

A 31.25m

B 250m

© 500m

D 5000m

Answer Key:

1	A	6	0
2	В	7	В
3	0	8	(D)
4	0	9	A
5	A	10	(C)



Q1: Explain translatory motion and give examples of various types of translatory motion.

Ans: Translatory motion:

The motion, in which a body moves along a line (straight or curved) without any rotation, is called translator motion.

Example:

Motion of Ferris wheel

Types of translatory motion:

- (a) Circular motion (b) Linear motion
- (c) Random motion

(a) Circular motion:

The motion of an object in a circular path is known as circular motion.

Example:

A car is moving along a circular track.

(b) Linear motion:

The straight line motion of a body is known as its linear motion.

Example:

Rocket flying straight in the air is linear motion.

(c) Random motion:

The disordered or irregular motion of an object is called random motion.

Example:

The motion of insects and birds is random motion.

Q2: Define the terms speed, velocity, and acceleration.

Ans: Speed (V):

The rate of change of position with time is called speed. Its unit is ms⁻¹.

Velocity (\overrightarrow{V}):

The rate of change of displacement is called velocity and its unit is ms⁻¹.

Acceleration (\vec{a}) :

The rate of change of velocity is called acceleration and its unit is ms⁻².

Q3: Differentiate between the following:

- (a) Rest and motion.
- (b) Circular motion and rotatory motion.
- (c) Distance and displacement.
- (d) Speed and velocity.
- (e) Linear and random motion.
- (f) Scalars and vectors.

Ans: Difference between Rest and Motion is:

Rest	Motion & pakcity.org
"A condition in which a body does not	"A condition in which a body changes
change its position with respect to its	its position with respect to its
surroundings".	surroundings".
Example:	Example:
A book lying on the table.	A flying bird.
A bench fixed in a park.	A boy playing football.

Difference Circular Motion and Rotatory Motion is:

	Circular Motion		Rotatory Motion
>	The motion of an object or body in	>	The motion of a body around an
	a circular path is called circular		axis passing through it is called
	motion.		rotatory motion.
>	In circular motions, the point	>	In rotatory motion, the line
	about which a body goes around is		around which a body moves about

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outside the body.	is passing through the body itself.	
Examples:	Examples:	
The moon circling the earth.A satellite circling round the earth.	A rotating fan.A spinning top.	

Difference Distance and Displacement:

	Distance			Displace	ment
>	Total length of a path between two	>	The	shortest	distance
	points is called distance.		betwe	en two poin	ts is called
>	Distance is a scalar quantity.		displa	cement.	
5		>	Displa	acement is a	vector quantity.

Difference Speed and Velocity:

	Speed	Velocity
>	Distance covered by a body in unit	> The shortest distance between
	time is called speed.	two points is called displacement.
>	Distance is a scalar quantity.	Displacement is a vector quantity.
Formula:		Formula:
	$V = \frac{S}{I}$	$v - \frac{d}{d}$
	t	t

Difference Linear and Random Motion:

Linear Motion	Random Motion
The motion of a body along a straight	The irregular or zigzag motion of a
line is called linear motion.	body is called random motion.
Example: pakcity	Example:
Freely falling object.	Random motion of gas molecules.

Difference Scalars and vectors:

Scalars	Vectors 🏶 pakcity.org 🐉
A scalar quantity is a quantity which	Vectors are quantities, which are
	completely specified by both magnitude
magnitude only.	and direction.
Example:	Example:
Work, power, speed and distance, etc.	Velocity, force, torque and displacement

	etc.
Market and the second	

- Q4: Can a body moving at a constant speed have acceleration?
- **Ans: Yes,** a body moving at constant speed has acceleration if it changes its direction or moves in a circular path.
- Q5: How do riders in a Ferries wheel possess translatory motion but not rotatory motion?
- **Ans:** In rotatory motion, the line, about which a body moves, it's passing through the body itself. Here, riders in the Ferris wheel have circular motion (a type of translatory motion) because the line about which wheel riders go around lies outside the body.
- Q6: What would be the shape of a speed-time graph of a body moving with variable speed?
- **Ans:** The shape of the velocity-time graph is zigzag i.e. not a straight line, when the body is moving at variable speed.
- Q7: Sketch a distance-time graph for a body starting from rest. How will you determine the speed of a body from this graph?
- Ans: The shape of the graph is as shown in Fig.

