

General Instructions:

1. Attempt all the questions.
2. There is no overall choice. However an internal choice has been provided in one question of two marks, one question of three marks, three questions of five marks. You have to attempt only one of the choices in such questions.
3. Question numbers 1 to 5 are very short answer questions, carrying 1 mark each.
4. Question numbers 6 to 10 are short answer questions, carrying 2 marks each.
5. Question numbers 11 to 22 are short answer questions, carrying 3 marks each.
6. Question numbers 23 carries 4 marks.
7. Question numbers 24 to 26 are long answer questions, carrying 5 marks each.
8. Use of calculators is not permitted, you may use log tables, if necessary.

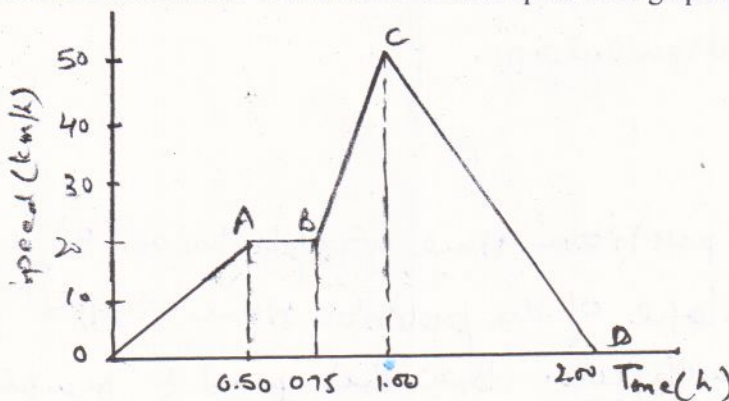
1. If the temperature of a body increases from $(28.6 \pm 0.1)^\circ\text{C}$ to $(79.4 \pm 0.1)^\circ\text{C}$, then find the increase in temperature of the body. (1)
2. When a body falls to the earth, the earth also moves up to meet it. But the earth's motion is not noticeable. Why? (1)
3. What is the work done by earth's gravitational force in keeping the moon in its orbit? Explain. (1)
4. Is centre of mass a reality? (1)
5. It is difficult to open the door by pushing it or pulling it at the hinge. Why? (1)
6. Find the angle between the vectors $A = i + 2j - k$ and $B = -i + j - 2k$. (1)

OR

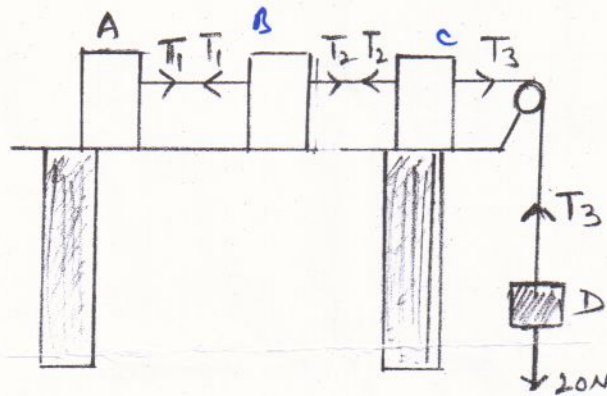
A drop of olive oil of radius 0.25mm spreads into a circular film of radius 10cm on the water surface. Estimate the molecular size of olive oil. (2)

7. Rain is falling vertically with a speed of 30m/s. A woman rides a bicycle with a speed of 10 m/s in the north to south direction. What is the direction in which she should hold her umbrella? (2)
8. A body rolled on ice with a velocity of 8m/s comes to rest after travelling 4m. Compute the coefficient of friction. Given $g = 9.8\text{m/s}^2$. (2)
9. Define the term angular momentum. Give its units and dimensions. (2)
10. A wheel is rotating at a rate of 1000 rpm and its kinetic energy is 10^6 J. Determine the moment of inertia of the wheel about its axis of rotation. (2)
11. How is random error eliminated? What do you mean by
 - a) Relative error
 - b) Percentage error
 (3)

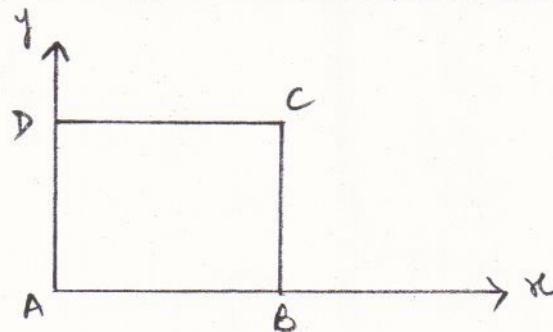
12. A train moves from one station to another in two hours time. Its speed-time graph during the motion is shown below



