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Free Notes

Class 9 Science
C8: Motion

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Now... Padhle!

- <u>What is motion</u>?

- When the location of an object changes with time, the object is said to be in motion.
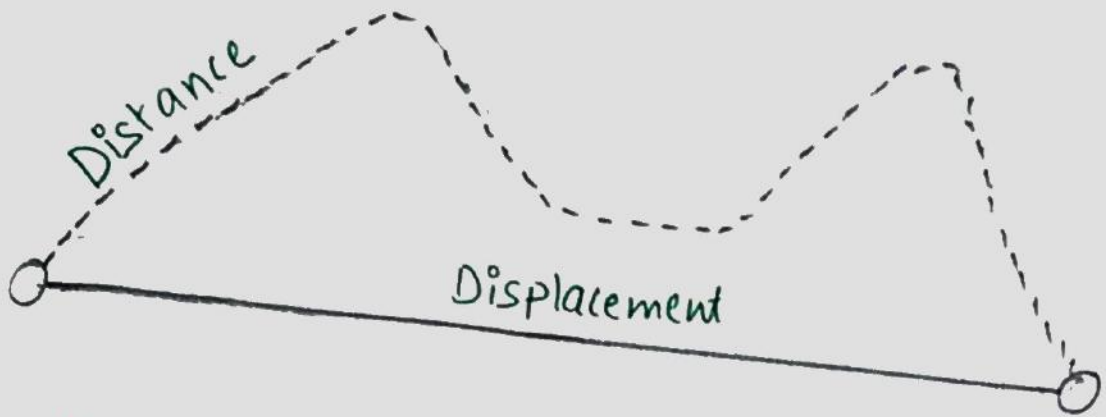
- <u>Motion in a straight line</u> :

- The simplest type of motion is the motion along a straight line.

- In the diagram, if an object moves from 'O' to 'C' and the 'C' to 'A' then the total distance covered is 85 km.

- <u>What is displacement</u> ?

- Displacement - The shortest possible distance between the initial and final position of an object is called Displacement.

- In the diagram, a person can either chose the long path or the short one.

- The shortest distance from A to B is called as displacement.

- When the initial and final positions of an object are same, the displacement is 'zero'.

Distance	Displacement
1) It is the length of the actual path covered by an object, irrespective of its direction of motion.	The shortest distance between the initial and final positions of an object in a given direction.
2) It is a scalar quantity.	It is a vector quantity.
3) Distance is always covered can never be negative. - It is always positive as zero.	It maybe positive, negative or zero.
4) Distance between two given points maybe same or different for different path chosen.	Displacement between two given points is always the same.

- Uniform Motion :

- Consider an object moving along a straight line.

- Let it travel 5m in the first second, 5m more in the next second, 5m in the third second and 5m

in the fourth second.

- In this case, the object covers 5m each second.

- As the object covers equal distances in equal intervals of time, it is said to be in uniform motion

- When a car is moving on a crowded street or a person is jogging in a park, these are some instances of non-uniform motion.

- Uniform motion : When an object travels equal distances in equal intervals of time the object is said to have a uniform motion.

- Non-uniform motion : When an object travels unequal distances in equal intervals of time the object is said to have a non-uniform motion.

- What are scalar and vector quantities ?

- What is Speed ?

- Speed is of an object is known as distance travelled by the object per unit time.

- It's SI unit is m.

- It is written as :
  Speed = distance/time

- Average Speed :

- The average speed of an object is obtained by dividing the total distance travelled by the total time taken.

Formula : average speed = $\left(\dfrac{\text{total distance travelled}}{\text{total time taken}}\right)$

If an object travel travels a distance 's' in the time 't' then its speed 'v' is = ?

$$V = \frac{S}{t}$$

— Velocity :

~ The rate of change of displacement of a body with the passage of time is known as velocity of the body.

~ Velocity of an object is measured in meter per second in SI units.

$$Velocity = displacement / time \ taken.$$

— Acceleration :

- Acceleration is a measure of the change in the velocity of an object per unit time.

$$acceleration = \frac{change \ in \ velocity}{time \ taken}$$

- If the velocity of an object changes from an initial value 'u' to the final value 'v' in time 't', the acceleration 'a' is;

$$a = \frac{v - u}{t} \qquad (8.3)$$

- This kind of motion is known as accelerated motion.

- The acceleration is taken to be positive if it is in the direction of velocity and negative when it is opposite to the direction of velocity.

- The SI unit of acceleration is $m\ s^{-2}$

- If an object travels in a straight line and its velocity increases or decreases by equal amounts in equal intervals of time, then the acceleration of the object is said to be uniform.

- The motion of a freely falling body is an example of uniformly accelerated motion.

- On the other side, an of object can travel with non-uniform acceleration if its velocity changes at a non-uniform rate.

     - For example: if a car travelling along a straight road increases its speed by unequal amounts in equal intervals of time, then the car is said to be moving with non-uniform acceleration.