The slope of this graph gives $=\frac{\Delta S}{t}$

The slope of this graph gives = $\frac{\text{change in distance}}{\text{time}}$

The slope of this graph gives $=\frac{d}{t}$

i.e. slope of this graph = speed

- Q8: Which of the following can be obtained from speed-time graph of a body?
 - (a) Initial speed

- (b) Final speed
- (c) Distance covered in time t
- (d) Acceleration of motion
- **Ans:** All the above quantities can be obtained from the speed-time graph of a moving body.
- Q9: How can vector quantities be represented graphically?
- **Ans:** Vectors are graphically represented by a straight line with an arrowhead. The length of a line shows the magnitude and arrowhead tells about direction.
- Q10: How are vector quantities important to us in our daily life?



Ans: Vectors quantities are important to us in our daily life because they provide complete information about quantity i.e. magnitude and direction.

Q11: Why vector quantities cannot be added and subtracted like scalar quantities?

Ans: Scalar quantities are the quantities which can be described completely by magnitude while vector quantities need direction and magnitude for their complete description. The quantities having direction cannot be added and subtracted like scalar quantities.

Q12: Derive equations of motion for uniformly accelerated rectilinear motion?

Equations of motion for uniformly accelerated rectilinear motion is:

(a)
$$v_f = v_i + at$$

Slope of AB = a, =
$$\frac{BC}{AC} = \frac{BC - CD}{OD_{\hat{A}}}$$

As
$$BD = v_f \quad , \quad CD = v_i \quad , \quad DD = t$$

$$a = \frac{v_f - v_i}{t}$$

$$v_f = v_i + at$$

$$a = \frac{v_f - v_i}{t}$$

$$v_f = v_i + at$$

(b)
$$S = v_i t + \frac{1}{2} a t^2$$
From figure,

From figure,

Area of OACD =
$$OA \times OD$$

Area of OACD =
$$V_i \times t$$

Area of triangle ABC =
$$\frac{1}{2}$$
 × height × base

Area of triangle ABC =
$$\frac{1}{2}$$
 (AC) (BC)
Area of triangle ABC = $\frac{1}{2}$ at²

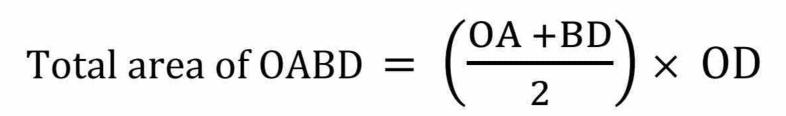
Area of triangle ABC =
$$\frac{1}{2}$$
 at²

Total area OABD = Area of rectangle OACD + Area of triangleABC

Total area =
$$v_i t + \frac{1}{2} a t^2$$

$$S = v_i t + \frac{1}{2} a t^2$$

$$(c) 2aS = v_f^2 - v_i^2$$



$$S = \left(\frac{OA + BD}{2}\right) \times OD$$

$$2S = (OA + BD) \times OD$$

Multiplying by $\left(\frac{BC}{OD}\right)$ on both sides

$$2S \times \left(\frac{BC}{OD}\right) = \left[(OA + BD) \times OD \right] \left(\frac{BC}{OD}\right)$$

$$2S \times \left(\frac{BC}{OD}\right) = (OA + BD) \times BC$$

$$2S \times a = (v_f + v_i) (v_f - v_i)$$

$$2aS = v_f^2 - v_i^2$$





Important Formulas

$$\triangleright$$
 $v_f = v_i + at$

$$v_f = v_i + at$$

$$2aS = v_f^2 - v_i^2$$

$$S = v_i t + \frac{1}{2} a t^2$$

$$S = v_{av} \times t$$

$$\gt$$
 $S = v_{av} \times t$

Reparcity.org Proportant Values

$$> 1 \text{km} = 1000 \text{m}$$

$$\triangleright$$
 1hour = 3600second

$$1 \text{kmh}^{-1} = \frac{10}{36} \, \text{ms}^{-1}$$

$$\rightarrow$$
 1kmh⁻¹ = 0.277 ms⁻¹

$$\rightarrow$$
 1m = 10⁻³km = 0.001km

$$\rightarrow$$
 1m = $\frac{1}{3600}$ h

 $1 \text{ms}^{-1} = 0.001 \times 3600 \text{ kmh}^{-1}$

$$1 \text{ms}^{-1} = 3.6 \text{ kmh}^{-1}$$

Units: (S.I)

