process and isochoric process? **[MARCH 2021]**

15. Draw the schematic diagram of a heat engine. **[IMP – 2021]**

16. Derive an equation for the work done in an isothermal process. **[IMP – 2021]**

17. Draw the block diagram of a refrigerator and write an expression for its coefficient of performance. **[MARCH 2022]**

18. (a) Write an equation of an isothermal process.
(b) Obtain an expression for work done in an isothermal process.
(c) A Carnot engine operates between the temperatures 398K and 293K. Find its efficiency.
[MARCH 2022]

19. Carnot engine is an ideal heat engine. Explain Carnot cycle. **[IMP – 2022]**

20. (a) State First law of thermodynamics
(b) one mole of an ideal gas expands from volume V_1 to volume V_2 at a constant temperature T. Derive an expression for the work done.
[MARCH 2023]

21. Thermodynamic variable whose value is equal for two systems in thermal equilibrium is called ..... **[IMP – 2023]**

22. Thermodynamic state variables are of two kinds, extensive and intensive.
(a) Which of the following is extensive?
(i) Pressure (ii) Temperature
(iii) Density (iv) Mass
(b) Explain Carnot cycle
(c) What is the difference between isothermal and adiabatic process? **[IMP – 2023]**

23. "The heat given to a system is used to increase the internal energy and doing external work". This is
(a) Zeroth law in thermodynamics
(b) First law in thermodynamics
(c) Second law in thermodynamics
(d) Newton's third law in motion. **[MARCH 2024]**

24.
a) What are isothermal and adiabatic process?
b) Derive the expression for work done in an isothermal process. **[MARCH 2024]**

25.
a) State first law of thermodynamics.
b) The increase in internal energy of a system is equal to the work done on the system. Which process does the system undergo?
i. Isothermal
ii. Isobaric
iii. Adiabatic
iv. Isochoric **[MODEL 2025]**

26. Obtain an expression for work done in an isothermal process. **[MODEL 2025]**

27. Match the columns A&B.

	A	B
1	Isothermal process	Volume constant
2	Adiabatic process	Temperature constant
3	Isochoric process	No heat transfer
4	Isobaric process	Pressure constant

[MARCH 2025]

28. Sadi Carnot, the scientist arrived at a cycle of processes to be adopted to achieve the maximum efficiency of a heat engine.
a) Name the processes in Carnot cycle.
b) Draw P-V diagram of Carnot cycle for a heat engine with an ideal gas as the working substance.
[MARCH 2025]

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CHAPTER – 12, KINETIC THEORY OF GASES

1. According to kinetic theory of gases, gas molecules are always in random motion.
(a) State the law of equipartition of energy.
(b) What do you mean by free path? Give an equation for the mean free path?
[MARCH 2014]

2. (a) Write ideal gas equation.
(b) Write any four postulates of the kinetic theory of gases. **[IMP-2014]**

3. "No real gas is truly ideal".
(a) When does a real gas approach ideal gas behaviour?
(b) Define the law of equipartition of energy? **[MARCH 2015]**

4. Mention two condition under which the real gases obey the ideal gas equation. **[IMP – 2015]**

5. What do you understand by the term, mean free path of molecules? Name the factors on which it depends?
[**IMP-2016]**

6. Estimate the average thermal energy of helium atom at a temperature of 27^0C.
Boltzmann constant is 1.38×10^{-23}J/K **[MARCH 2017]**

7. A mixture of gas consists of 2 moles of oxygen and 4 moles of argon at the temperature 27^0C. Find the total internal energy of the system. (Neglect all vibrational modes).
[IMP – 2017]

8. Based on the kinetic theory of gases, derive an expression for the pressure exerted by an ideal gas.
[MARCH 2018]

9. According to the kinetic theory of gases, gas molecules are always in random motion.
(a) State the law of equipartition of energy.
(b) Write the average value of energy of a molecule for each vibrational mode.
[IMP – 2018]

10. By using the law of equipartition of energy, derive the value of ratio of specific heats of a mono atomic gas.
[MARCH 2019]

