Ambience Public School
Mid Term Exam: 2024-25
Subject: Physics
Class: XI
Date:06/09/2024

Time Allowed: 3 hours.
Maximum Marks: 70

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.
(3) All the sections are compulsory.
(4) 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.
(5) 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 must attempt only one of the choices in such questions.
(6) Use of calculators is not allowed.
(7) You may use the following values of physical constants where ever necessary

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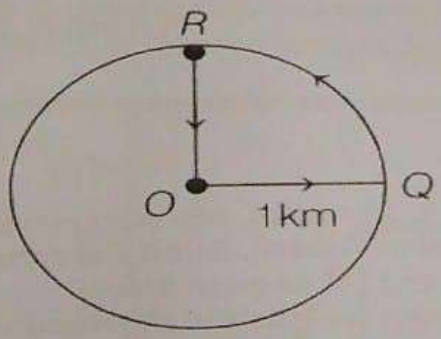
SECTION-A

Q1. An object is moving on a circular path of radius 'n' meters at a constant speed of 4.0 m/s. The time required for one revolution is:

(a) $2/n^2$ s (b) $n^2/2$ s
(c) $n/2$ s (d) $n^2/4$

Q2. A runner starts from O and comes back to O following path OQRO in 1h. What is his net displacement and average speed?



(a) 0,3.57 km/h (b) 0,0 km/h (c) 0,2.57 km/h (d) 0,1 km/h

Q3. Equal forces **F** act on isolated bodies A and B. The mass of B is three times that of A. the magnitude of the acceleration of A is:

(a) three times that of B (b) 1/3 that of B
(c) the same as B (d) nine times that of B

Q4. The potential energy of a particle varies with distance x from a fixed origin as T

$$U = \frac{A\sqrt{x}}{x + B}.$$

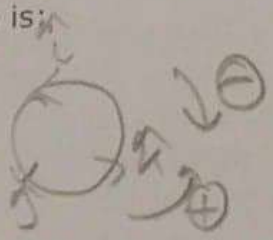
where A and B are constants. The dimensions of AB are

(a) $[ML^{5/2} T^{-2}]$ (b) $[ML^2 T^{-2}]$
(c) $[M^{3/2}L^3 T^{-2}]$ (d) $[ML^{7/2} T^{-2}]$

Q5. At the top of the trajectory of a projectile, the directions of its velocity and acceleration are
(a) parallel to each other
(b) antiparallel to each other
(c) inclined to each other at an angle of 45°
(d) perpendicular to each other

Q6. An object of mass 1 g is whirled in a horizontal circle of radius 0.5 m at a constant speed of 2 m/s. The work done on the object during one revolution is:

(a) 0 (b) 1 J
(c) 2 J (d) 4 J



Q7. The value of $\hat{j} \cdot (\hat{i} \times \hat{j})$ is:

(a) zero (b) +1
(c) −1 (d) 3

Q8. A 6-kg object is moving towards the south. A net force of 12 N North on it results in the object having an acceleration of:

(a) 2 m/s², north (b) 2 m/s², south
(c) 6 m/ s², north (d) 18 m/ s², north

Q9. A baseball is thrown vertically into the air. The acceleration of the ball at its highest point is:

(a) zero (b) g, down
(c) g, up (d) 2g, down

Q10. A forward horizontal force of 12 N is used to pull a 240 N crate at constant velocity across a horizontal floor. The coefficient of friction is:

(a) 0.5 (b) 0.05
(c) 2 (d) 0.2

Q11. You stand on a spring scale on the floor of an elevator. Of the following, the scale shows the highest reading when the elevator:

(a) moves downward with increasing speed (b) moves downward with decreasing speed
(c) remains stationary (d) moves upward with decreasing speed

Q12. The unit of force called the newton is:

(a) 9.8 kg · m/s² (b) 1 kg · m/s²
(c) 9.8 kg · m/s (d) 1 kg of mass

For question numbers 13, 14, 15 and 16, two statements are given-one labelled Assertion and the other labelled Reason. Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

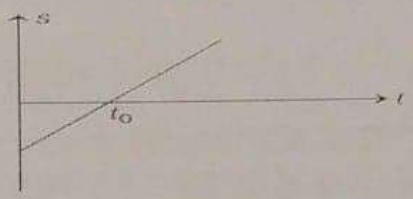
a. If both assertion and reason are true and the reason is correct explanation of the assertion.
b. If both assertion and reason are true and the reason is not the correct explanation of the assertion.
c. If the assertion is true but the reason is false.
d. If both the Assertion and Reason are false.

Q13. **Assertion:** If the initial and final positions coincide, the displacement is a null vector.
Reason: A physical quantity can not be called a vector, if its magnitude is zero.

Q14. **Assertion:** A seasoned cricketer allows a longer time for his hands to stop the ball, while catching the ball. His hand is not hurt.

Reason: The novice (new player) keeps his hand fixed and tries to catch the ball almost instantly. He needs to provide a much greater force to stop the ball instantly and this hurts.

