



PHYSICS

BOOKS - PEARSON IIT JEE

FOUNDATION

KINEMATICS

Example

1. A horse is tied to a rope of length 5 m and the other end of the rope is tied to a pole.

Find the displacement and the distance travelled by the horse in the following cases.

When the horse makes half revolution along a circular path.



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2. A horse is tied to a rope of length 5 m and the other end of the rope is tied to a pole.

Find the displacement and the distance travelled by the horse in the following cases:

When it makes one full revolution.



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3. A horse is tied to a rope of length 5 m and the other end of the rope is tied to a pole. Find the displacement and the distance travelled by the horse in the following cases:

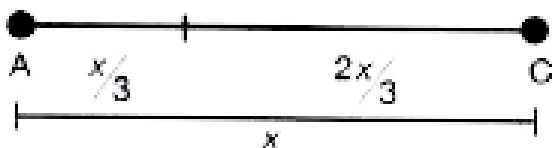
When it makes $\frac{3}{4}$ th of the revolution.



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4. A body moving along a straight path covers one-third of a distance with a velocity of 5

Kmph and the rest of the path with a velocity of 20 Kmph. Find the average velocity of the body.



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5. A bird sitting on a tree top at a height of 5 m from the ground, picks up sticks lying on the ground to build a nest on the tree top. It

starts picking up the sticks at 7:00 a.m. and ends up at 7:10 a.m. During this interval it makes 5 trips up and down. Find the average speed and average velocity of the bird.



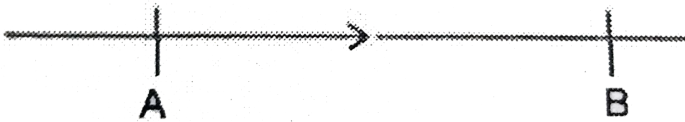
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6. A clock has its minut hand 14 cm long. At what speed and at what velocity does the tip of the minute hand move in a half an hour duration ?



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7. A car moves along a straight path with variable velocity as shown in the figure. When the car is at position A, its velocity is 10ms^{-1} and when it is at position B, its velocity is 20ms^{-1} . If the car takes 5 seconds of time to move from A to B, find the acceleration of the car.



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8. The driver of a passenger train moving at a speed of 90kmh^{-1} observes a goods train at rest on the same track at a distance of 250 m and immediately applies the brakes. What should be the minimum retardation of the passenger train so as to avoid collision of the two trains?



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9. A train moving at a speed of 100 ms^{-1} comes to rest in 5 seconds. Find its retardation.



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10. A car accelerates uniformly at 4 m s^{-2} from rest. Find its velocity at the end of 5 seconds.



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Test Your Concepts Very Short Answer Type Questions

1. What are the different branches of mechanics?



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2. What is kinematics?



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3. How, do you represent a vector geometrically?



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4. What does the length of the line in geometrical representation of a vector signify?



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5. A body is first displaced by 5 m and then by 12 m in different direction. The minimum displacement it can have is _____ m



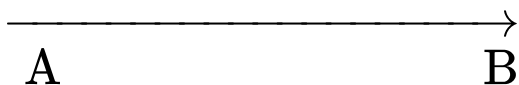
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6. Motion and rest are relative . How do you justify this?



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7. You are walking towards India Gate. Is India Gate at rest with respect with to you or in motion with respect to you?



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8. A passanger, seated in a train is at rest with reference to _____



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9. Define scalar quantities and vector quantities.

Give some examples.



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10. The average value of gravity at sea level is

_____ ms^{-2} .



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11. A particle moved 5 m towards east and then moved 8 m towards west. What is the total distance travelled and the magnitude of displacement?



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12. Define distance, displacement, speed, velocity and acceleration.



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13. Speedometer of a vehicle measures its _____ speed.



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14. When does a particle motion have uniform speed?



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15. For a particle in a non-uniform accelerated circular motion



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16. What is instantaneous velocity?



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17. The ratio of the total distance travelled by a body to the total time taken is known as its



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18. Convert the following speeds into ms^{-1} .

18 $km\ h^{-1}$



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19. Convert the following speeds into ms^{-1} .

63 $km\ h^{-1}$



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20. Convert the following speeds into ms^{-1} .

99 km h⁻¹



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21. Convert the following speeds into ms^{-1} .

108 km h⁻¹



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22. Convert the following speeds into km h^{-1} .

$$2 \text{ m s}^{-1}$$



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23. Convert the following speeds into km h^{-1} .

$$10 \text{ m s}^{-1}$$



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24. Convert the following speeds into km h^{-1} .

$$12.5 \text{ m s}^{-1}$$



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25. Convert the following speeds into km h^{-1} .

$$15 \text{ m s}^{-1}$$



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26. $1 \text{ m s}^{-2} = \underline{\hspace{2cm}} \text{ km h}^{-2}$



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27. A car attains a velocity of 20 m s^{-1} in 2.5 s. If initially it had been at rest, its acceleration must be _____.



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28. What is the acceleration of a body moving with uniform velocity ?



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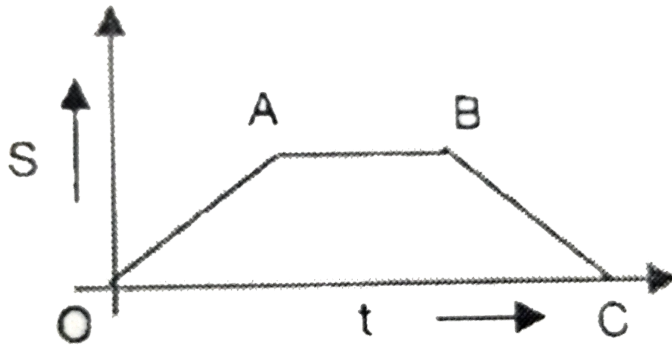
29. Rate of decrease in the magnitude of velocity is also known as _____



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30. The displacement-time graph of a body is shown in the figure below. The part of the graph that represents the uniform motion of

the body is _____



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31. What are acceleration due to gravity

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32. A bus moves by 8 m from its position of rest in 2 s, along a straight road. If it covers 10 m in the next second, it is moving with _____.



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33. What are the different types of graphs that can be drawn to represent the motion of a particle?



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34. Give the equations of motion of a particle undergoing retardation along a straight line.



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35. In a displacement versus time graph _____ is taken on the x-axis



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Test Your Concepts Short Answer Type Questions

1. Explain briefly what is mechanics and mention the different branches of mechanics.



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2. Compare and contrast scalars and vectors



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3. A race horse runs straight north and covers a distance of 12m then turns east and travels a

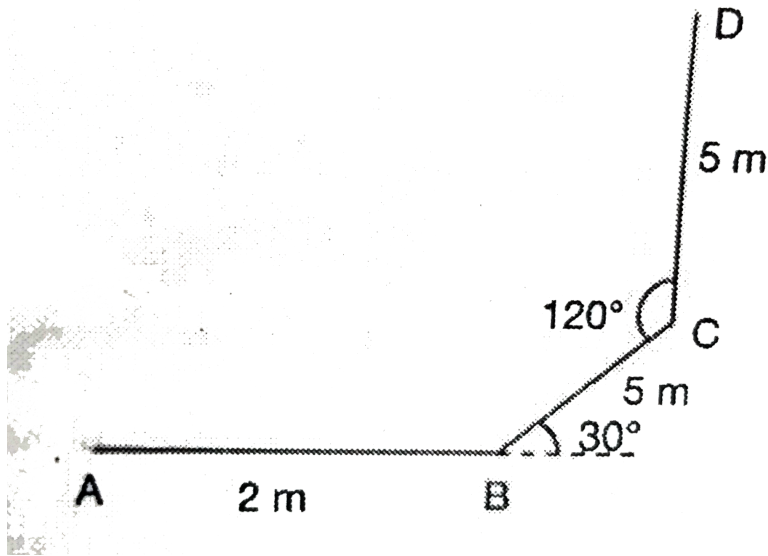
distance of 5m Draw the diagram showing the displacements and from the figure, calculate the net displacement of the horse.