11. What do you mean by Mean free path? Give an equation for Mean free path. **[IMP – 2019]**

12. Prove that the average kinetic energy of a molecule is proportional to the absolute temperature of the gas.
[MARCH 2020]

13. Derive an expression for the pressure exerted by an ideal gas based on kinetic theory.
[IMP – 2020]

14. Using kinetic theory of an ideal gas, prove that the average kinetic energy of a molecule is proportional to the absolute temperature of the gas.
[MARCH 2021]

15. Write perfect gas equation. **[MARCH 2021]**

16. Write the equation for the pressure of an ideal gas based on kinetic theory of gases.
[IMP – 2021]

17. Using kinetic theory of gases, prove that the average kinetic energy of gas molecule is proportional to the absolute temperature of the gas.
[IMP – 2021]

18. The pressure exerted by a gas is given by the equation: $P = \frac{1}{3} nm\bar{v}^2$ where n is the number density of molecules, m is mass of each molecule and $\bar{v}^2$ is the mean of squared speed. Find the average kinetic energy of a molecule. **[MARCH 2022]**

19. State law of equipartition of energy. **[IMP – 2022]**

20. Kinetic energy of a gas molecule is directly proportional to the ..... of the gas. **[MARCH 2023]**

21.

(a) State the law of equipartition of energy.

(b) A box contains an equal number of molecules of hydrogen and oxygen. If there is a fine hole on top of the box, which gas will leak rapidly? Why?

(c) When gas is heated, its temperature increases. Explain it on the basis of kinetic theory of gases. **[MARCH 2023]**

22. Write short notes on:

(a) Law of equipartition of energy.

(b) Mean free path. **[IMP – 2023]**

23. According to kinetic theory of gases. "The collision between gas molecules are elastic". The statement is True/False. **[MARCH 2024]**

24. Write the C_v and C_p values of one mole of diatomic gas. **[MARCH 2024]**

25. The average kinetic energy of a molecule of a gas is directly proportional to …… **[MODEL 2025]**

26.

a) What would be the effect on r.m.s. velocity of a molecule, if the temperature of a gas is increased?

b) Calculate the root mean square velocity of oxygen molecule at 100K. (Given R = 8.31J $mol^{-1}K^{-1}$, molecular mass = 32g). **[MODEL 2025]**

27. Write the expression between average kinetic energy of molecule and absolute temperature of the gas. **[MARCH 2025]**

28. State law of equipartition of energy. **[MARCH 2025]**

NEW10'S
A NEW TURN IN EDIFICATION

CHAPTER – 13, OSCILLATIONS

1. All types of simple harmonic motion are periodic in nature. Derive the mathematical expressions of kinetic and potential energies of a particle executing simple harmonic motion. **[IMP – 2017]**

2. Oscillation of a simple pendulum is an example for simple harmonic motion. Derive the period of oscillation of a simple pendulum. **[IMP – 2017]**

3. What is the time period of a second's pendulum? **[MARCH 2018]**

4.

a) Which one of the following relationships between the acceleration (a) and the displacement (x) of a particle involve simple harmonic motion?

(i) $a = 0.7x$

(ii) $a = -200x^2$

(iii) $a = -10x$

(iv) $a = 100x^3$

b) A simple harmonic motion is represented as $x = A \cos \omega t$. Obtain the expression for velocity and acceleration of the object and hence prove that acceleration is directly proportional to the displacement. **[MARCH 2018]**

5. Which one of the following relationships between the acceleration a and the displacement x of a particle involve simple harmonic motion?

(i) $a = 5x$ (ii) $a = -200x^2$

(iii) $a = -5x$ (iv) $a = -100x^3$ **[IMP– 2018]**

6. The simplest example of simple harmonic motion is the oscillations of a simple pendulum.
(a) Derive an expression for the period of oscillation of a simple pendulum.
(b) In a simple pendulum made of a metallic wire, what will happen to the period when temperature increases? Given a reason. **[IMP – 2018]**

