



Physicsaholics



Exercise

**Kinematics- 1D
(Physicsaholics)**



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PRATEEK JAIN
PHYSICSAHOLICS

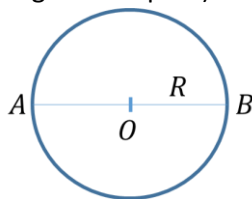
Exercise-4

(Subjective Type: Level- 1)

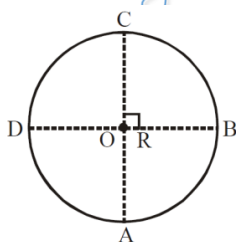


- Q 1.** The position of a particle along the x-axis is given in centimeters by $x=9.75+1.50t^3$, where t is in seconds. Consider the time interval $t = 2s$ to $t = 3s$ and calculate
- the average velocity
 - instantaneous velocity at $t = 2s$;
 - the instantaneous velocity when $t = 2.5s$;
 - the instantaneous velocity when the particle is mid way between its position at $t = 2s$ and $t = 3s$.

- Q 2.** What will be the distance and displacement while moving in a circle from A to B (along circular path) and then B to A (along circular path) as shown in adjoining figure?



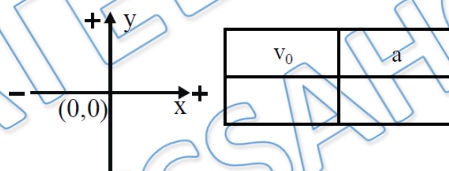
- Q 3.** A particles starts from point A with constant speed v on a circle of radius R . Find magnitude of average velocity during its journey from :-



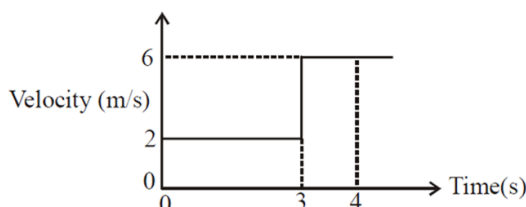
- A to B (anticlockwise)
 - A to C (anticlockwise)
 - A to D (anticlockwise)
- Q 4.** A ball is thrown vertically up with a certain velocity from the top of a tower of height 40 m. At 4.5 m above the top of the tower its speed is exactly half of that it will have at 4.5 m below the top of the tower. Find the maximum height reached by the ball above the ground?
- Q 5.** A car accelerates with uniform rate from rest on a straight road. The distance travelled in the last second of a three second interval from the start is 15 m then find the distance travelled in first second in m.
- Q 6.** A body travelling in straight line a travels 2 m in the first two seconds and 2.2m in the next four seconds with constant retardation. What will be its velocity at the end of the seventh second from the start?
- Q 7.** A particle moving in one-dimension with constant acceleration of 10 m/s^2 is observed to cover a distance of 100 m during a 4s interval. How far will the particle move in the next 4s?



- Q 8.** The window of the fourth floor of a building is 5 m high. A man looking out of the window sees an object moving up and down the height of window for 2 sec. Find the height that the object reaches from the top end of the window.
- Q 9.** A car moving on a straight road with a speed 20m/s. At $t = 0$, the driver of the car applies the brakes after watching an obstacle 150m ahead. After application of brakes the car retards with 2m/s^2 . Find the position of the car from the obstacle at $t = 15\text{s}$.
- Q 10.** A driver travelling at speed 36 kmh^{-1} sees the light turn red at the intersection. If his reaction time is 0.6s, and then the car can deaccelerate at 4ms^{-2} . Find the stopping distance of the car.
- Q 11.** A particle starts from rest at $t = 0$ and $x = 0$ to move with a constant acceleration $= +2\text{ m/s}^2$, for 20 seconds. After that, it moves with -4 m/s^2 for the next 20 seconds. Finally, it moves with positive acceleration for 10 seconds until its velocity becomes zero.
(a) What is the value of the acceleration in the last phase of motion?
(b) What is the final x-coordinate of the particle?
(c) Find the total distance covered by the particle during the whole motion.
- Q 12.** A particle is moving along x-axis. Initially it is located 5 m left of origin and it is moving away from the origin and slowing down. In this coordinate system, what are the signs of the initial velocity and acceleration.