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4. Redraw the following figure to scale and find out the distance and displacement of

particle moving along the path A-B-C-D



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5. Write three difference between distance and displacement.



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6. A crow picks up pebbles and puts them into a pot which is 10 m away from the pot. In doing so, it makes 5 trips within 80 seconds. What is the average speed of the crow?



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7. Differentiate between speed and velocity



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8. Write short notes on instantaneous speed and instantaneous velocity. Give examples.



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9. Explain , with an examples how a particle moving with uniform speed has variable velocity



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10. A pencil is tied to one end of a string of length 5 cm and the other is fixed to a nail. If the time taken to draw a half circle and a full circle, with the pencil is 2 and 4 seconds, respectively, find the speed and velocity pencil

(a) to draw half circle is drawn.

(b) when full circle is drawn

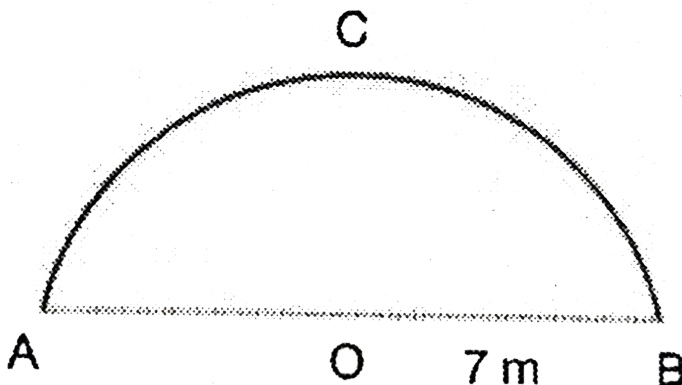


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11. Write short notes on acceleration and deceleration Give example.

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12. A particle travel along a semi-circular path A-C-B as shown in the figure below. The radius of the semi-circular path is 7m.



(a) Find the distance travelled by the particle

(b) Find the displacement (magnitude and direction)

(c) What would be these quantities if the particle completes the circle?



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13. If a particle is moving along a circle of radius 3 m with a constant speed 9 m/s , then it covers a quarter of the circle in time of

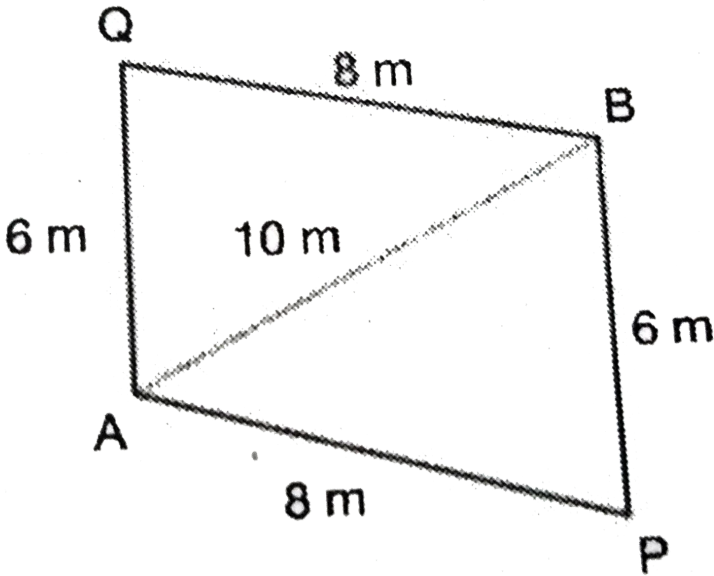


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Test Your Concepts Essay Type Questions

1. A partice takes 8 s to travel from A to B through P (see the figure given below) and another partice travelling through Q takes 7 s.

Find the speed and velocity of each particle.



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2. A particle moving along a straight line has instantaneous velocities during the first 5 seconds as given below. Draw a velocity - time

graph

Time (t) in s	0	1	2	3	4	5
Velocity (v) in m s^{-1}	0	2.5	5	7.5	10	12.5



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3. Draw a displacement-time graph for the data given below with respect to a particle moving in a straight line

Time (t) in s	0	1	2	3	4
Displacement(s) in m	0	5	20	45	80



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4. For the previous question, the acceleration of the particle at any time t is :



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Concept Application Level 1 True Or False

1. Uniform speed is a vector quantity?



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2. For a body moving along a circular path the average velocity and average speed can never be equal



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3. Can a body at a constant speed and still have a varying velocity ?



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4. The magnitude of average velocity is equal to the average speed when a particle moves:-



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5. Velocity-time graph cannot be used to find instantaneous velocity



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6. Prove that average velocity of an object can never be greater than the average speed of an object over a given interval of time.



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7. The travel from a train from one station to another is an example of translatory motion



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1. velocity is taken on _____ axis In velocity-time graph.



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2. The ratio of the total displacement of a body to the total time taken is _____.



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3. The velocity-time graph of a body moving with uniform velocity is a straight line parallel to _____



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4. A body moving with constant speed has zero acceleration only when the particle is in _____ dimensional motion.



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5. The average speed of a bus in its whole journey when it travels a given distance between two places with a speed of 20 km hr^{-1} and returns back with a speed of 12 km hr^{-1} is _____.



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6. When a body has unequal displacements in equal interval, of time it is said to be moving with _____



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7. When a particle moves in a straight line from point A to point B the distance covered is _____ the magnitude of the displacement.



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Concept Application Level 1

1. Match the entries given in Column A with appropriate ones in Column B.

Column A		Column B	
A. Scalar quantity	()	a. One dimensional motion	
B. Vector quantity	()	b. Displacement in n th second	
C. s/t	()	c. $ut + \frac{1}{2}at^2$	
D. $v - u$	()	d. $\frac{(v+u)}{2}$	
E. S_n	()	e. Two dimensional motion	
F. Motion of a shell fired by a gun	()	f. $2as$	
G. Motion of a kite	()	g. Uniform velocity	
H. Motion of a car on a straight road	()	h. Three dimensional motion	
I. s	()	i. at	
J. $v^2 - u^2$	()	j. Average speed	



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Concept Application Level 1 Select The Correct Alternative

