Date: 24/9/2021

Q1. An object has moved through a distance. Can it have zero displacement? If yes, support your answer with an example.

Q2. Under what condition(s) is the magnitude of average velocity of an object equal to its average speed?

Q3. What does the odometer of an automobile measure?

Q4. What does the path of an object look like when it is in uniform motion?

Q5. What can you say about the motion of an object whose distance-time graph is a straight line parallel to the time axis?

Q6. What can you say about the motion of an object if its speed-time graph is a straight line parallel to the time axis?

Q7. What is the quantity which is measured by the area occupied below the velocity-time graph?

Q8. A farmer moves along the boundary of a square field of side 10 m in 40 s. What will be the magnitude of displacement of the farmer at the end of 2 minutes 20 seconds?

Q9. Which of the following is true for displacement?

(a) It cannot be zero.

(b) Its magnitude is greater than the distance travelled by the object.

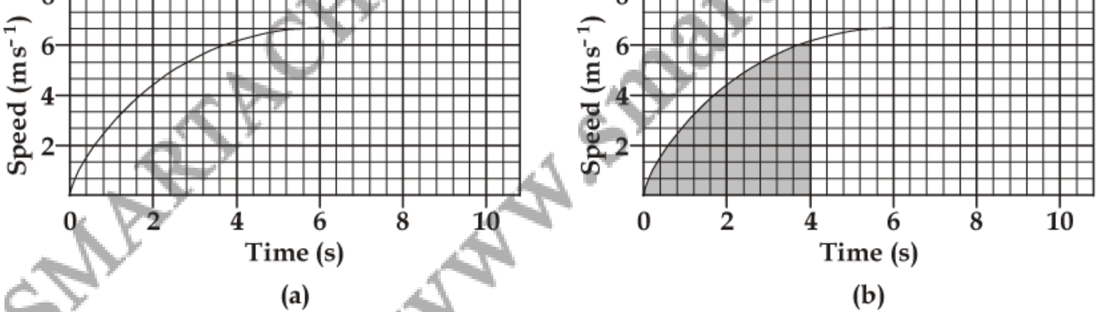
Q10. Distinguish between speed and velocity.

Q11. During an experiment, a signal from a spaceship reached the ground station in five minutes. What was the distance of the spaceship from the ground station? The signal travels at the speed of light that is $3 \times 10^8 \text{ m s}^{-1}$.

Q12. The speed-time graph for a car is shown in figure

(a) Find how far does the car travel in the first 4 seconds. Shade the area on the graph that represents the distance travelled by the car during the period.

(b) Which part of the graph represents uniform motion of the car?



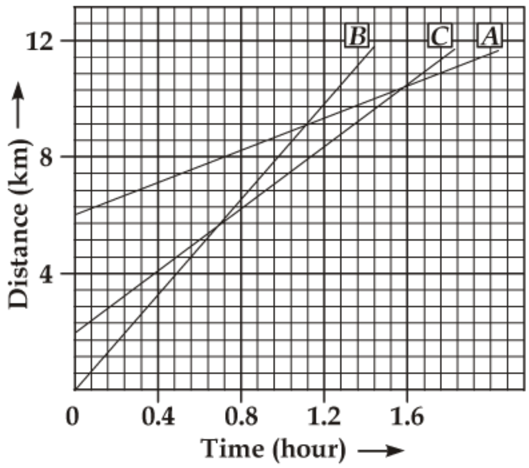
Q13. Figure shows the distance-time graph of three objects *A*, *B* and *C*. Study the graph and answer the following questions:

(a) Which of the three is travelling the fastest?

(b) Are all three ever at the same point on the road?

(c) How far has *C* travelled when *B* passes *A*?

(d) How far has *B* travelled by the time it passes *C*?



Q14. What is the nature of the distance-time graphs for uniform and non-uniform motion of an object?

Q15. A train starting from a railway station and moving with uniform acceleration attains a speed 40 km h^{-1} in 10 minutes. Find its acceleration.

Q16. A bus decreases its speed from 80 km h^{-1} to 60 km h^{-1} in 5 s. Find the acceleration of the bus.

Q17. When will you say a body is in (a) uniform acceleration? (b) non-uniform acceleration?