Q15. **Assertion**: In the s-t diagram as shown in figure, the body starts moving in positive direction but not from s = 0.



Reason: : At t = 0, velocity of body changes its direction of motion.

Q16. **Assertion**: a rocket moves forward by pushing the surrounding air backwards.
Reason: it drives the necessary thrust to move forward, according to Newton's third law of motion.

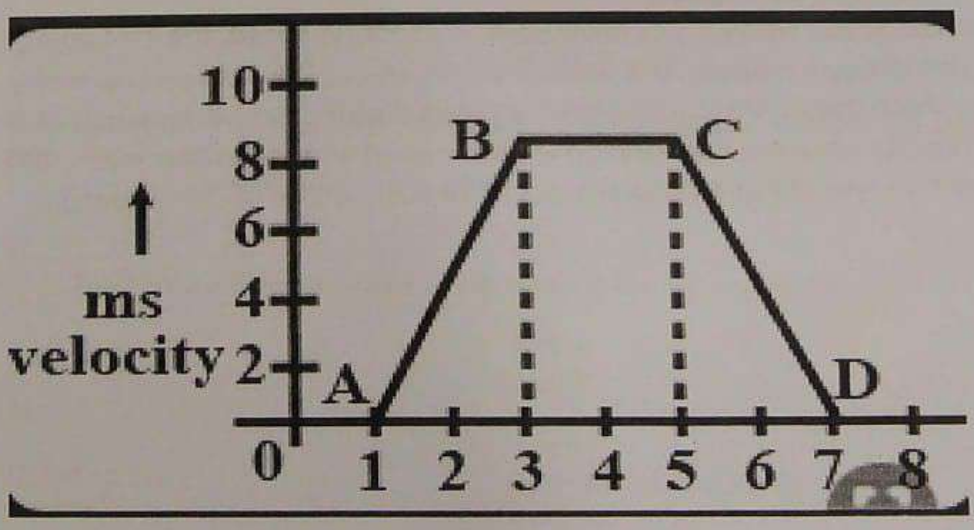
SECTION-B

Q17. For an object projected upward with a velocity *v*, which comes back to the same point after some time, draw
(i) Acceleration-time graph
(ii) velocity-time graph.

Q18. $|\mathbf{A} \times \mathbf{B}| = \sqrt{3}\,(\mathbf{A} \cdot \mathbf{B})$, calculate the value of angle θ.

Q19. A constant retarding force of 50 N is applied to a body of mass 20 kg moving initially with a speed of 15 ms^{-1}. How long does the body take to stop?

Q20. Compute the displacement covered by the vehicle between 3 to 5 seconds using the given velocity-time graph and also calculate acceleration between 1 to 3 seconds.



Q21. Write the dimensions of a and b in the relation $P= (b-x^2)/at$. where P is power, x is distance and t is time.

SECTION-C

Q22. What do you mean by 'dimension' of a physical quantity? Write its two limitations.

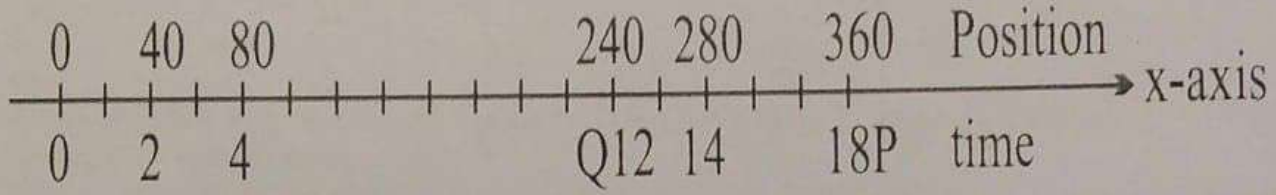
Q23. Write differences between elastic collision and inelastic collision. Show that in a head-on collision between two balls of equal masses moving along a straight line the balls exchange their velocities.

Q24. A body is released from the top of a tower of height h. It takes t sec to reach the ground. Where will be the ball after time t/2 sec from the ground?

Q25. A car is moving along the x-axis. As shown in figure it moves from O to P in 18 seconds and return from P to Q in 6 seconds. What are the average velocity and average speed of the car in going from

(i) O to P

(ii) from O to P and back to Q



Q26. A bullet of mass 0.04 kg moving with a speed of $90ms^{-1}$ enters a heavy wooden block and is stopped after a distance of 60 cm. What is the average resistive force exerted by the block on the bullet?

Q27. The frequency v of vibration of stretched string depends on its length L its mass per unit length m and the tension T in the string obtain dimensionally an expression for frequency v.

Q28. A light inextensible string with ends connected to two unequal masses runs over a frictionless pulley and is free to move. Derive an expression for the acceleration of masses and the tension in the string.