1. Two persons X and Y take 10 hours and 12 hours, respectively to travel from Bangalore to Hyderabad, then the

A. average velocity of X is equal to the average velocity of Y.

B. average velocity of X is less than that of Y.

C. average velocity of X is more than that of Y.

D. We cannot compare their velocities.

Answer: C



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2. A car starting from rest traveling along a straight path with uniform acceleration covers S_1 , S_2 and S_3 distances in the first, second and that seconds of its travel. Then, the ratio

of $\frac{(S_2 - S_1)}{(S_3 - S_2)}$ is _____

A. 3 : 5

B. 1 : 2

C. 1:3

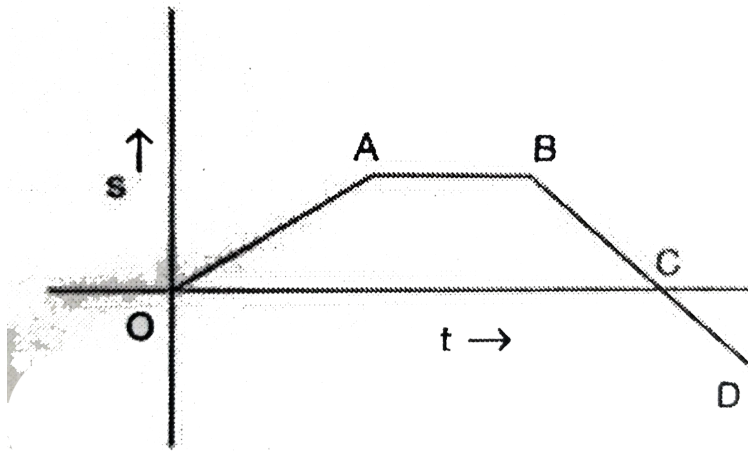
D. 1:1

Answer: D



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3. The displacement-time graph of a body is shown in the figure below.



The part of the graph that represents the body at rest is

A. OA

B. AB

C. BC

D. CD

Answer: B



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4. A body is first displaced by 5 m and then by 12 m in different directions. The minimum displacement it can have is _____ m.

A. 0

B. 17

C. 7

D. 13

Answer: C



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5. A passenger, seated in a train is at rest with reference to _____

A. the bus.

B. a jeep moving in the opposite direction to the bus.

C. the trees on the ground.

D. both (a) and (c).

Answer: D



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6. A body starting from rest along straight line is traveling with an acceleration of $6ms^{-1}$, then the distance traveled by it in the 3rd seconds is _____ m

A. 27

B. 18

C. 15

D. 21

Answer: C



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7. A body starts from rest and moves along a straight line path with uniform acceleration.

The ratio of velocities at $t = 1\text{ s}$ and $t = 2\text{ s}$ is

_____.

A. 2:1

B. 1:2

C. $1:\sqrt{2}$

D. $\sqrt{2}:1$

Answer: B



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8. A body undergoes a displacement of 3 m in the 1st second, 4 m in the 2nd second, 5 in the

3rd second and so on. The body is moving with
a/an

- A. uniform velocity
- B. uniform acceleration
- C. uniform deceleration
- D. None of these

Answer: B



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9. $45\text{kmh}^{-1} = \underline{\hspace{2cm}}\text{ms}^{-1}$

A. 162

B. 12.5

C. 2.5

D. 75

Answer: B



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10. A body moving from its initial position of rest along a straight line covers 1 m in 1s. It then covers 8 m in the next, then the body is moving with _____

A. uniform velocity

B. an acceleration of 2 m s^{-2} in the first second

C. average acceleration from $t = 1 \text{ s}$ to 3 s of 2 m s^{-2}

D. both (b) and (c)

Answer: D



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11. The ratio of the numerical values of the average velocity and average speed of a body is always.

- A. greater than
- B. less than or equal to
- C. greater than or equal to
- D. less than

Answer: B



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12. A bus travels one third of the distance with a speed of 12kmh^{-1} and the remaining distance with a speed of 20kmh^{-1} . The average speed of the bus is _____ kmh^{-1}

A. 14

B. 20

C. 12

D. 16.4

Answer: D



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13. The ratio of distances traveled by two bodies, A and B starting from rest moving along a straight line with equal accelerations is x , where $x \geq 1$, then

A. time taken by body A $>$ time taken by
body B.

B. time taken by body A $<$ time taken by
body B.

C. time taken by body A \geq time taken by
body B.

D. time taken by body A \leq time taken by
body B.

Answer: C



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14. When a body moves with uniform velocity then

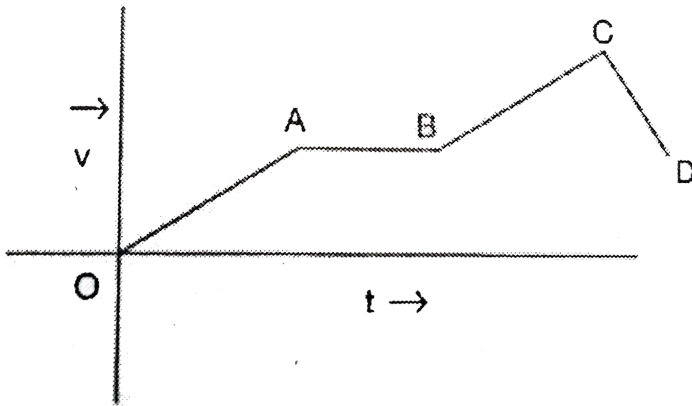
- A. it has zero acceleration.
- B. it moves along a straight line path.
- C. average velocity = instantaneous velocity.
- D. All the above

Answer: D



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15. The velocity-time graph of a certain is shown in the following graph. The part of the graph that shows deceleration of the body is



A. OA

B. AB

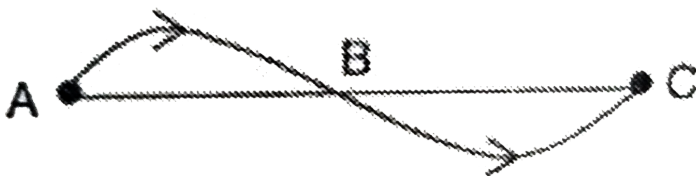
C. BC

D. CD

Answer: D

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16. A body is moving along the curve, ABC as shown in the figure, and the initial and final positions are A and C, respectively. Displacement is the line joining



A. initial and final position of the body.

B. midpoint (B) and final position of the body.

C. midpoint (B) and initial position of the body.

D. Both (b) and (c)

Answer: A



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17. The speedometer of a car indicates

A. its instantaneous speed.

B. average speed.

C. average velocity

D. Both (a) and (c).

Answer: A



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18. A boy throw a ball vertically upwards and catches it after 2 seconds. Which of the following is true regarding the motion of the ball?

(a) The displacement is zero

(b) Magnitude of acceleration is constant

A. Only (i) is true.

B. Only (ii) is true.

C. Both (i) and (ii) are true.

D. Both (i) and (ii) are false.

Answer: C



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19. If a sports car at rest accelerates uniformly to a speed of 144 km h^{-1} in 5 s, it covers a distance of _____ m.

A. 100

B. 140

C. 60

D. 80

Answer: A



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20. Arrange the following steps in sequential order to show that the conduction of heat is different in different conductors

(a) take two identical rods one is copper and the other is iron

(b) The ends of the two rods are heated with the same spirit lamp

(c) fix some nails on the rods with the help of

wax at equal distances

(d) The nails near to the flame first from the copper rod and then from the iron rod.