Q18. Joseph jogs from one end *A* to the other end *B* of a straight 300 m road in 2 minutes 30 seconds and then turns around and jogs 100 m back to point *C* in another 1 minute. What are Joseph's average speeds and velocities in jogging (a) from *A* to *B* and (b) from *A* to *C*?

Q19. A bus starting from rest moves with a uniform acceleration of 0.1 m s^{-2} for 2 minutes. Find (a) the speed acquired, (b) the distance travelled.

Q20. A trolley, while going down an inclined plane, has an acceleration of 2 cm s^{-2}. What will be its velocity 3 s after the start?

Q21. A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of 3.0 m s^{-2} for 8.0 s. How far does the boat travel during this time?

Q22. A racing car has a uniform acceleration of 4 m s^{-2}. What distance will it cover in 10 s after start?

Q23. A train is travelling at a speed of 90 km h^{-1}. Brakes are applied so as to produce a uniform acceleration of – 0.5 m s^{-2}. Find how far the train will go before it is brought to rest.

Q24. A stone is thrown in a vertically upward direction with a velocity of 5 m s^{-1}. If the acceleration of the stone during its motion is 10 m s^{-2} in the downward direction, what will be the height attained by the stone and how much time will it take to reach there?

Q25. A driver of a car travelling at 72 km h^{-1} applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5 s. Another driver going at 36 km h^{-1} in another car applies his brakes slowly and stops in 10 s. On the same graph paper, plot the speed versus time graphs for the two cars. Which of the two cars travelled farther after the brakes were applied?

Q26. An artificial satellite is moving in a circular orbit of radius 42,250 km. Calculate its speed if it takes 24 hours to revolve around the Earth.

Q27. Abdul, while driving to school, computes the average speed for his trip to be $20\,km\,h^{-1}$. On his return trip along the same route, there is less traffic and the average speed is $30\,km\,h^{-1}$. What is the average speed for Abdul's trip?

Q28. A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of $10\,m\,s^{-2}$, with what velocity will it strike the ground? After what time will it strike the ground?

Q29. An athlete completes one round of a circular track of diameter 200 m in 40 s. What will be the distance covered and the displacement at the end of 2 minutes 20 s?

Q30. State which of the following situations are possible and give an example for each of these:

(a) an object with a constant acceleration but with zero velocity.

(b) an object moving in a certain direction with an acceleration in the perpendicular direction.

Date: 24/9/2021

S1. Yes, it is possible that an object has moved through a certain distance but has zero displacement. A student goes to school from his home and then returns back to his home. Here, he has covered a finite distance but the displacement is zero.

S2. Magnitude of average velocity of a object will be equal to its average speed when motion is along a given line and direction of motion throughout remains same.

S3. Odometer measures the total distance covered by the automobile.

S4. In a uniform motion, the path of an object is a straight line.

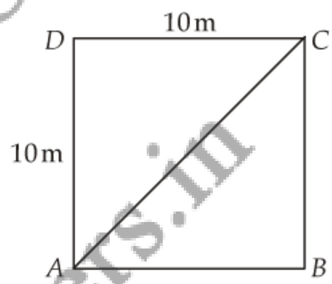
S5. The object is at rest.

S6. The motion of the object is uniform linear motion *i.e.*, the object is moving with a constant speed.

S7. Area under the velocity-time graph gives the magnitude of displacement [distance] covered by the object in that time.

S8. As the farmer moves once along the boundary of field in 40 s, hence in time $t = 2$ min 20 s = 140 s, he will compete n revolutions of field, where

$$n = \frac{140}{40} = 3\frac{1}{2}$$



It means that if farmer had started from point A, then after completing $3\frac{1}{2}$ revolutions he wil reach at diagonally opposite point C and magnitude of his displacement

$$= \sqrt{AD^2 + DC^2} = \sqrt{(10)^2 + (10)^2} = 10\sqrt{2}\ .$$

S9. (a) Wrong, the displacement can be zero.

(b) Wrong, magnitude of displacement can never be greater than the distance travelled by the object.

S10.