- Distance = S = metre (m)
- Displacement = d = metre (m)
- Speed = $v = ms^{-1}$
- Velocity = $v = ms^{-1}$
- Acceleration = $a = ms^{-2}$ pakeity.org
- Time = t





Ans: Given data:

$$V = 36 \text{ kmh}^{-1} = \frac{36 \times 1000}{3600}$$

$$V = \frac{36000}{3600}$$

$$V = 10 \text{ms}^{-1}$$

$$t = 10s$$

To Find:

$$S = ?$$

Solution:

$$s = v_i \times t$$

$$S = 10 \times 10$$

$$S = 100m$$

2. A train starts from rest. It moves through 1km in 100s with uniform acceleration. What will be its speed at the end of the 100s?

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Ans: Given data:

$$V_i = 0 \text{ms}^{-1}$$

$$S = 1km = 1000m$$

$$t = 100s$$

To Find:

$$V_f = ?$$

Solution:

By using 2nd equation of motion.

$$S = v_i t + \frac{1}{2} a t^2$$

$$1000 = 0 \times t + \frac{1}{2}(a)(100)^2$$

$$1000 = \frac{1}{2} (a)(10000)$$

$$2000 = (a)(10000)$$

$$\frac{2000}{10000} = a$$

$$0.2 \text{ ms}^{-2} = a$$

Now, we can find the final velocity:

$$v_f = v_i + at$$

Using the values:

$$v_f = 0 + (0.2) (100)$$

$$v_f = 20 \text{ms}^{-1}$$

The speed of the train is 20ms⁻¹.

3. A car has a velocity of 10ms⁻¹. It accelerates at 0.2ms⁻² for half a minute. Find the distance travelled during this time and the final velocity of the car.

Ans: Given data:

$$V_i = 10 \text{ms}^{-1}$$

$$a = 0.2 \text{ ms}^{-2}$$

$$t = \frac{1}{2}$$
minute = 30sec

To Find:

$$S = ?$$

$$V_f = ?$$

Solution:

(i) By using 2nd equation of motion.

$$S = v_i t + \frac{1}{2} a t^2$$

$$S = 10 \times 30 + \frac{1}{2}(0.2)(30)^2$$

$$S = 300 + \frac{1}{2}(0.2)(900)$$

$$S = 300 + (0.1)(900)$$

$$S = 300 + 90$$

$$S = 390m$$

(ii) Using 1st equation of motion.

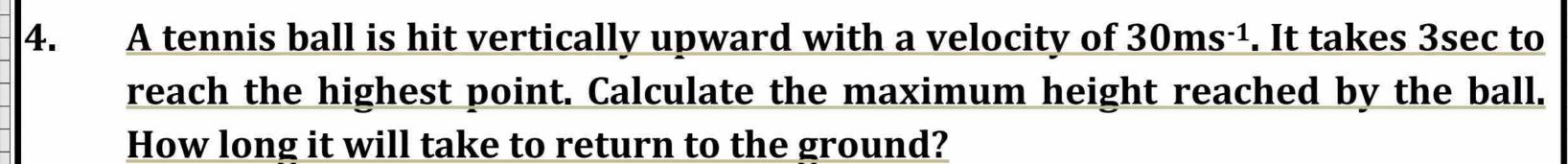
$$v_f = v_i + at$$

Using the values

$$V_f = 10 + (0.2)(30)$$

$$v_f = 10 + 6$$

$$v_f = 16ms^{-1}$$



Ans: Given data:

$$\begin{aligned} v_i &= 30ms^{\text{-}1} \\ v_f &= 0ms^{\text{-}1} \\ g &= -10ms^{\text{-}2} \\ t &= 3sec \end{aligned}$$

