CLASS: XI

SESSION: 2023-24

DAV SAMPLE QUESTION PAPER

SUBJECT: PHYSICS (THEORY)

Maximum Marks: 70 **Time Allowed: 3 hours.**

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

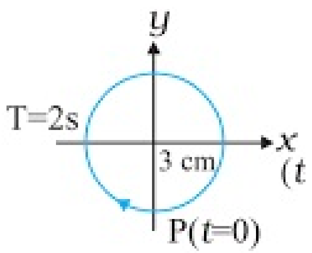
(3) **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study based questions of four marks each and **Section E** contains three long answer questions of five marks each.

(4) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

(5) Use of calculator is not allowed.

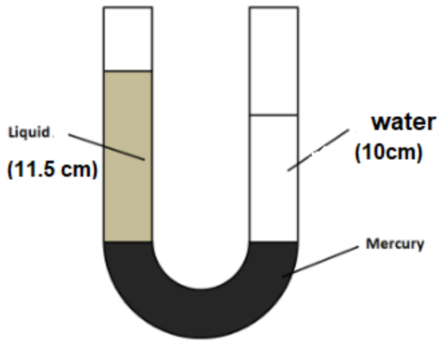
SECTION A

1. The given figure corresponds to a circular motion. The radius of circle, the period of revolution, the initial position and the sense of revolution are marked in the figure. The corresponding SHM of the y-projection of the radius vector of the revolving particle P is



a) -(3.0cm) sin πt
b) (3.0cm) cos πt
c) -(3.0cm) cos πt
d) (3.0cm) sin πt

2. A U – tube contains water and an unknown liquid separated by mercury as shown in the figure. The mercury column in the two arms is in the level with 10.0cm of water in one arm and 11.5cm of unknown liquid in other arm. The relative density of the unknown liquid is



a) $0.869 g/cm^3$
b) $0.899 g/cm^3$
c) $0.798 g/cm^3$
d) $0.888 g/cm^3$

3. Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by the gas is W_1, if process is isothermal, W_2 if isobaric and W_3, if adiabatic. Then,

a) $W_2 > W_1 > W_3$
b) $W_2 > W_3 > W_1$
c) $W_1 > W_2 > W_3$
d) $W_1 = W_2 = W_3$

4. The ratio of specific heats (C_P/C_V) for a diatomic molecule is

a) (5/2)R
b) (7/2)R
c) (9/2)R
d) (9/7)R

5. A wire of length L and cross-sectional area A is made of a material of Young's modulus Y. It is stretched by an amount x. The work done in this process is

a) $\frac{YxA}{2L}$
b) $\frac{Yx^2A}{L}$
c) $\frac{Yx^2A}{2L}$
d) $\frac{2Yx^2A}{L}$

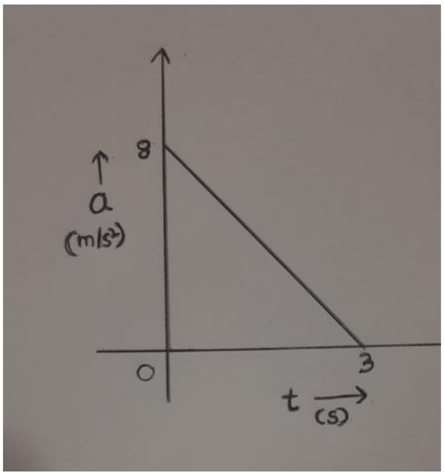
6. A black body at a temperature T radiates energy E. If the temperature falls by 50%, the fractional decrease in radiated energy will be

a) 15/16
b) 16/15
c) 17/16
d) 16/17

7. Which of the physical quantities have same dimensions?

a) Force and Impulse
b) Planck's constant and Angular Momentum
c) Surface Tension and Bulk's Modulus
d) Time period and Frequency

8. An object starting with 2m/s moves along a straight line. The acceleration – time graph of the object is shown in the figure. Its final velocity is