A. B C E F A D G

B. A B C E G F D

C. A C B D F G E

D. B C A D F E G

Answer: D



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21. The driver of a car moving with a velocity of 54kmh^{-1} applies to decrease its velocity to 36kmh^{-1} . If the retardation produced by the breaks is 2.0ms^{-1} , arrange the following steps in sequential order to calculate the distance travelled by the car.

(a) Write down the required equation of motion as $v^2 - u^2 = 2as$ where v, u, a and s are final velocity, initial velocity, retardation and displacement,

(b) Write down the given data and convert all the values into the same system of unit

(c) Get the value of 's' as $\frac{v^2 - u^2}{-2a}$

(d) Substitute the given values in the above equations

A. A B D C

B. B A C D

C. A D B C

D. A B C D

Answer: C



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22. Assrtion o (A) : A body may have velocity and displacement in the oppostie direction

Reason (R) : Velocity is distance travellled by the body in a unit time

A. A and R are correct and R is the correct explanation for A

B. A and R are correct but R is not the correct explanation for A

C. A is correct but R is incorrect.

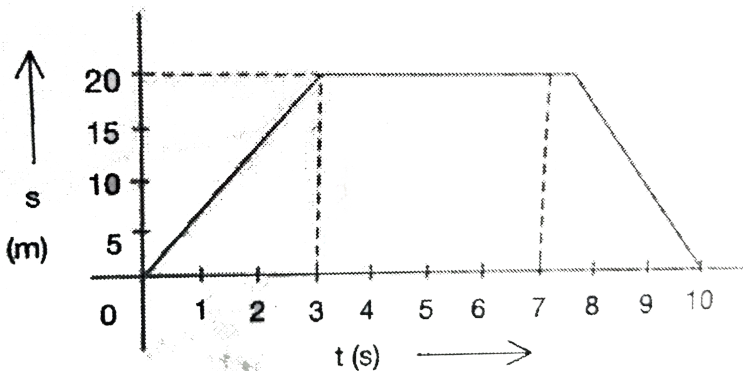
D. Both A and R are incorrect.

Answer: C



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23. The $\vec{s} - t$ graph of a body is as shown in the figure. The time for which the body is in motion is _____ second



A. 2

B. 3

C. 6

D. 10

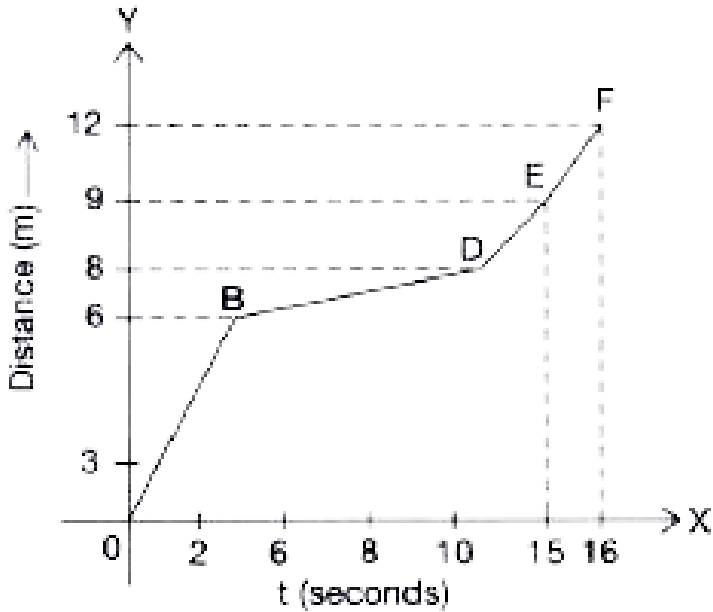
Answer: C



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24. The motion of a body is depicted graphically as shown in the figure. The average

speed of the body is _____ $m s^{-1}$.



A. $3/4$

B. $9/8$

C. $4/3$

D. $8/9$

Answer: A



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25. An object moves the first half of the total distance with a speed of 2 m s^{-1} . If the average speed of the body is 3 m s^{-1} , the speed of the body when it travelled the remaining distance is _____ m s^{-1}

A. 3

B. 6

C. 4

D. 2

Answer: B



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26. An electric fan rotates 100 times in 50 s. If the length of its wing from its axis of rotation is 0.5 m, then the speed of particle at the edge of the wing is _____ m s^{-1} .

A. 2π

B. 0.5π

C. π

D. 2

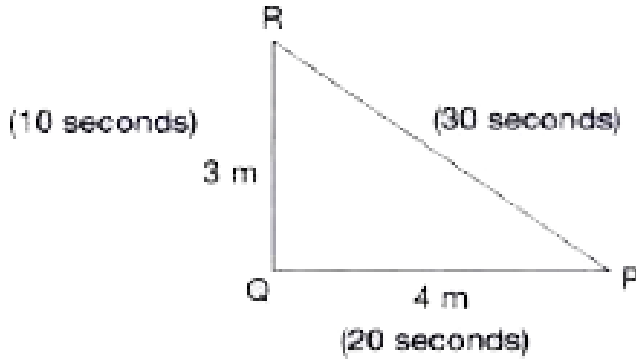
Answer: A



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27. A person starts from a point and travels along a path PQRP as shown in the figure.

Then, the speed of the person is _____ ms^{-1} .



A. 0.2

B. 20

C. 12

D. 0.4

Answer: A



28. The ratio of the unit of acceleration and velocity gives the unit of the physical quantity _____.

- A. Time
- B. Frequency
- C. Amplitude
- D. Speed

Answer: B



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29. A bus moves with uniform velocity along a straight line path. If the average velocity of the bus is 80 km h^{-1} , then its instantaneous velocity at $t=0$ is _____ km h^{-1}

A. 70

B. 100

C. 80

D. zero

Answer: C



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30. A bus travels one-third of the distance with a speed of $12 \text{ km } h^{-1}$ and the remaining distance with a speed of $20 \text{ km } h^{-1}$. The average speed of the bus is nearly _____ $\text{km } h^{-1}$.

A. 14

B. 20

C. 12

D. 16

Answer: D

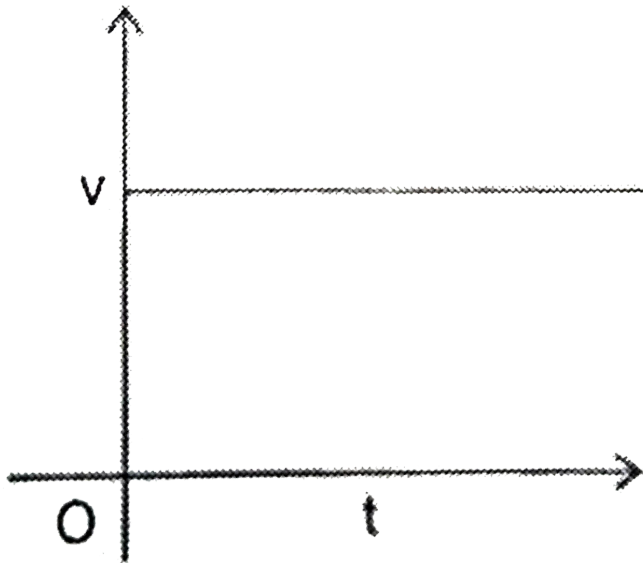


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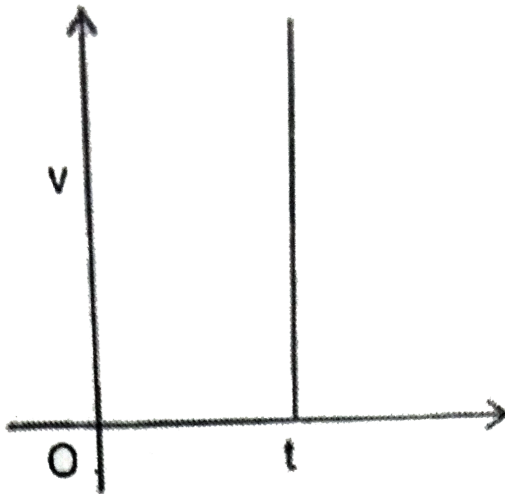
Concept Application Level 2