To Find:

$$S = h = ?$$

Solution:

$$H = v_i t + \frac{1}{2} g t^2$$

$$h = 30 \times 3 + \frac{1}{2} (-10)(3)^2$$

$$h = 30 \times 3 + (-5)(9)$$

$$h = 90 - 45$$

$$h = 45$$

The time taken by the ball to come to the ground:

Data can be written in this case as,

Initial velocity
$$= v_i = 0 m s^{-1}$$

Gravitational Acceleration $= g = 10 m s^{-2}$
Time $= t = ?$
Distance $= height = h = 45 m$

As we know from second equation of motion.

$$H = v_i t + \frac{1}{2} a t^2$$

By putting values, we get

$$45m = (0) (t) + \frac{1}{2} (10)(t)^{2}$$

$$45m = (5) t^{2}$$

$$\frac{45}{5} = t^{2}$$

$$9 = t^{2}$$

$$0r t^2 = 9$$

By taking under root on both sides:

$$\sqrt{t^2} = (3)^2$$

$$t = 3s$$

Total time taken by the ball is

$$3 + 3 = 6s$$

5. A car moves with a uniform velocity of 40ms⁻¹ for 5s. It comes to rest in the next 10s with uniform deceleration. Find (i) the deceleration (ii) the total distance travelled by the car.

Given data: Ans:

$$Time = t = 10sec$$

Initial velocity =
$$v_i = 40 \, ms^{-1}$$

Final velocity =
$$v_f = 0 \text{ms}^{-1}$$

To Find:

Deceleration
$$= a = ?$$

Solution:

$$v_f = v_i + at$$

$$v_f = v_i + at$$
 $0 = 40 + a (10)$
 $-40 = 10a$
 $A = -4ms^{-2}$

$$-40 = 10a$$

$$A = -4ms^{-2}$$

Part (II)

To find the total distance (s)

$$S = v \times t$$

Using the values, we have

$$S = 40 \times 10$$

$$S = 400m$$

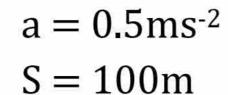
The total distance covered by a car is 400m.

A train starts from rest with an acceleration of 0.5ms⁻². Find its speed in kmh⁻¹ 6. when it has moved through 100m.

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Given data: Ans:

$$V_i = 0 \text{ms}^{-1}$$



To Find:

$$V_f = ?$$

Solution:

Using 3rd equation of motion

$$2aS = v_f^2 - v_i^2$$

 $2 (0.5) (100) = v_f^2 - 0^2$
 $v_f^2 = 100$

By taking square root on both sides

$$V_f = 10 \text{ms}^{-1}$$

Conversion of ms⁻¹ into Kmh⁻¹

$$V_f = \frac{10 \times 3600}{1000} \, kmh^{-1}$$

$$V_f = 36 \text{kmh}^{-1}$$

7. A train starting from rest accelerates uniformly and attains a velocity of 48 kmh⁻¹ in 2 minutes. It travels at this speed for 5 minutes. Finally, it moves with uniform retardation and is stopped after 3 minutes. Find the total distance traveled by the train.

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Ans: Given data:

$$V_i = 0 \text{ms}^{-1}$$

$$V_f = 48 \text{kmh}^{-1} = \frac{48 \times 100}{36000} \text{ ms}^{-1}$$

$$V_f = 13.3 \text{ms}^{-1}$$

$$t_1 = 2min = 2 \times 60 = 120sec$$

Required:

Total distance
$$= S = ?$$

Solution:

$$v_f = v_i + at$$

$$13.3 = 0 + a (120)$$

$$a = 0.1 \text{ms}^{-2}$$

(i) Distance
$$= S_1 = ?$$

$$S_1 = v_i t + \frac{1}{2} a t^2$$



$$S_1 = 0 \times 120 + \frac{1}{2}(0.1)(120)^2$$

 $S_1 = 0 + \frac{1}{2}(0.1)(14400)$

$$S_1 = 720m$$

(ii) Motion with constant velocity

$$v = 13.33 \text{ms}^{-1}$$

$$t_2 = 5min = 5 \times 60 = 300sec$$

$$S_2 = v \times t_2$$

$$S_2 = 13.33 \times 300$$

$$S_2 = 3999m$$

(iii) Motion with negative acceleration

$$V_i = 13.33 \text{ms}^{-1}$$

$$V_f = 0 \text{ms}^{-1}$$

$$V_i = 13.33 \text{ms}^{-1}$$
 $V_f = 0 \text{ms}^{-1}$
 $t_3 = 3 \text{min} = 3 \times 60 = 180 \text{sec}$
 $S_3 = v_{av} \times t_3$