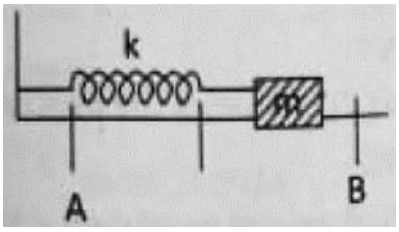
7.
a) Prove that the oscillations of a simple pendulum are simple harmonic and hence derive an expression for the time period of a simple pendulum.
b) What is the length of a simple pendulum, which ticks seconds? **[MARCH 2019]**

8. A particle executes SHM of amplitude A. At what distance from the mean position is its kinetic energy equal to its potential energy? **[IMP – 2019]**

9. Derive an expression for period of oscillation of a loaded spring. **[IMP-2019]**

10. Show that the function (sinωt -cosωt) represents simple harmonic motion. **[MARCH 2020]**

11. Simple harmonic motion of a block of mass m attached to a spring is shown in figure. The distance between extreme points A and B is 10 cm.

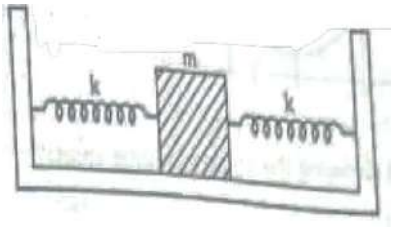


Take the direction from A to B as the positive. Redraw the given table and give the signs of velocity, acceleration and force.

	Point	V	A	F
(a)	At the end B	0		
(b)	At the mid-point of AB going towards A		0	0
(c)	At 2cm away from B going towards A			

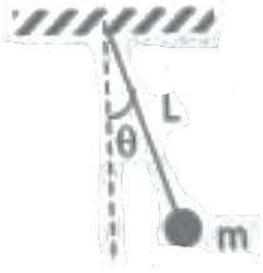
[MARCH 2020]

12. Two identical springs of spring constant k are attached to a block of mass m and to fixed supports as shown below. Show that when the mass is displaced form its equilibrium position on either side, it executes a simple harmonic motion.



[IMP – 2020]

13. Simple pendulum in oscillatory motion is as shown in the figure.

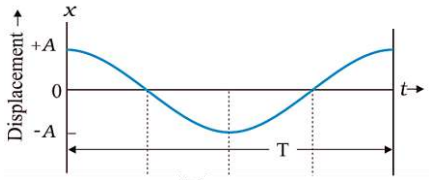


a) Mark the different forces acting on the bob.
b) Derive the expression for the time period of simple pendulum. **[IMP -2020]**

14. Derive an expression for period of a simple pendulum. **[MARCH 2021]**

15.

a) The displacement-time relation of a simple harmonic motion is shown below.



Draw a graph showing the corresponding velocity-time relation.

b) What is the length of a simple pendulum, which ticks seconds if value of acceleration due to gravity at the place is 9.8m/s^2?

[IMP – 2021]

16. The displacement of a particle executing SHM is Y = a sinωt where a is amplitude, ω is angular frequency.

(a) Draw the variation of velocity of the particle with time.

(b) A 2 kg body performs SHM of amplitude 20cm and the restoring force acting at that position is 50N. Find the acceleration and kinetic energy of the particle when the displacement is 10cm.

[MARCH 2022]

17.

a) Show that the oscillations produced in a simple pendulum are simple harmonic.
b) Write an expression for time period oscillation.
c) What is seconds pendulum? Find the length of seconds pendulum. **[MARCH 2022]**

18. State true or false:
Time period of a simple pendulum depends on mass of the bob. **[IMP – 2022]**

19.

a) Derive the expression for period of oscillation of a simple pendulum
b) What is the length of second pendulum? **[IMP – 2022]**

20.

a) Derive an expression for time period of oscillation of a simple pendulum.
b) Can a pendulum clock show correct time inside a spaceship? Why?

[MARCH 2023]

21. Derive an expression for period of oscillation of a loaded spring. **[IMP – 2023]**

22.

a) Define Simple Harmonic Motion (SHM).
b) For a SHM, time period is T = 2s. If the displacement from the mean position is 10cm, Calculate the instantaneous acceleration.