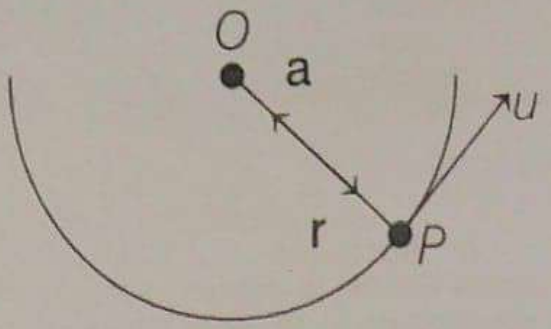
SECTION-D

Q29. **CASE STUDY QUESTION**

Read the passage given below and answer the questions

Uniform Circular Motion

When an object follows a circular path at a constant speed, the motion of the object is called uniform circular motion. The word uniform refers to the speed which is uniform (constant) throughout the motion. Although the speed does not vary, the particle is accelerating because the velocity changes its direction at every point on the circular track. The figure shows a particle P which moves along a circular track of radius r with a uniform speed u.



(i) A circular motion
(a) is one-dimensional motion
(b) is two-dimensional motion
(c) it is represented by combination of two variable vectors
(d) Both (b) and (c)

(ii) For a particle performing uniform circular motion, choose the incorrect statement from the following.
(a) Magnitude of particle velocity (speed) remains constant.
(b) Particle velocity remains directed perpendicular to the radius vector.
(c) Direction of acceleration keeps changing as the particle moves.

(iii) Two cars A and B move along a concentric circular path of radius r_A and r_B with velocities v_A and v_B maintaining constant distance, then v_A/v_B is equal to

(a) $\frac{r_B}{r_A}$ (b) $\frac{r_A}{r_B}$

(c) $\frac{r_A^2}{r_B^2}$ (d) $\frac{r_B^2}{r_A^2}$

(iv) A particle is revolving at 1200 rpm in a circle of radius 30 cm. Then, its acceleration is
(a) 1600 ms^{-2} (b) 4740 ms^{-2} (c) 2370 ms^{-2} (d) 5055 ms^{-2}

Q30. **CASE STUDY QUESTION**

Read the passage given below and answer the questions

In everyday life, the term work is used to refer to any form of activity that requires the exertion of mental or muscular efforts. In physics, work is said to be done by a force or against the direction of the force, when the point of application of the force moves towards or against the direction of the force. If no displacement takes place, no work is said to be done.

i. A box is pushed through 4.0 m across a floor offering 100 N resistance. How much work is done by the applied force?

a. 100J b. 200 J
c. 300 J d. 400 J

ii. What is work done in holding a 15 kg suitcase while waiting for 15 minutes?

a. 22.5 J b. 225 J
c. zero d. 150 J

iii. Frictional forces are:

a. conservative forces b. non- conservative forces
c. buoyant force. d. none of these

iv. When the body moves in circular motion, net 'work' done is:

a. positive b. negative

c. zero d. none of these

OR

Force of 4N is applied on a body of mass 20 kg. The work done in 3rd second is:

a. 2J b. 4J
c. 6J d. 8J

SECTION-E

Q31. A body is projected at an angle θ with the horizontal velocity 'u'. Derive an expression for its (i) time of flight (ii) horizontal range. (b) Show that there are two angles of projection for which the horizontal range is the same.

OR

State the parallelogram law of vectors addition.
Find analytically the magnitude and direction of the resultant of two vectors inclined at a certain angle with each other.
Determine a unit vector perpendicular to both $\mathbf{A} = 2i + j + k$ and $\mathbf{B} = i - j + 2k$

Q32. (a) What do you mean by impulse of force? Show that impulse of a force is equal to the change in momentum produced by the force. (b) A ball of mass 200 g hits a wall at an angle of 45^0 with a velocity of 15 m/s. If the ball rebounds at 90^0 to the direction of incidence, calculate the impulse received by the ball.

OR

State Newton's second law of motion. From it derive the relation between force, mass, and acceleration of a body. Hence from it define one newton force.
A ball of mass 100 g moving with a velocity of 10 m/s is brought to rest by a boy in 0.02 sec. Calculate the impulse and the force applied by the boy.

Q33. (a) A body starts accelerating uniformly with acceleration 'a' with an initial velocity 'u' and travels in a straight line. Derive an equation for the distance covered by it in n^{th} second of its motion. (b) A ball is dropped from the top of a tower of height h. The total distance covered by it in the last second of its motion is equal to the distance covered by it in the first three seconds, what is the value of h? ($g = 10\ m/s^2$)

OR

Draw the velocity- time graph of uniformly accelerated motion in one dimension. Derive the relations (i) ~~$v^2 = u^2 + 2as$~~ (ii) $s = ut + (1/2)at^2$ and (iii) $v^2 = u^2 + 2as$
All symbols have a common meaning.

$v = u + at$.

$$T = \frac{2m_1 m_2 g}{m_1 + m_2}$$

$$= \frac{[M][M] \cdot [LT^{-2}]}{[M]}$$

$$= M^2 M^{-1} L T^{-2}$$

$$= M^{-1} L T^{-2}$$

	0°	30°	45°	60°	90°
Sin	1	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	0
Cos	0	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	1
tan	n.d	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	0.