$$S_3 = v_{av} \times t_3$$

$$S_3 = \frac{v_i - v_f}{2} \times t_3$$

$$S_3 = \frac{13.33 - 0}{2} \times 180$$

$$S_3 = 1199.7m$$

Total distance =
$$720m + 3999m + 1199.7m$$

Total distance = 5918.7 m

- A cricket ball is hit vertically upwards and returns to the ground in 6s later. **Calculate** pakcity.org
 - (i) The maximum height reached by the ball
 - (ii) The initial velocity of the ball.

Ans: Given data:

Time taken by the ball to return to ground = 6s

Time to reach maximum height = t =
$$\frac{6}{2}$$

$$t = 3s$$

$$v_f = 0 \text{ms}^{-1}$$

To find:

i.
$$v_i = ?$$

ii.
$$S = h = ?$$

Solution:

By using the 1st equation of motion.

$$v_f = v_i + at$$

$$v_i = v_f - at$$

$$v_i = v_f - gt$$

$$v_i = 0 - (-10)(3)$$

$$v_i = 30 \text{ms}^{-1}$$

ii. By using the 3rd equation of motion.

$$2aS = v_f^2 - v_i^2$$

$$2aS = v_f^2 - v_i^2$$

$$2(-10)h = (0)^2 - (300)^2$$

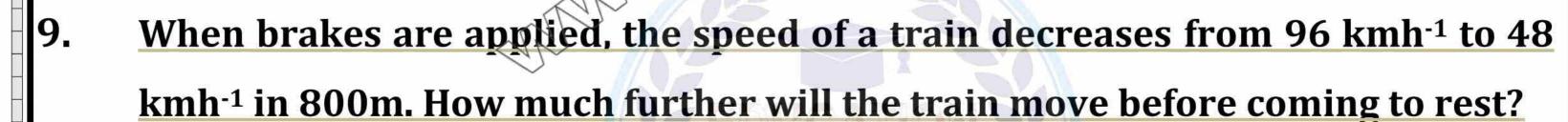
$$-20h = -900$$

$$-20h = -900$$

$$H = \frac{-900}{-20}$$

$$h = \frac{1}{-20}$$

$$h = 45$$



Given data: Ans:

$$V_i = 96 \text{kmh}^{-1} = \frac{96 \times 1000}{3600} \text{ms}^{-1} = 26.67 \text{ms}^{-1}$$

$$V_f = 48 \text{kmh}^{-1} = \frac{48 \times 1000}{3600} \text{ms}^{-1} = 13.33 \text{ms}^{-1}$$

$$S_1 = 800 m$$

To find:

$$S_2 = ?$$

Using 3rd equation of motion

Solution:

The motion of train consists of two steps:

$$2aS_1 = v_f^2 - v_i^2$$

$$a = \frac{v_f^2 - v_i^2}{2S_1}$$

$$a = \frac{(13.33)^2 - (26.67)^2}{2(800)}$$

$$a = -0.33 \text{ms}^{-2}$$

Distance covered =?

Using 3rd equation of motion

$$2aS_{2} = v_{f}^{2} - v_{i}^{2}$$

$$S_{2} = \frac{v_{f}^{2} - v_{i}^{2}}{2a}$$

$$S_{2} = \frac{(13.33)^{2} - (26.67)^{2}}{2(-0.33)}$$

$$S_2 = 266.6m$$

10. In the above problem, find the time taken by the train to stop after the application of brakes.

Ans: Given data:

$$V_i = 26.67 \text{ ms}^{-1}$$
 $V_f = 0 \text{ ms}^{-1}$
 $a = -0.33 \text{ ms}^{-2}$

To find:

$$t = ?$$

Using 1st equation of motion,

Solution:

$$v_f = v_i + at$$
 $at = v_i - v_f$
 $t = \frac{v_i - v_f}{a}$
 $t = \frac{0 - 26.67}{-0.33}$
 $t = 80.1S$

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