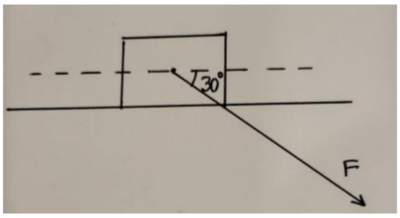


a) 10 m/s
b) 12 m/s
c) 14 m/s
d) 16 m/s

9. The moment of inertia of a thin rod of mass M and length L about an axis perpendicular to the rod and passing through its mid-point is

a) $ML^2/2$
b) $ML^2/3$
c) $ML^2/6$
d) $ML^2/12$

10. A block of mass 2kg is lying on a horizontal floor. A force of 10 N acts on it at an angle of 30° with the horizontal. The coefficient of kinetic friction between the block and the floor is 0.2. The acceleration of the block is (Given g = 10 m/s^2)

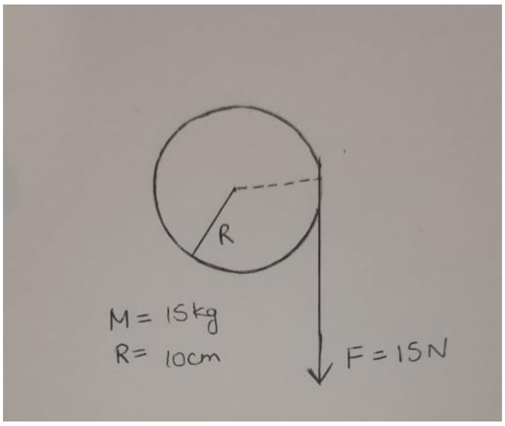


a) 1.33 m/s^2
b) 4.66 m/s^2
c) 2.66 m/s^2
d) 2.33 m/s^2

11. The velocity of a particle at an instant is given by **v =** $3\hat{i} + 2\hat{j} + 5\hat{k}$ m/s. At that instant, the force acting on the particle is **F** = $(4\hat{i} - 5\hat{j})$ N. The power delivered by the force to the particle at that instant is

a) 2 W
b) 4 W
c) 11 W
d) 22 W

12. A cord of negligible mass is wound round the rim of a fly wheel of mass 15 kg and radius 10 cm. A steady force 15 N is applied on the cord as shown in the figure. The fly wheel is mounted on horizontal axle with frictionless bearings. The angular acceleration of the wheel is

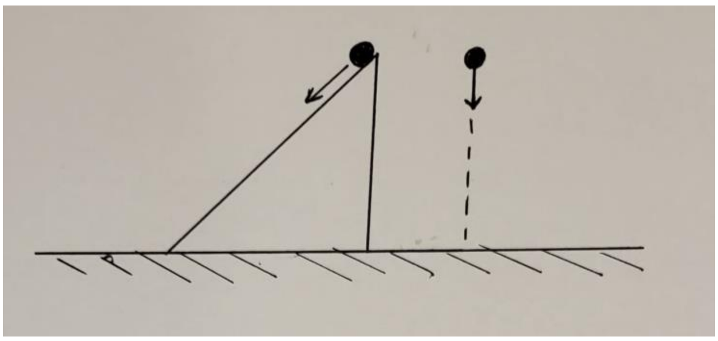


a) 0.2 rad/s^2
b) 2 rad/s^2
c) 20 rad/s^2
d) 200 rad/s^2

For Questions 13 to 16, two statements are given- one labelled assertion (A) and other labelled reason (R). Select the correct answer to these questions from the options as given below.

a) If both assertion and reason are true and reason is correct explanation of assertion.
b) If both assertion and reason are true and reason is not the correct explanation of assertion.
c) If assertion is true but reason is false.
d) If both assertion and reason are false.

13. Assertion (A): Two identical bodies falling through the same height, as shown in figure, reach bottom with the same velocity.



Reason (R): Both bodies move under the action of gravitational force.

14. Assertion (A): In a harmonic progressive wave of a given frequency all particles have the same amplitude but different phases at a given instant of time.

Reason (R): In a sound wave, a displacement node is a pressure antinode and vice-versa.

15. Assertion (A): The escape speed of an object from the surface of the earth is the same as the escape speed from the surface of moon.