Speed	Velocity
1. It is the distance covered per unit time. 2. Speed has only magnitude *i.e.*, it is a scalar. 3. Speed is always positive.	1. It is the displacement covered per unit time. 2. Velocity has both magnitude as well as direction *i.e.*, it is a vector. 3. Velocity can be positive or negative or even zero.

S11. Here, constant speed of signal $v = 3 \times 10^8\ \text{m s}^{-1}$

Time $t = 5\ \text{min} = 5 \times 60\ \text{s} = 300\ \text{s}$

$\therefore$ Distance of the spaceship from the ground station

$$s = vt = 3 \times 10^8 \times 300 = 9 \times 10^{10}\ \text{m}.$$

S12. (a) From graph we find that the car has travelled nearly 15 m in first 4 seconds. The shaded area representing the distance travelled by the car during the period has been shown in figure (b).

(b) The graph after time $t = 6$ s represents uniform motion of car.

S13. (a) The object B is travelling the fastest because slope of its distance-time graph is maximum.

(b) All three are not at the same point on the road at any instant.

(c) B is passing A at a time $t = 1.1$ h and at that time, C was at a position 8 km. As at start position of C was at 2 km, hence distance travelled by C = 8 km – 2 km = 6 km.

(d) B is passing C at a time 0.7 s and at that time B had covered 5.5 km.

S14. For uniform motion of an object, the distance-time graph is a straight line inclined to the time axis.

For non-uniform motion of an object the distance-time graph is a curve, which may have any shape other than a straight line.

S15. Here, initial speed of train at the time of start $u = 0$

$$\text{Final speed} = v = 40\ \text{km h}^{-1} = \frac{40 \times 5}{18}\ \text{m s}^{-1} = \frac{100}{9}\ \text{m s}^{-1}$$

$$\text{Time } t = 10 \text{ minutes} = 10 \times 60\ \text{s} = 600\ \text{s}$$

$$\therefore \quad \text{Acceleration } a = \frac{v-u}{t} = \frac{\frac{100}{9} - 0}{600} = \frac{100}{9 \times 600} = \frac{1}{54}\ \text{m s}^{-2}.$$

S16. Here,

$$\text{Initial speed } u = 80\ \text{km h}^{-1} = 80 \times \frac{5}{18}\ \text{m s}^{-1} = \frac{200}{9}\ \text{m s}^{-1}$$

$$\text{Final speed } v = 60\ \text{km h}^{-1} = 60 \times \frac{5}{18}\ \text{m s}^{-1} = \frac{150}{9}\ \text{m s}^{-1} \text{ and time } t = 5\ \text{s}$$

$$\therefore \quad \text{Acceleration } a = \frac{v-u}{t} = \frac{\frac{150}{9} - \frac{200}{9}}{5} = \frac{-50}{9} \times \frac{1}{5} = -\frac{10}{9}\ \text{m s}^{-1}$$

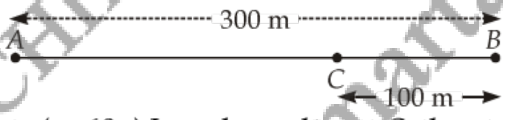
The –ve sign denotes that it is in fact retardation.

S17. (a) If velocity of a body changes by equal amounts in equal intervals of time, the acceleration is said to be uniform. Acceleration due to gravity is an example of uniform acceleration.

(b) If velocity changes by unequal amounts in equal intervals of time then the acceleration is said to be non-uniform. Acceleration of a train running from one station to another is a non-uniform acceleration.

S18. (a) While jogging from A to B distance as well as displacement $s = 300$ m and time $t = 2$ minutes 30 s = 150 s.

$$\therefore \quad \text{Average speed} = \text{Average velocity} = \frac{s}{t} = \frac{300}{150} = 2.0\ \text{m s}^{-1}$$



(b) When after further 1 minute (or 60 s) Joseph reaches at C, then total time $t = 150 + 60 = 210$ s. Now, the total distance covered = $AB + BC$ = 300 + 100 = 400 m

$$\therefore \quad \text{Average speed} = \frac{400}{210} = 1.90\ \text{m s}^{-1}$$

However, now the total displacement = $AC = AB - BC$ = 300 – 100 = 200 m

$$\therefore \quad \text{Average velocity} = \frac{200}{210} = 0.95\ \text{m s}^{-1}$$

S19. Here initial speed $u = 0$, acceleration $a = 0.1\ \text{m s}^{-2}$ and time $t = 2$ minutes $= 2 \times 60\ \text{s} = 120\ \text{s}$.