[IMP – 2023]

23. The condition for simple harmonic motion is ..... **[MARCH 2024]**

24. Write the expression for kinetic energy and potential energy of a body executing SHM and draw their variations in a graph. **[MARCH 2024]**

25.

a) Give one example of S.H.M. oscillation.
b) Derive equations for the kinetic energy and potential energy of a body executing simple harmonic motion. **[MODEL 2025]**

26. Expression for displacement of particle in simple Harmonic Motion is $x(t) = A\cos(\omega t + \phi)$. Derive the equation for particle's velocity and its acceleration. **[MARCH 2025]**

NEW 10'S
A NEW TURN IN EDIFICATION

CHAPTER – 14, WAVES

1. In resonance column experiment, we can hear maximum sound at a certain height. This is due to the phenomenon of resonance.

(a) Show that for a pipe closed at one end, the frequencies in the ratio $v_1 : v_2 : v_3 = 1 : 3 : 5$

(b) Open pipes are preferred to closed pipes in musical instruments. Why?

[MARCH 2016]

2. A woman is travelling in a car at a speed of 25m/s. She is moving away from a source producing a sound of 512Hz.

(a) Calculate the frequency of sound heard by her. (Speed of sound in air is 340m/s)

(b) Draw the second harmonic of open pipe (both end open). Mark a node and an antinode in the figure. **[IMP – 2016]**

3.

a) A transverse harmonic wave is described by Y = 3.0 sin(0.018x+36t) where 'x' and 'y' are in cm. The amplitude of this wave is .....

b) Figure below shows the fundamental mode or first harmonic in a stretched string, when a standing wave is formed in the string segment.

Draw the figure that shows the second harmonic in the string. If 'L' is the length of the string and 'v' is the speed of the wave in the string, what are the equations of first and second harmonic frequencies? **[MARCH 2017]**

4. Standing waves can be produced in the air column of a pipe.

a) Standing waves produce in an open pipe contains .....

(i) Fundamental frequency only
(ii) Odd harmonics only
(iii) Even harmonic only
(iv) All harmonics

b) Which harmonic mode of the pipe is resonantly exerted by 1.1kHz in an open pipe of length 30cm? (Velocity of sound = 330m/s)

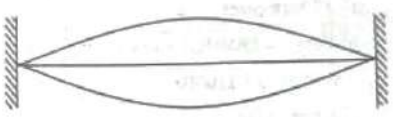
c) If an open pipe produces a fundamental frequency "f" in air, the fundamental frequency produced by the same pipe dipped half in water is .....

(i) f (ii) $\frac{f}{2}$ (iii) 2f

(iv) no harmonics is produced

[IMP – 2017]

5. The fundamental mode of vibration of a stretched string is shown below.



a) Draw the second and third harmonics.

b) Prove that frequencies produced in the string are in the ratio of 1:2:3.

c) Let the fundamental frequency is 45Hz and the length of the wire is 87.5cm. If linear density of the wire is 4.0×10^{-2}kg/m, find the tension in the string. **[MARCH 2018]**

6. A transverse harmonic wave on a string is described by

$y_{(x,t)} = 3.0\sin(36t + 0.018x + \frac{\pi}{4})$

where '*x*' and 'y' are in cm and 't' is in seconds. The positive direction of '*x*' is from left to right.

NEW 10'S
A NEW TURN IN EDIFICATION

a) Is this a travelling wave or a stationary wave? If it is travelling, what are the speed and direction of its propagation?
b) What are its amplitude and frequency?
c) What is the least distance between two successive crests in the wave?

[IMP – 2018]

7. A wave travelling along a string is described by $y_{(x,t)} = 0.005\sin(80.0x-3.0t)$ in which the numerical constants are in SI units. Calculate the wavelength and frequency of the wave.

[MARCH 2019]

8.

a) Draw diagrams showing the first and third harmonics produced in a closed pipe.
b) Write the equation for the fundamental frequency in the terms of length of the pipe.

[MARCH 2019]

9. While conducting a resonance column experiment in the laboratory you can hear the maximum sound at a certain height.

a) Which phenomenon is responsible for this?
b) Is resonance column apparatus an open pipe or a closed pipe?
c) Find the ratio of frequency of the first three harmonics in the resonance column apparatus.