Reason (R): The value of escape speed for a planet is independent of its mass and size.

16. Assertion (A): A rain drop after falling through some height attains a constant velocity.

Reason (R): At constant velocity, the viscous drag is exactly equal to its weight.

SECTION- B

17. Twenty seven identical drops of water are falling independently vertically downwards in air, each with a terminal velocity 0.15 m/s. If they combine before falling to form a single bigger drop, what will be its terminal velocity?

18. A particle is executing linear simple harmonic motion. Plot the graph of kinetic energy and potential energy as a function of displacement. What is the periodicity of kinetic energy and potential energy.

19. Two objects A and B starting from rest move along x-axis. Their positions at time t are given by

$$X_A(t) = (2t+2t^2)$$

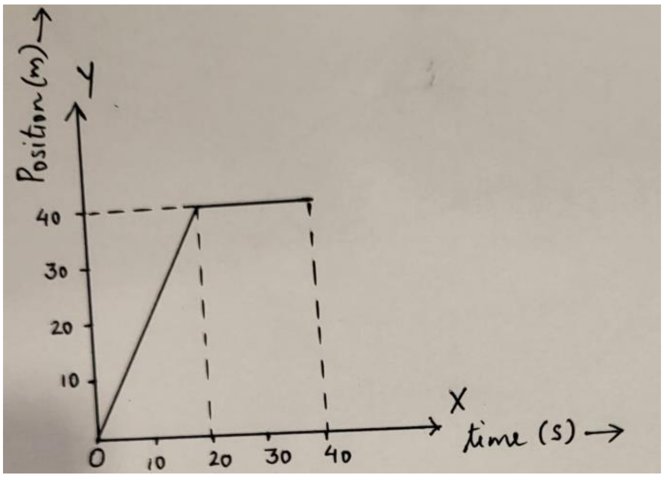
$$X_B(t) = (8t- t^2)$$

where x is in meters and t is in seconds. Find the time at which the two objects will have the same velocity.

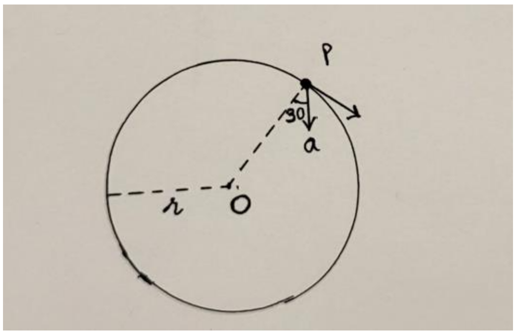
OR

The position-time graph of a body of mass 5kg is shown in figure. Calculate the

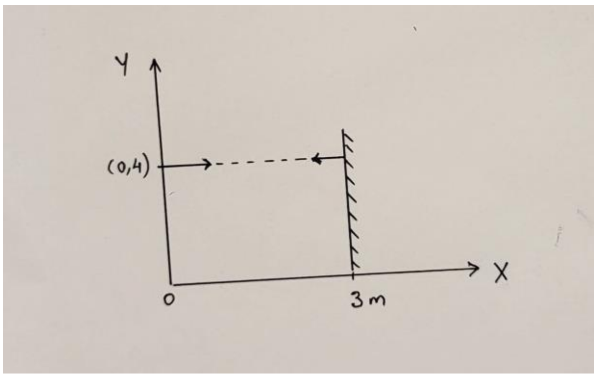
(i) Impulse on the body at t=20s
(ii) Velocity of the body at t=40 s.



20. In the given figure, a= 8m/s^2 represent total acceleration of particle moving in the clock-wise direction in a circle of radius, r = 1/√3 m at a given instant of time. Calculate the speed of the particle at that instant.



21. A particle of mass 0.2kg moves horizontally from a point (0,4 m) in x-y plane with a uniform velocity 5 î. It is reflected back with the same speed by a rigid wall at x=3m as shown in figure. Calculate the change in its angular momentum about the origin, during process of reflection.