(a) The final speed acquired $v = u + at = 0 + 0.1 \times 120 = 12\ \text{m s}^{-1}$.

(b) The total distance travelled in given time

$$s = ut + \frac{1}{2}at^2 = 0 \times 120 + \frac{1}{2} \times 0.1 \times (120)^2$$
$$= 0 + 720 = 720\ \text{m}.$$

S20. Here initial velocity $u = 0$, acceleration $a = 2\ \text{cm s}^{-2} = 0.02\ \text{m s}^{-2}$, and time $t = 3\ \text{s}$.

$\therefore$ Final velocity of the trolley $v = u + at = 0 + (0.02) \times 3 = 0.06\ \text{m s}^{-1}$ or $6\ \text{cm s}^{-1}$.

S21. Here initial velocity of motorboat $u = 0$, acceleration $a = 3.0\ \text{m s}^{-2}$, and time $t = 8.0\ \text{s}$.

$\therefore$ Distance covered by motorboat $s = ut + \frac{1}{2}at^2 = 0 \times 8 + \frac{1}{2} \times (3.0) \times (8.0)^2 = 96\ \text{m}$.

S22. Here initial velocity $u = 0$, time $t = 10\ \text{s}$ and uniform acceleration $a = 4\ \text{m s}^{-2}$.

$\therefore$ Total distance covered by the racing car

$$s = ut + \frac{1}{2}at^2 = 0 \times 10 + \frac{1}{2} \times 4 \times (10)^2 = 0 + 200 = 200\ \text{m}.$$

S23. Here, Initial speed of train $u = 90\ \text{km h}^{-1} = \frac{90 \times 5}{18}\ \text{m s}^{-1} = 25\ \text{m s}^{-1}$

Uniform acceleration $a = -0.5\ \text{m s}^{-2}$, and Final speed $v = 0$

Using the relation $v^2 - u^2 = 2as$, we have

$$\text{Distance covered by train } s = \frac{v^2 - u^2}{2a} = \frac{(0)^2 - (25)^2}{2 \times (-0.5)} = \frac{0 - 625}{-1} = 625\ \text{m}.$$

S24. Here initial velocity of stone in vertically upward direction $u = 5\ \text{m s}^{-1}$

Acceleration $a = 10\ \text{m s}^{-2}$ downward $= -10\ \text{m s}^{-2}$ upward

The stone will attain a maximum height h where its final velocity v just becomes zero *i.e.*, $v = 0$.

Using the equation $v^2 - u^2 = 2as$, we get

$$(0)^2 - (5)^2 = 2 \times (-10) \times h$$

$\Rightarrow$ $-25 = -20h$

or $h = \frac{-25}{-20} = 1.25\ \text{m}$

Again by using the equation $v = u + at$, we get

$$0 = 5 - 10t$$

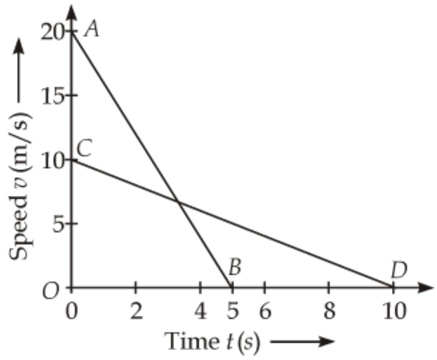
$\Rightarrow$ $10t = 5$

or $t = \frac{5}{10}\ \text{s} = 0.5\ \text{s}.$

S25. Here, For first car $u_1 = 72\ \text{km h}^{-1} = \frac{72 \times 5}{18}\ \text{m s}^{-1} = 20\ \text{m s}^{-1}$, $v_1 = 0$ and time $t_1 = 5\ \text{s}$

and For second car $u_2 = 36\ \text{km h}^{-1} = 36 \times \frac{5}{18}\ \text{m s}^{-1} = 10\ \text{m s}^{-1}$, $v_2 = 0$ and $t_2 = 10\ \text{s}$

The speed-versus time graph for two cars have been shown in figure.