- a) Determine the maximum acceleration during the journey
 b) Also calculate the distance covered during the time interval from 0.75 hour to 1 hour. (3)
13. Deduce an expression for relative velocity of one object with respect to another in terms of their velocities relative to the earth. (3)
14. State and prove work-energy theorem for a variable force. (3)
15. Give two examples from daily life that illustrate the law of inertia. (3)
16. What do you mean by impulse of a force? Show that impulse is equal to the product of average force and the time interval for which the force acts. Give the units and dimensions of impulse. (3)
17. Four particles of masses $2m$, m , $4m$, $3m$ are placed at the corner A, B, C and D respectively of a square of each side 'a' as shown in figure. Find the position of the centre of mass of the system. (3)



18. Three blocks A, B and C are kept on a horizontal smooth table connected by strings as shown in figure. A string attached to block C passes over a smooth pulley and carries a block D of mass 2kg at the other end. If masses of A, B and C are 3kg , 4kg and 1kg respectively, find the tensions T_1 , T_2 and T_3 in different parts of the string. Given $g=10\text{m/s}^2$.



OR

- ≡ A block of metal of mass 50g when placed over an inclined plane at an angle of 15° slides down without acceleration. If the inclination is increased by 15° , what would be the acceleration of the block? (3)
19. State parallel axes theorem. The moment of inertia of a circular disc about a diameter is $\frac{1}{4}MR^2$ where M is mass and R is radius of disc. Using this theorem find the moment of inertia about an axis passing through its centre and perpendicular to its plane. (3)
20. A projectile is fired with a velocity u making an angle θ with horizontal. Derive its expressions for time of maximum height and time of flight. (3)

21. A man arrived at Delhi Railway station and wanted to go to his relative's house 10km away from the station. He hired a taxi to reach the destination. The driver followed a long path 25km to reach the destination in 1 hour and charged from the man for 25km. (3)

22. Define the terms: Collision, elastic collision, inelastic collision. (3)

23. A man arrived at Delhi Railway station and wanted to go to his relative's house 10 km away from the station. He hired a taxi to reach the destination. The driver followed a long path 25km to reach the destination in 1 hour and charged from the man for 25 km.

Now answer the following questions:

a) Comment on the behavior of taxi driver.

b) Calculate the average speed of the taxi.

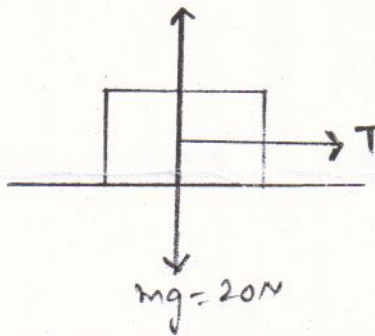
c) Calculate the average velocity of the taxi. (4)

24. Why is friction greatly reduced when a body rolls over a surface? What is the cause of rolling friction? On what factors does the rolling friction depend? Write an expression for the coefficient of rolling friction.

OR

a) What are two types of kinetic friction? Which one of them is smaller than the other?

b) A block of weight 20N is placed on a horizontal table and a tension T , which can be increased to 8N before the block begins to slide, is applied at the block as shown in figure. A force of 4N keeps the block moving at constant speed once it has been set in motion. Find the coefficient of static friction.



25. a) What is kinetic energy? Give some examples. Derive an expression for the kinetic energy of a body of mass m moving with velocity v . (5)

b) A body of mass 4kg initially at rest is subject to a force 16N. What is the kinetic energy acquired by the body at the end of 10s?

OR

Show that the elastic force of a spring is a conservative force. Hence write an expression for the potential energy of an elastic stretched spring. (5)

26. Define torque. Derive an equation that relates the torque to the angular momentum. If no external torque acts on the system, will its external velocity remain constant?

A solid cylinder of mass 20kg rotates about its axis with angular speed 100 rad/s. The radius of the cylinder is 0.25m. What is the kinetic energy associated with the rotation of the cylinder?

OR

Derive a relation between angular momentum, moment of inertia and angular velocity of a rigid body.

A torque of 2×10^4 Nm is applied to produce an angular acceleration of 4 rad/s^2 in a rotating body. What is the moment of inertia of the body? (5)