[IMP – 2019]

10. A steel wire has a length of 12.0m and a mass of 2.10Kg. What is the tension in the wire if speed of a transverse wave on the wire is 343m/s?

[MARCH 2020]

11. A transverse harmonic wave on a string is described by $y_{(x,t)} = 3.0\sin(36t+0.018x+\frac{\pi}{4})$ where x and y are in cm and t is s.

a) Is this a travelling wave or stationary wave?
b) What are its amplitude and frequency?
c) What is the initial phase at the origin?
d) What is the least distance between two successive crests in the wave?

$\left(\frac{1}{2}+1+\frac{1}{2}+1\right)$

12. A wire 0.72m long has a mass of 5×10^{-3}kg. If the wire is under a tension of 60N. What is the speed of transverse waves on the wire?

[IMP – 2020]

13. A wave is represented by the equation
$y(x, t) = A \sin(kx + \omega t)$

a) Is it a travelling or stationary wave?
b) What does ω and k represent?
c) Find out the wavelength from the equation. **[IMP – 2020]**

14. A wave is travelling along a string is described by $y(x.t) = 0.005 \sin(80.0x-3t)$ in which the numerical constants are in SI units. Calculate

a) Amplitude
b) The wavelength
c) The period and frequency of the wave. **[MARCH 2021]**

15. A harmonic wave of amplitude 'a' and angular frequency 'ω' travels along positive x-direction.

a) Write an equation for the displacement of this harmonic wave.
b) Show that the ratio of angular frequency to angular wave number $\left(\frac{\omega}{k}\right)$ represents velocity of the wave. **[IMP – 2021]**

16. In the case of stationary waves, the displacement of a particle at positions of node is .....

[MARCH 2022]

NEW10'S A NEW TURN IN EDIFICATION

17.

a) Draw the pattern of waveforms of the first two harmonics in a closed pipe

b) Show that in a closed pipe, the frequencies of first two harmonics are in the ratio 1:3

[MARCH 2022]

18. Write the equation for a speed of a transverse wave on a stretched string. **[IMP – 2022]**

19. Find equations of the first, second and third harmonics of standing waves formed in an open pipe and show that $\nu_1 : \nu_2 : \nu_3 = 1 : 2 : 3$.

[IMP – 2022]

20. Most fundamental property of wave is

(a) Temperature

(b) Pressure

(c) Frequency

(d) Wavelength **[MARCH 2023]**

21.

a) A string is stretched between two fixed supports and a note of sound is heard when it is plucked at its middle point.

(i) How standing waves are produced?

(ii) Derive an expression for the frequency of sound produced by the first two modes of vibration.

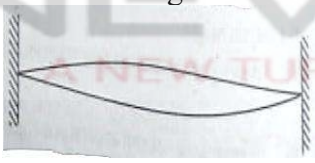
b) Where will a man hear a louder sound in the case of stationary wave (node or anti node)?

[MARCH 2023]

22.

a) A transverse harmonic wave is described y = 3sin(0.018x+36t), where 'x' and 'y' are in cm. The amplitude of this wave is .....

b) The figure below shows the fundamental mode or first harmonic in a stretched string when a standing wave is formed in the string.



Draw the figure that shows the second harmonic in the string. If L is the length of the string and v is the speed of the waves in the string, what are the equations of first and second harmonic frequencies? **[IMP – 2023]**

23. What are beats? **[MARCH 2024]**

24. Explain the speed of longitudinal wave and write the value of speed of sound at 0^0C after Laplace. **[MARCH 2024]**

25.

a) On what factor does the speed of sound in a medium depend?

b) Show that in a closed pipe, the frequencies of first three harmonies are in the ratio 1:3:5.

[MODEL 2025]

26. A transverse harmonic wave on a string is described by

$y(x,t) = 3.0\sin(36t + 0.018x + \frac{\pi}{4})$

Where x and y are in cm and t in s.

a) Is this a travelling wave or a stationary wave?

b) If it is travelling, what is it's speed?

c) What is its frequency?

d) What is the initial phase at the origin? **[MARCH 2025]**