Distance covered by 1st car = area $OAB = \frac{1}{2}(OA \times OB) = \frac{1}{2} \times 20 \times 5 = 50\ \text{m}$ and distance covered by 2nd car = area $OCD = \frac{1}{2}(OC \times OD) = \frac{1}{2} \times 10 \times 10 = 50\ \text{m}$.

Thus, both cars covered equal distance before stopping.

S26. Here, Radius of orbit $r = 42{,}250\ \text{km}$

and Revolution time $t = 24\ \text{h} = 24 \times 60 \times 60\ \text{s} = 86400\ \text{s}$

$\therefore$ Speed of satellite $v = \frac{\text{Circumference of orbit}}{\text{Time}} = \frac{2\pi r}{t}$

$$= \frac{2 \times \left(\frac{22}{7}\right) \times 42{,}250\ \text{km}}{86{,}400\ \text{s}} = 3.07\ \text{km s}^{-1}.$$

S27. Let distance of school from Abdul's house be s km.

During his trip from house to school average speed is $20\ \text{km h}^{-1}$, hence, time taken by him

$$t_1 = \frac{s}{20}\ h$$

Similarly, during the return trip from school to home average speed is 30, so the time taken by him

$$t_2 = \frac{s}{30}\ \text{h}$$

$\therefore$ Total distance for round trip $= s + s = 2s$ km

$$\text{and total time } t = t_1 + t_2 = \frac{s}{20} + \frac{s}{30} = \frac{5s}{60}\ \text{h} = \frac{s}{12}\ \text{h}$$

$\therefore$ Average speed for complete trip $= \frac{\text{Total distance}}{\text{Total time}} = \frac{2s\ \text{km}}{\frac{s}{12}\ \text{h}} = 2s \times \frac{12}{s} = 24\ \text{km h}^{-1}$.

S28. Here initial velocity $u = 0$, acceleration $a = +10\ \text{m s}^{-2}$ and distance covered by the ball before striking the ground $s = 20\ \text{m}$.

If final velocity of ball at the time of striking the ground be v, then using the relation $v^2 - u^2 = 2as$, we have

$$v^2 = u^2 + 2as = (0)^2 + 2 \times 10 \times 20 = 0 + 400 = 400$$

$\Rightarrow$ $v = \sqrt{400} = 20\ \text{m s}^{-1}$

Again using the relation $v = u + at$, we have

$$20 = 0 + 10 \times t = 10t$$

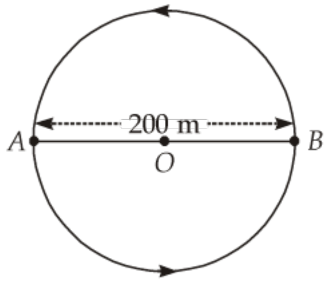
$\Rightarrow$ time $t = \frac{20}{10} = 2\ \text{s}$.

S29. Here, diameter of circular track D = 200 m. As the athlete completes one round of track in 40 s, hence in time t = 2 minutes 20 s = 140 s, the number of rounds completed by athlete

$$n = \frac{140}{40} = 3\frac{1}{2} = \frac{7}{2}.$$

(a) As in 1 round athlete covers distance equal to circumference of circle *i.e.*, $2\pi R = \pi D$, hence in 2 minutes 20 s, the distance covered will be

$$s = n \cdot \pi D = \frac{7}{2} \times \frac{22}{7} \times 200 \text{ m} = 2200 \text{ m}$$



(b) As shown in figure, if athlete starts running from point A then after completing $3\frac{1}{2}$ rounds, he will be at point B, diagonally opposite end of diameter AOB. Hence, his displacement

$$= AB = D = 200 \text{ m}.$$

S30. (a) Yes possible. Consider a ball thrown upwards. At the highest point, the velocity of ball is zero but a constant acceleration ($a = g = 9.8 \text{ m s}^{-2}$ downwards) is acting on it.

(b) Yes possible. A particle in uniform circular motion has its speed along the tangent drawn at a point on circle and acceleration is along radius and the two are mutually perpendicular to each other.