1. In the following graphs, the velocity of linearly moving body is against its time of travel. Analyse each of the given graphs and

discuss the type of motion of the body

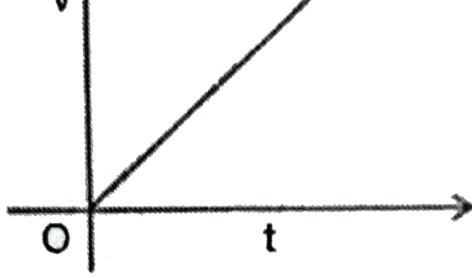


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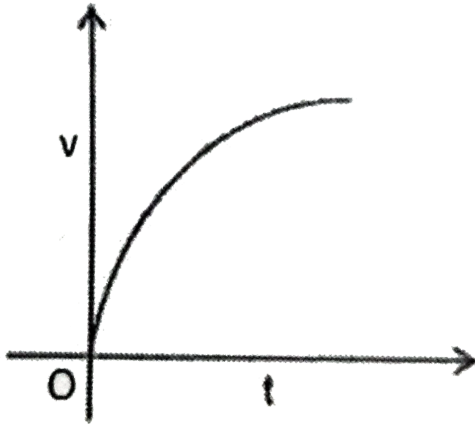


(iii)

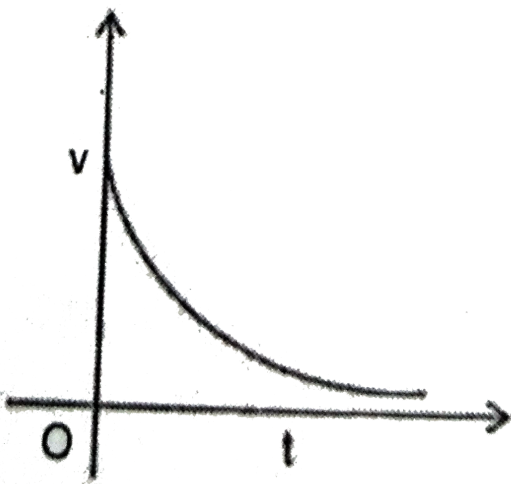




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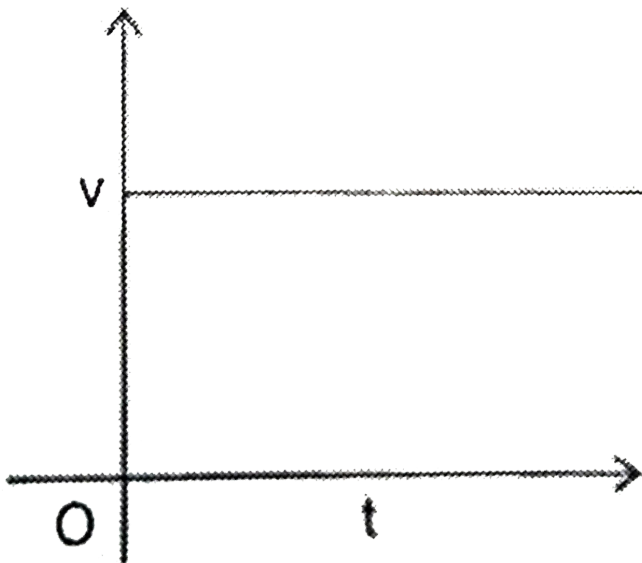


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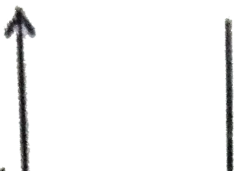


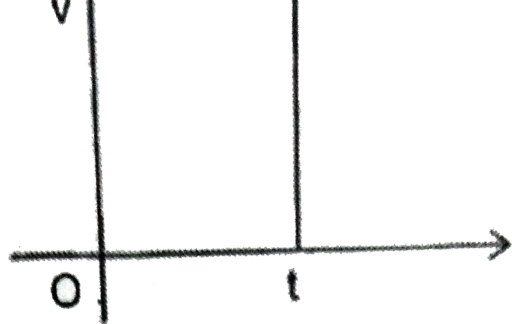
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2. In the following graphs, the velocity of linearly moving body is against its time of travel. Analyse each of the given graphs and discuss the type of motion of the body

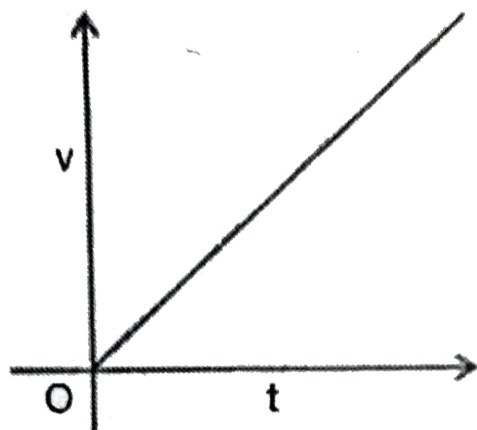


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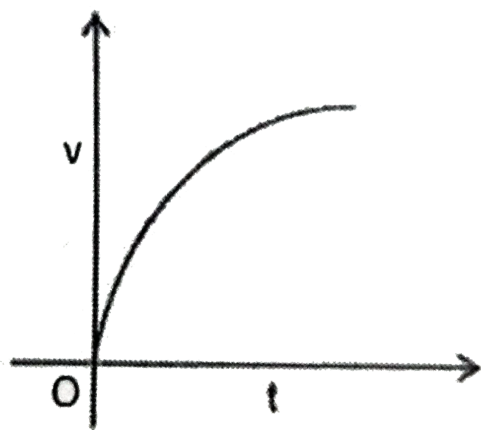




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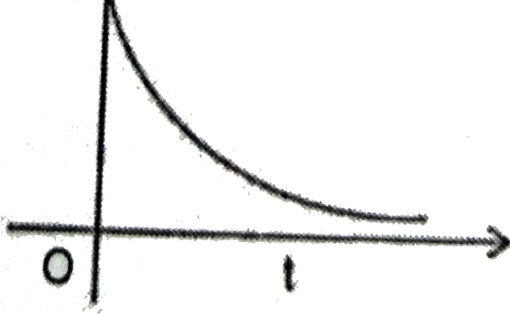