- Q 13.** Speed of train is increasing linearly with time. The train passes a hut with speed 2 m/s and acquires a speed of 12 m/s after 10 s. What is the speed of the train in m/s, 5 s after passing the hut?
- Q 14.** In the following graph variation with time (t), in velocity (v) of a particle moving rectilinearly is shown. What is average velocity in m/s of the particle in time interval from 0 s to 4 s?



- Q 15.** From the top of a tower, a ball is thrown vertically upwards. When the ball reaches h below the tower, its speed is double of what it was at height h above the tower. Find the greatest height attained by the ball from the tower.



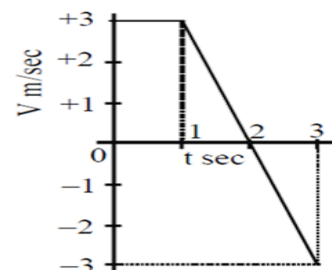
- Q 16.** A body is dropped from a height of 300 m. Exactly at the same instant another body is projected from the ground level vertically up with a velocity of 150 ms^{-1} . Find when they will meet.
- Q 17.** A particle goes from A to B with a speed of 40 km/h and B to C with a speed of 60 km/h . If $AB = 6BC$, the average speed in km/h between A and C is.
- Q 18.** A body moving with uniform acceleration has a velocity of -11 cm/s when its x coordinate is 3.00 cm . If its x coordinate 2 s later is -5 cm , what is the magnitude in cm/s^2 of its acceleration?
- Q 19.** A balloon rises from rest on the ground with constant acceleration $\frac{g}{3}$. A stone is dropped when the balloon has risen to a height 60 metre. The time taken by the stone to reach the ground is.
- Q 20.** The momentum of a particle moving in straight line is given by $p = \ln t + \frac{1}{t}$ (in kg m/s) find the time $t > 0$ at which the net force acting on particle is 0 and its momentum at that time.
[Hint: $F = \frac{dp}{dt}$]
- Q 21.** A wheel rotates so that the angle of rotation is proportional to the square of time. The first revolution was performed by the wheel for 8 sec. Find the angular velocity ω , 32 sec after the wheel started. [Hint: Consider $\theta = kt^2$, find k]
- Q 22.** Two particles A and B are moving in same direction on same straight line. A is ahead of B by 20m. A has constant speed 5 m/sec and B has initial speed 30 m/sec and retardation of 10 m/sec^2 . Then if x (in m) is total distance travelled by B as it meets A for second time. Then value of x will be.
- Q 23.** The charge flowing through a conductor beginning with time $t = 0$ is given by the formula $q = 2t^2 + 3t + 1$ (coulombs). Find the current $i = \frac{dq}{dt}$ at the end of the 5th second.
- Q 24.** A point moves in a straight line so that its distance from the start in time t is equal to
$$s = \frac{1}{4}t^4 - 4t^3 + 16t^2.$$

(a) At what times was the point at its starting position?
(b) At what times is its velocity equal to zero?
- Q 25.** A body whose mass is 3 kg performs rectilinear motion according to the formula $s = 1 + t + t^2$, where s is measured in centimetres & t in seconds. Determine the kinetic energy $\frac{1}{2}mv^2$ of the body in 5sec after its start.



Q 26. A driver applies brakes to the vehicle on seeing traffic signal 400 m ahead. At the time of applying the brakes vehicle was moving with 15 ms^{-1} and then starts retarding with 0.3 ms^{-2} . The distance of vehicle after 1 min from the traffic light?

- Q 27.** A particle moves along a straight line, x. At time $t = 0$, its position is at $x = 0$. The velocity, V , of the object changes as a function of time t , as indicated in the figure; t is in seconds, V in m/sec and x in meters.
- (a) What is x at $t = 3 \text{ sec}$?
(b) What is the instantaneous acceleration (in m/sec^2) at $t = 2 \text{ sec}$?
(c) What is the average velocity (in m/sec) between $t = 0$ and $t = 3 \text{ sec}$?
(d) What is the average speed (in m/sec) between $t = 1$ and $t = 3 \text{ sec}$?