SECTION -C

22. Reynold number N_R (a dimensionless quantity) determines the condition of laminar flow of viscous liquid through a pipe. N_R is a function of density of liquid ρ, its average speed v and coefficient of viscosity η. Given that N_R is also directly proportional to 'D' (the diameter of pipe). Show from dimensional condition that

$$N_R = k\,\rho v D/\eta$$

where k is dimensionless constant

23. A cylindrical piece of cork of density 'd', base area A and hight 'h' floats in a liquid of density ρ_l. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a frequency

$$\nu = \frac{1}{2\pi}\sqrt{\frac{\rho_l g}{h d}}$$

24. A particle starts from origin at t = 0 with a velocity (2î+3ĵ) m/s and moves in x- y plane with acceleration of (8î+ 2ĵ) m/s^2.

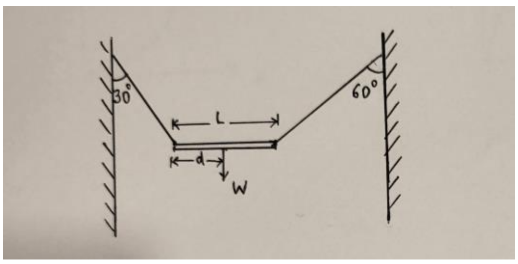
(a) At what time x- co-ordinate of the particle is 6m?
(b) What is the position of the particle along y -direction at that time?

25. A pipe 20 cm long is closed at one end. Which harmonic mode of the pipe is resonantly excited by a 440 Hz source? Will the same source be in resonance with the pipe if both ends are open? (speed of sound in air = 340 m/s)

26. Justify the following statements-

a) It is possible to increase the temperature of a gas without adding heat to it.
b) An ideal gas undergoes isothermal process from some initial state i to final state f, then the amount of heat absorbed is equal to work done.
c) The velocity of water is greater in a narrow tube than in a broader tube, both lying horizontally.

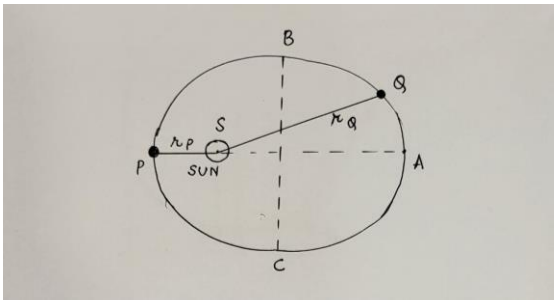
27. A non- uniform bar of weight W and length L is suspended by two strings of negligible mass, as shown in figure. The distance (d) of the centre of gravity of the bar from its left end is marked in the figure. Calculate the ratio (d/L).



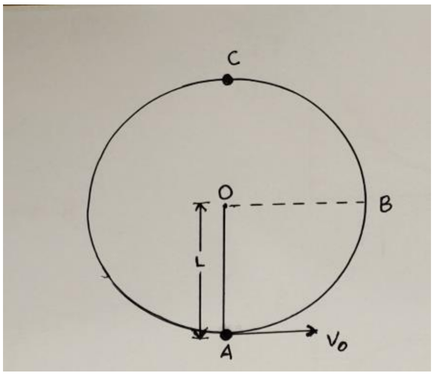
OR

(a) State Kepler's law of areas. Show that it is a consequence of conservation of angular momentum.

(b) P and Q represent the positions of a planet around the Sun, as shown in the figure. Find the ratio of velocities of the planet at P and Q, v_P/v_Q.



28. A bob of mass 0.1 kg is suspended by a light string of length 2m, as shown in figure



Derive an expression for minimum velocity at point A so that it reaches point C. Also calculate its magnitude.