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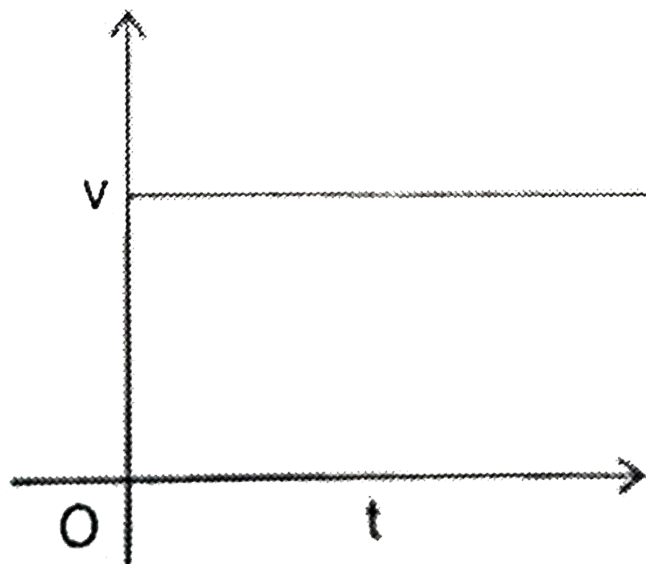
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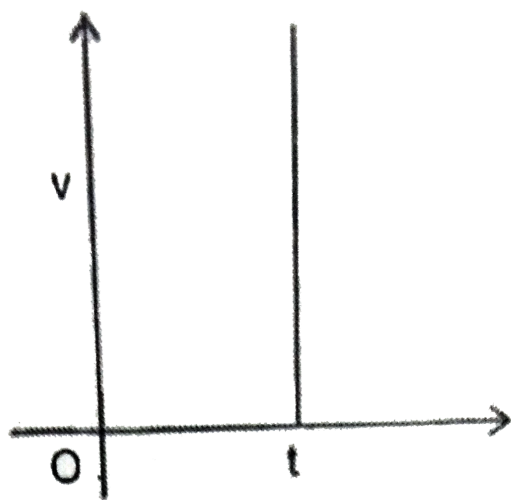


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3. In the following graphs, the velocity of linearly moving body is against its time of travel. Analyse each of the given graphs and discuss the type of motion of the body

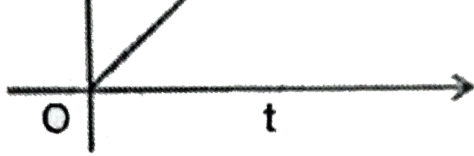


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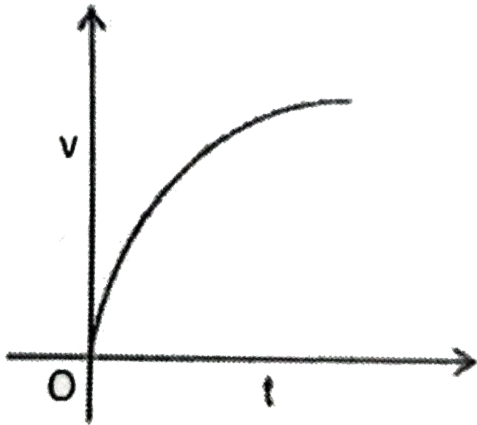


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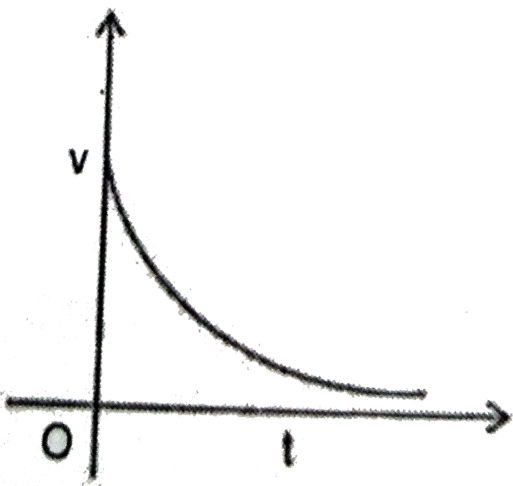




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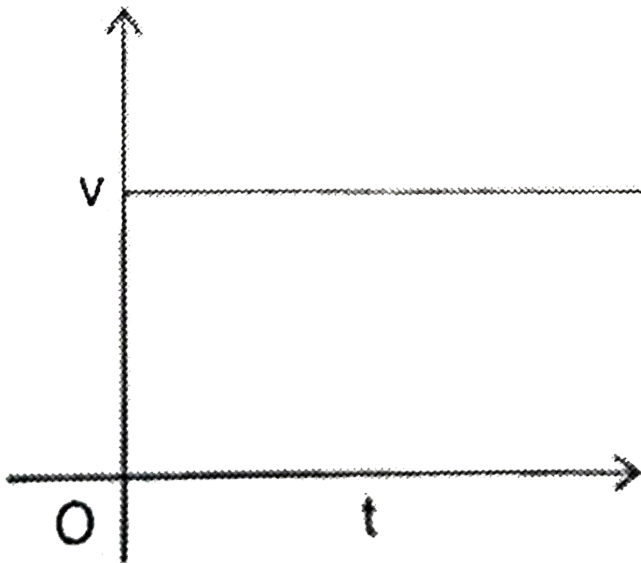


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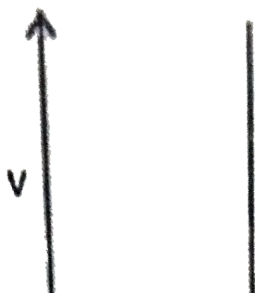


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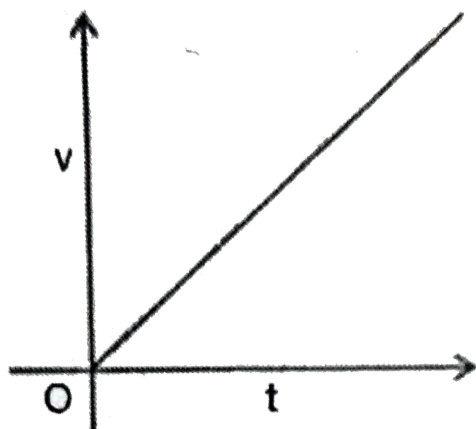


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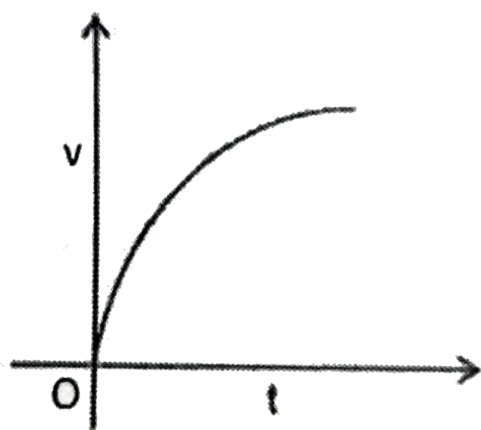




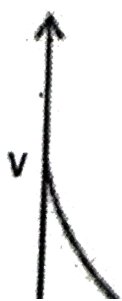
(iii)



(iv)