Q 28. A force of 40N is responsible for the motion of a body governed by the equation $s = 2t + 2t^2$ where s is in meters and t in sec. What is the momentum of the body at $t = 2 \text{ sec}$?
[Hint: Find acc. then $m = F/a$ & $p = mv$]

Q 29. A rocket is fired vertically upwards with initial velocity 40 m/s at the ground level. Its engines then fired and it is accelerated at 2 m/s^2 until it reaches an altitude of 1000 m . At that point the engines shut off and the rocket goes into free-fall. If the velocity (in m/s) just before it collides with the ground is $40a$. Then fill the value of a . Disregard air resistance ($g = 10 \text{ m/s}^2$).

Q 30. The angle rotated by a disc is given by $\theta = \frac{2}{3}t^3 - \frac{25}{2}t^2 + 77t + 5$, where θ is in rad and t in seconds.

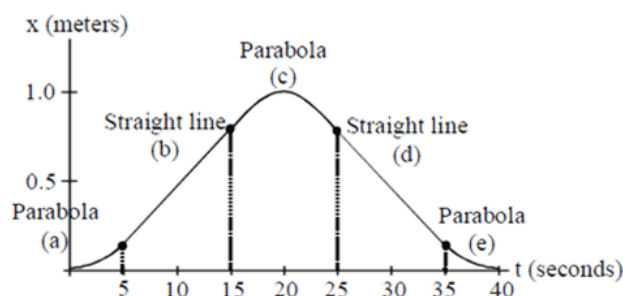
- (a) Find the times at which the angular velocity of the disc is zero.
(b) Its angular acceleration at these times.

Q 31. The velocity of the particle is given as $v = 3t^3 + \frac{1}{t^2}$. Calculate the net force acting on the body at time $t = 2 \text{ sec}$, if the mass of the body is 5 kg .

Q 32. A stone is dropped from the top of a tall cliff, and 1 s later a second stone is thrown vertically downward with a velocity of 20 ms^{-1} . How far below the top of the cliff will the second stone overtake the first?

Q 33. The acceleration of a particle starting from rest vary with respect to time is given by $a = (2t - 6)$, where t is in seconds. Find the time (in seconds) at which velocity of particle in negative direction is maximum.

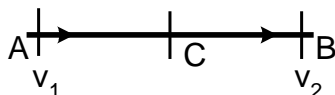
Q 34. The figure below is a displacement vs time plot for the motion of an object, answer questions (i) & (ii) with the letter of appropriate section of the graph.



- (i) Which section represents motion in the forward direction with positive acceleration?
(ii) Which section represents uniform motion backwards ($-x$ direction)?

Q 35. Acceleration of a particle is defined as $a = (75V^2 - 30V + 3)(\text{m/s}^2)$. If the constant speed achieved by the particle is given by V_c , then find the value of $10V_c$.

Q 36. A particle moving with uniform acceleration from A to B along a straight line has velocities v_1 and v_2 at A and B respectively. If C is the mid point between A and B then determine the velocity of the particle at C.



Q 37. The angle θ through which a pulley turns with time t is specified by the function $\theta = t^2 + 3t - 5$. Find the angular velocity $\omega = \frac{d\theta}{dt}$ at $t = 5$ sec.

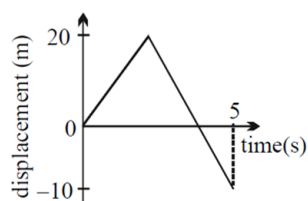
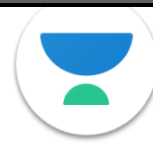
Q 38. Position vector of a particle is given by $\vec{r} = 3t^3\hat{i} + 4t\hat{j} + t^2\hat{k}$. Find avg. acceleration of particle from $t = 1$ to $t = 2$ sec.

Q 39. A particle moves along the x-axis according to $x = 4t - t^2$. Find the distance travelled from $t = 0$ s to $t = 3$ s.