SECTION D

Case Study Based Questions

29. Read the following paragraph and answer the questions that follow.

Liquids have no definite shape but have a definite volume. They acquire a free surface when poured in a container. Molecules in the surface film have some extra energy called surface energy. A liquid at rest tends to have minimum surface area to minimise surface energy. This tendency of the liquid is called surface tension. Temperature of the liquid also affects its surface tension. The surface of a liquid near the plane of contact with another medium is in general curved. The angle of contact is different at interface of different pairs of liquids and solids. Another interesting consequence of surface tension is that the pressure inside a spherical drop is more than the pressure outside.

i. When there are no external forces the shape of the liquid is determined by

a) surface tension of the liquid

b) Density of the liquid

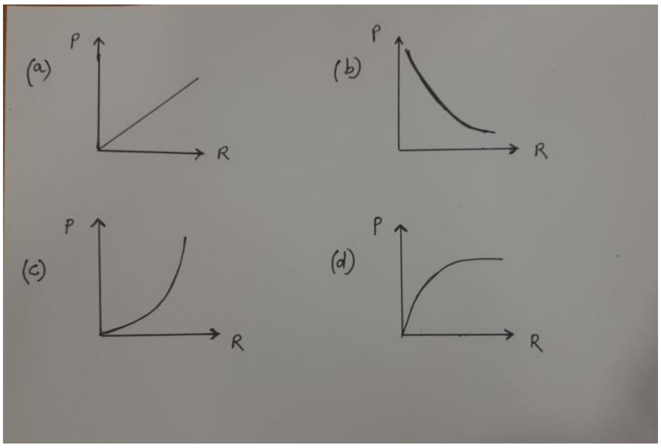
c) Viscosity of the liquid

d) Bulk modulus of the liquid

ii. Angle of contact between a water drop and a wax coated surface is

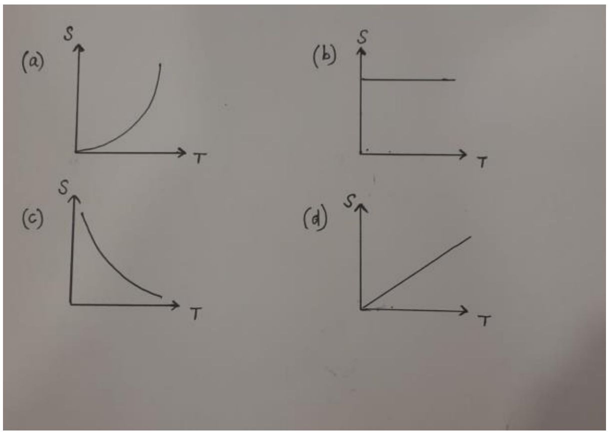
a) Zero
b) Acute
c) Obtuse
d) 90^0

iii. The variation of excess pressure P with radius R of a soap bubble is



OR

Which graph represents variation of surface tension with temperature over small temperature range for water



iv. The surface tension of a liquid is 10N/m. If thin film of area 0.02 m^2 is formed on a wire loop, it's surface energy will be

a) 2.0×10^{-1} J
b) 4.0×10^{-1} J
c) 2.0×10^{-2} J
d) 4.0×10^{-2} J

30. Read the following paragraph and answer the questions that follow.

An object that is in flight after being thrown or projected is called a projectile. It is an example of motion in a plane under the force of gravity. The path followed by a projectile is called its trajectory. The motion of a projectile may be thought of as a result of two separate simultaneously occurring components of motion. One component is along horizontal direction with uniform velocity and the other is along vertical direction with constant acceleration. The two motions of a projectile along horizontal and vertical directions are independent of each other. It is assumed that there is no air resistance on the projectile. Also acceleration due to gravity is constant both in magnitude and direction. The horizontal distance travelled by the projectile during its time of flight is called its horizontal range.

i. A projectile can have same range R for two angles of projection. If T_1 and T_2 be the times of flight in the two cases then the product T_1 T_2 is proportional to

a) R^2
b) $1/R^2$
c) $1/R$
d) R

ii. A missile is fired for maximum range with initial velocity of 30 m/s. If $g=10$ m/s^2 the range of missile is

a) 80m
b) 100m
c) 90m
d) 60m

iii. A stone of mass 2kg is projected with an initial velocity 5m/s at an angle $30^0$with the vertical. What is its momentum at the highest point?

a) $2.5\sqrt{3}$ kg m/s
b) 0 kg m/s
c) 5 kg m/s
d) 10 kg m/s

OR

The angle between directions of instantaneous velocity and acceleration at the highest point in the motion of a ball kicked by a footballer is

a) 270^0
b) 180^0
c) 45^0
d) 90^0

iv. A ball is projected in the x-y plane from origin at time t=0. At time t=2s its velocity is