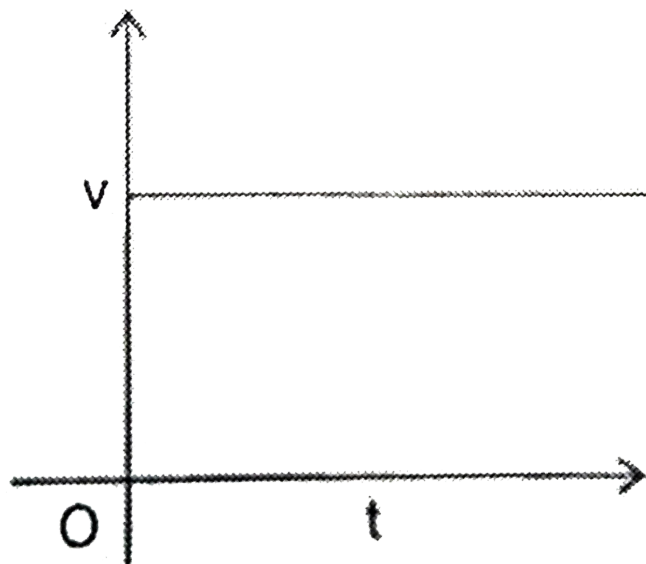
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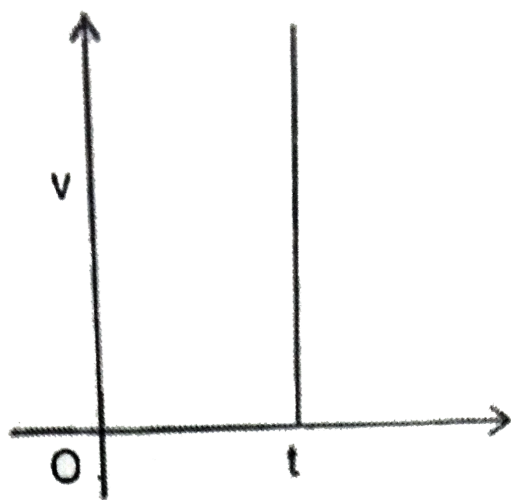


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5. In the following graphs, the velocity of linearly moving body is against its time of travel. Analyse each of the given graphs and discuss the type of motion of the body

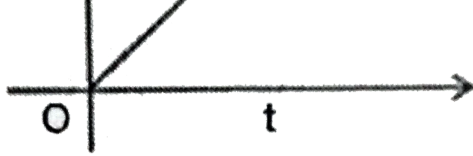


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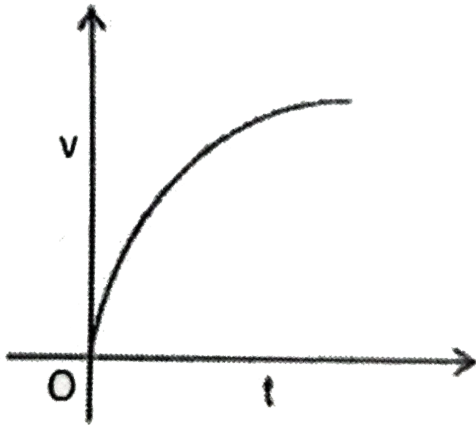


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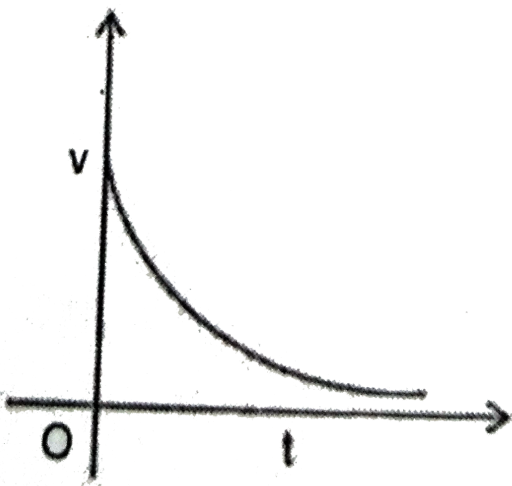




(iv)



(v)



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6. A bus moving along a straight highway with a speed of 72 km h^{-1} is brought to rest within a distance of 50 m. How long does it take for the bus to stop?



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7. A train of certain length traveling with a uniform speed of 36 km h^{-1} crosses a bridge of 600 m in 80 s. Find the length of the train.



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8. The length of a minute hand of clock is 3 cm. Find the average velocity of the tip of the minute hand when it moves during a time interval from 4:00 p.m. to 4:15 p.m.



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9. Give examples of variable velocity, when the magnitude is constant and the direction is changing.



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10. Give examples of variable velocity, when the magnitude is changing and the direction remains the same.



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11. Give examples of variable velocity, when

(a) the magnitude is constant and the direction is changing

(b) the magnitude is changing and the

direction remains the same

(c) both the magnitude and direction are changing



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12. The distance between two places A and B is 180 km by road and 120 km by air. An aeroplane takes 20 min to go from A to B whereas a deluxe bus starting at A takes 5h to reach B. Find the average speed and

average velocity by both means of transport)

(Ignore the vertical ascent of aeroplane)



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13. A car starting from rest and moving with uniform acceleration on a straight road travels for sometime such that the paths described by it in the last second and the penultimate second of its motion are in the ratio 4:3 respectively . Calculate the total time traveled by the body



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14. On a 60 km stretch of road a cyclist travels first 20 km at a uniform speed of 20 km h^{-1} . How fast must he travel the remaining distance so that his average speed is 10 km h^{-1} for the entire trip.



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15. A car starting from rest and moving along a straight path with uniform acceleration covers

distances p and q in the first two successive equal intervals of time. Find the ratio of p to q .



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16. A bus starts from rest with an acceleration of 5ms^{-2} . A man who is on a motorcycle, 24 m behind the bus, overtakes the bus in 2s. If the motorcyclist moves with uniform velocity, find his velocity



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17. The dimensions (measurements) of a hall are 12m, 4 m and 3, respectively. An ant starts at one corner of the hall, travels only along the adgees and reaches a diagonally opposite, corner, taking the shortest possible route. Find the distance travelled by the at t and its magnitude of displacement .



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18. A car takes 25 s to stop after the application of brakes. What is the distance

traveled by the car if the brakes produce a uniform retardation of 0.4 m s^{-2} ?



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19. A bus starts moving with uniform acceleration from its position of rest. It moves 48 m in 4 s. On applying the brakes, it stops after covering 24 m. Find the deceleration of the bus.



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20. A bus traveling along a straight highway covers one third of the total distance between two places with a velocity 20kmh^{-1} . The remaining part of the distance was covered with a velocity of 30kmh^{-1} for the first half of the remaining time and with velocity 50kmh^{-1} for the next half on the time. Find the average velocity of the bus for its whole journey.



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21. A particle starts from rest and moves with a constant acceleration along a straight path to attain 64 m s^{-1} in t s. If at $t = (t + 3)$ s the speed is 76 m s^{-1} , then find the acceleration of the particle and 't'.



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Concept Application Level 3 Understanding
Based Questions

1. A car accelerates uniformly from rest. If the reading on the speedometer after 5 s is 72 km h^{-1} , determine the acceleration of the car.