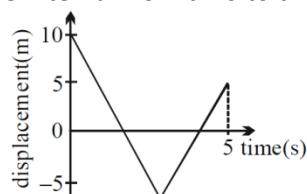
Q 40. The motion of a particle in a straight line is defined by the relation $x = t^4 - 12t^2 - 40$ where x is in meters and t is in sec. Determine the position x , velocity v and acceleration a of the particle at $t = 2$ sec.

Q 41. The position x of a particle w.r.t. time t along x-axis is given by $x = 9t^2 - t^3$ where x is in metre and t in second. Find
(a) Maximum speed along $+x$ direction
(b) Position of turning point
(c) Displacement in first ten seconds
(d) Distance travelled in first ten seconds

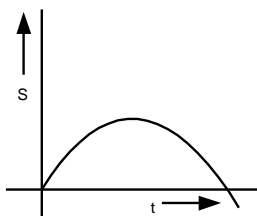
Q 42. (a) The diagram shows the displacement-time graph for a particle moving in a straight line. Find the average velocity for the interval from $t = 0$ to $t = 5$.



(b) The diagram shows the displacement-time graph for a particle moving in a straight line. Find the average speed for the interval from $t = 0$ to $t = 5$.



Q 43. The graph of displacement v/s time is



Draw its corresponding velocity-time graph.



Answer Key

Ans. 1 (a) 28.5 cm/s (b) 18.0 cm/s (c) 28.1 cm/s (d) 30.4 cm/s

Ans. 2

Physical quantity and direction	Half cycle A → B or B → A
Distance	πR
Displacement	$2R$
Direction of displacement	1. A → B, when particle moves from A to B. 2. B → A, when particle moves from B to A.

Ans. 3 (a) $2\sqrt{2} \frac{v}{\pi}$, (b) $\frac{2v}{\pi}$ (c) $\frac{2\sqrt{2}v}{3\pi}$

Ans. 4 47.5 m

Ans. 5 3

Ans. 6 0.1 m/s

Ans. 7 260

Ans. 8 Zero

Ans. 9 50 m

Ans. 10 18.5 m



Ans. 11 (a) 4 m/s^2 , (b) 200, (c) 1000 m

Ans. 12

v_0	a
—	+

$\leftarrow \text{vel}$

Because particle is slowing down so velocity & acceleration are in opposite direction.

Ans. 13 7

Ans. 14 3

Ans. 15 $5h/3$

Ans. 16 2 sec. after body is dropped

Ans. 17 42 km/hr

Ans. 18 7

Ans. 19 6

Ans. 20 1 kg m/sec.

Ans. 21 $2\pi \text{ rad/sec.}$

Ans. 22 50

Ans. 23 23 amp

Ans. 24 (a) 0, 8 sec (b) 0, 4, 8 sec

Ans. 25 $1.815 \times 10^5 \text{ ergs.}$

Ans. 26 25 m

Ans. 27 (a) 3 m; (b) -3 m/s^2 ; (c) 1 m/s ; (d) $3/2 \text{ m/s}$

Ans. 28 100 kgm/s

Ans. 29 4

Ans. 30 (a) $7, \frac{11}{2}$ (b) 3, -3



Ans. 31 186.25 N

Ans. 32 $\frac{45}{4}$ m

Ans. 33 3

Ans. 34 (i) section (a) as slope = $v = \frac{dx}{dt}$ is positive and increasing.

(ii) section (d) as slope = $v = \frac{dx}{dt}$ is negative and constant.

Ans. 35 2

Ans. 36 $v = \sqrt{\frac{v_1^2 + v_2^2}{2}}$

Ans. 37 13 rad/s

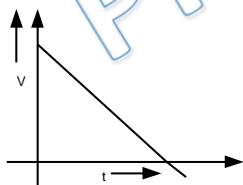
Ans. 38 $(27\hat{i} + 2\hat{k}) \text{ m/s}^2$

Ans. 39 5m

Ans. 40 -72, -16, 24

Ans. 41 (a) 27 m/s, (b) 108 m, (c) -100 m, (d) 316 m

Ans. 42 Ans. (a) -2 ms^{-1} (b) 5 m/s



Ans. 43