V= $(50\hat{i} + 20\hat{j})$ m/s. Find the horizontal range of the ball? (Given $g=10$m/s^2)

a) 100m
b) 200m
c) 400m
d) 800m

SECTION -E

31. a) Consider a tank containing a liquid of density ρ with a small hole in its side at a depth h, from the surface of water. Show that the speed of efflux is same as the speed of freely falling body.

b) The cylindrical tube of a spray pump with a cross section of 8 cm^2. One end of tube has 40 fine holes each of diameter 1 mm. If the liquid flow inside that tube is 11.5 m/minute, what is the speed of ejection of the liquid through the holes?

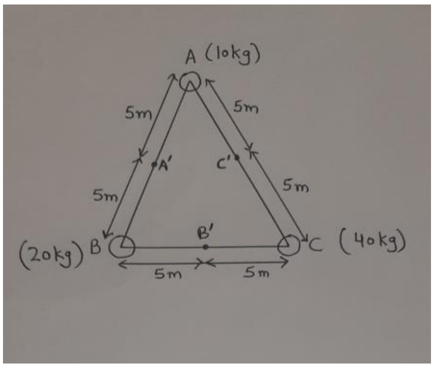
OR

a) Define angle of contact. Derive an expression for the rise of a liquid in capillary tube. Show that a liquid having an obtuse value of angle of contact will get depressed in capillary tube.

b) In a car lift, compressed air exerts a force F_1 on a small piston having radius 5 cm. This pressure is transmitted to a second piston of radius 1.5 cm. If the mass of the car to be lifted is 1350 kg, what is F_1? What is the pressure necessary to accomplish this task?

32. a) A satellite of mass M is orbiting around earth in a circle of radius (R + H), where R is the radius of the Earth. Prove that total energy of the satellite is half of its potential energy.

b) Three masses of 10 kg 20 kg and 40 kg are kept at corners of an equilateral triangle of side 10 m. Now particle A is move to A', B is move to B' and C is move to C'.



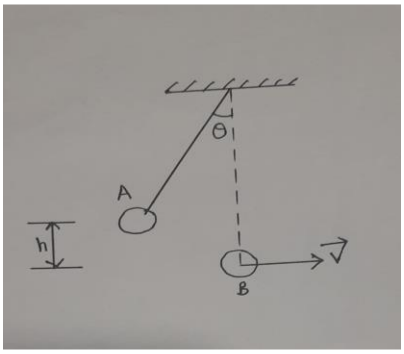
(i) Calculate gravitational potential energy of the system in final configuration?

(ii) Does the gravitational potential energy of the system increase or decrease? Justify your answer.

OR

a) A ball of mass M_1 moving with velocity u along x-axis collides head on with a ball of mass M_2 lying at rest. After collision they stick and move together with a velocity v along x-axis. Find loss in kinetic energy of the system.

b) A ball of mass 1 kg is suspended from a rigid stand as shown in figure it is pulled to one side so that it rises to a height of 10 cm and released. It collides elastically with another identical ball B lying at rest at its mean position. What is the velocity that ball B achieves and how high ball A rise after collision? (Given g=10m/s^2)



33. a) Sheela drives a car of mass m on a road banked at an angle ϴ with horizontal. Derive an expression for maximum speed with which she can drive the car. (Given that the coefficient of static friction between the tyres of car and road is μ_s)

b) An aircraft executes horizontal loop of radius 10 km at a speed of 540 km/hour with its wings banked at an angle ϴ. Calculate value of ϴ? (Given g=10 m/s^2)

OR

a) A small ball of mass m is executing uniform motion along a circle of radius R. With the help of a relevant diagram obtain an expression for centripetal acceleration.

b) Rohan is riding a cycle with a speed of 27 km/ hour as he approaches a circular turn on the road of radius 100 m. He applies breaks and reduces his speed at a constant rate of 1 m/s every second. What is the magnitude of net acceleration of the cyclist on the circular turn?