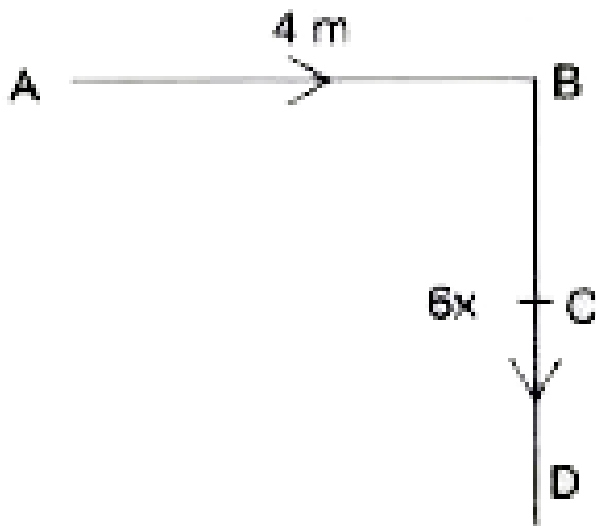


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2. A person starts from point A and reaches point C which is the midpoint of BD. If he takes four seconds time, then determine

(a) the average speed

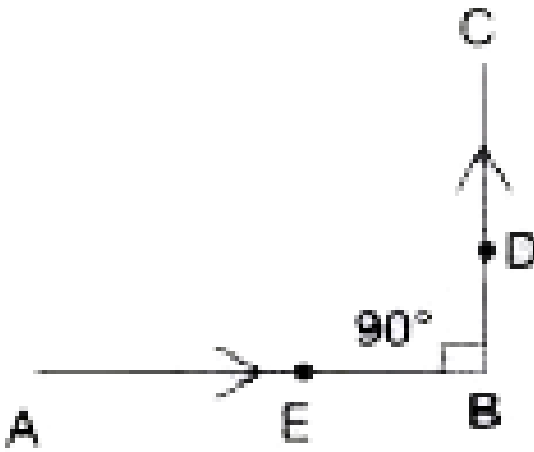
(b) the average velocity.



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3. In the figure shown, explain the difference

between \overrightarrow{DE} and \overrightarrow{ED} .



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4. A police man is running with a uniform speed of 5kmh^{-1} and a thief is running with a uniform speed of 2kmh^{-1} . Is it possible to find

whether the policeman can catch the thief?

Explain



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5. An object moves along the path ABC as shown in the figure. Determine the displacement.



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6. A policeman is running with a uniform velocity of 5kmh^{-1} towards east and a thief is running with a uniform velocity of 2kmh^{-1} towards east. Is it possible for the policeman to catch the thief? Explain



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7. A thief is running away on a straight road in a moving with a speed of 9ms^{-1} . A policeman chases him on a motor cycle moving at a

speed of 10ms^{-1} . If the instantaneous separation of the jeep from the motor cycle is 100m , how long will it take for the policeman to catch the thief ?.



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8. A bike starting from rest picks up a velocity of 72 km h^{-1} over a distance of 40 m . Calculate its acceleration.



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9. A pencil is tied to one end of a string of length 5 cm and the other is fixed to a nail. If the time taken to draw a half circle and a full circle, with the pencil is 2 and 4 seconds, respectively, find the speed and velocity pencil

(a) to draw half circle is drawn.

(b) when full circle is drawn

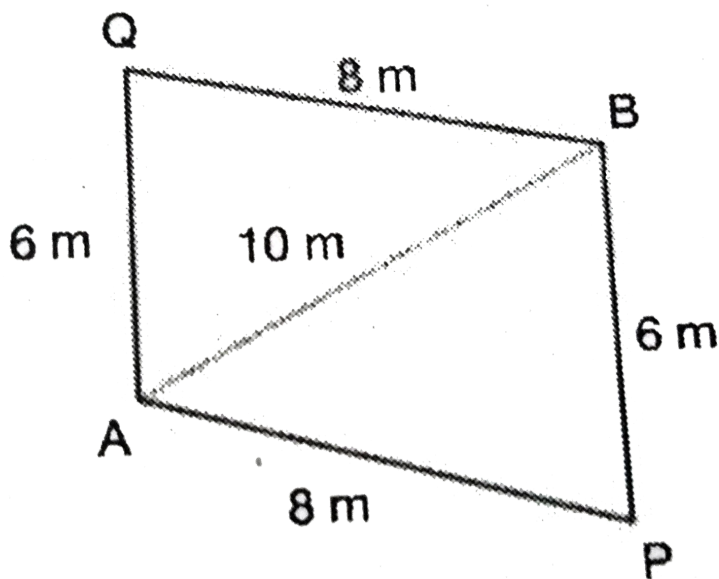


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10. A partical takes 8 s a to travel from A to B through P (sec the figure given below) and

another particle travelling through Q takes 7s.

Find the speed and velocity of each particle.



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Concept Application Level 3

1. A Bullet Train in Japan starting from rest accelerates uniformly at 0.5ms^{-2} for 2 minutes. It then maintains uniform speed for 20 minutes and then retards uniformly at the rate of 0.25ms^{-1} and comes to rest. Calculate the average speed of the train



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2. A stone is thrown vertically upward. The stone crosses a particular height twice at time t_1

and t_2 . Find the initial speed of the stone.



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3. Find the initial velocity and acceleration of a body if the distance traveled by that body in n th second is $(5.69 + 0.008n)$ m



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Concept Application Level 3 Application Based Questions

1. A race horse runs straight north and covers a distance of 12m then turns east and travels a distance of 5m Draw the diagram showing the displacements and from the figure, calculate the net displacement of the horse.



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2. A crow picks up pebbles and puts them into a pot which is 10 m away from the pot. In doing so, it makes 5 trips within 80 seconds. What is the average speed of the crow?



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3. A boy kicks a football horizontally from the roof of a building of height 10m, . If the line joining the initial position of the football and the point where it hits the ground make an angle of 45° with the ground, then find the displacement of the football

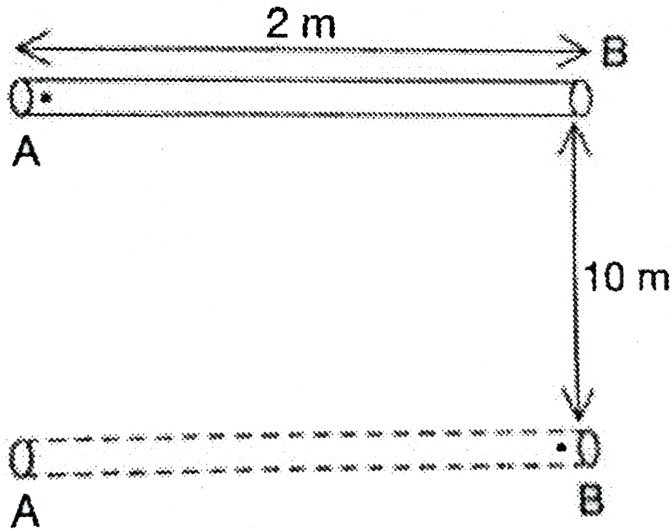


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4. A rod of length 2m starts to roll on a horizontal surface as shown in figure. At the same time an ant starts from one end of the rod to other and when the rod rolls through a distance 10m the ant reaches the other end (B). Calculate the distance and displacement of the ant

(a) with respect to the rod

(b) with respect to the ground.



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5. A bird sitting on a tree top at a height of 5 m from the ground, picks up sticks lying on the ground to build a nest on the tree top. It

starts picking up the sticks at 7:00 a.m. and ends up at 7:10 a.m. During this interval it makes 5 trips up and down. Find the average speed and average velocity of the bird.



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