– Graphical Representation Of Motion :

1) Distance – Time Graph :

– It represents a change in position of the object with respect to time.
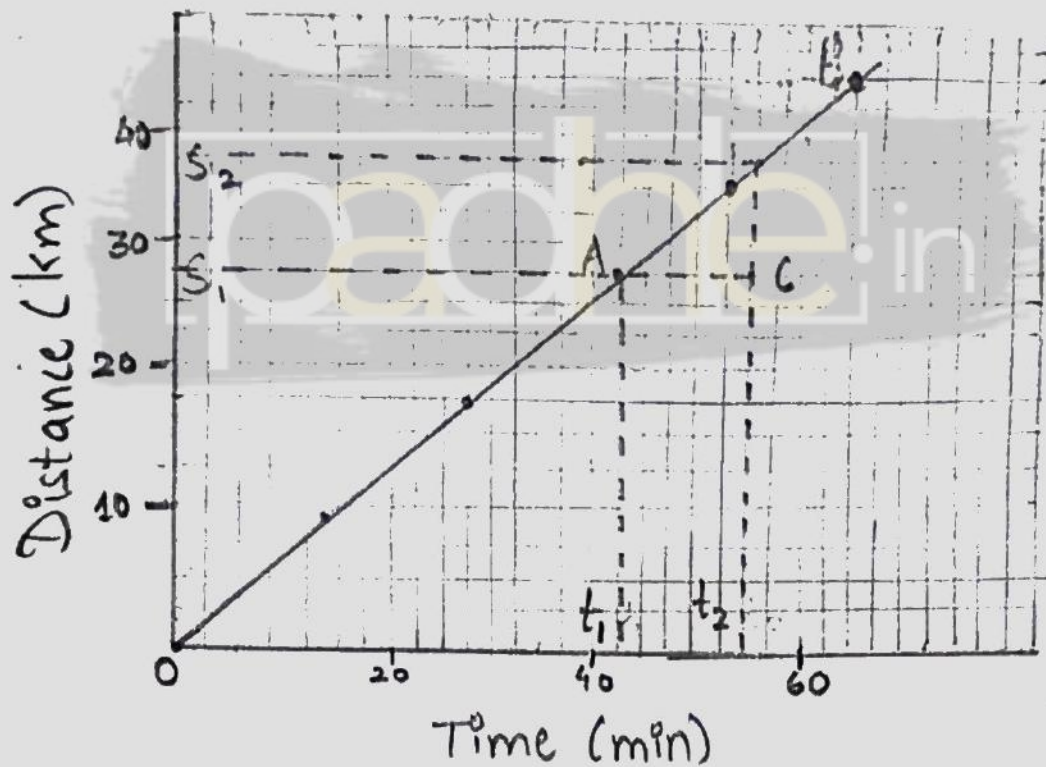
Distance–time graph of an object moving with uniform speed

– Draw a line parallel to the X-axis from point A and another line parallel to the y-axis from point B.

– These two lines meet each other at point C

to form a triangle ABC.

- Now, on the graph, AC denotes the time interva (t2-t1) while BC corresponds to the distance (s2-s1).

- We see from the graph that as the object moves from the point A to B, it covers a distance (s2-s1) in time (t2-t1).

- The speed, v of the object, therefore can be represented as:

$$V = \frac{s_2 - s_1}{t_2 - t_1}$$

- For <u>Non-Uniform Motion</u>:

- Draw a line parallel to the X-axis from point A and another line parallel to the y-axis from point B.

- These two lines meet each other at point C, to form a triangle ABC.

- Now, on the graph, AC denotes the time interval (t2-t1) while BC corresponds to the

distance (s2-s1).

- We can see from the graph that as the object moves from the point A to B, it covers a distance (s2-s1) in time (t2-t1).

- The speed, v of the object, therefore can be represented as :

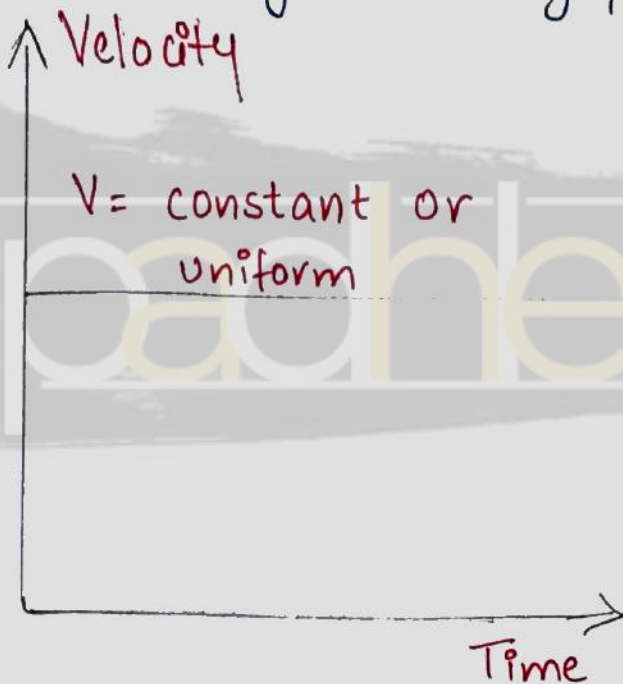$$v = \frac{S_2 - S_1}{t_2 - t_1}$$

— For Non-Uniform Motion :

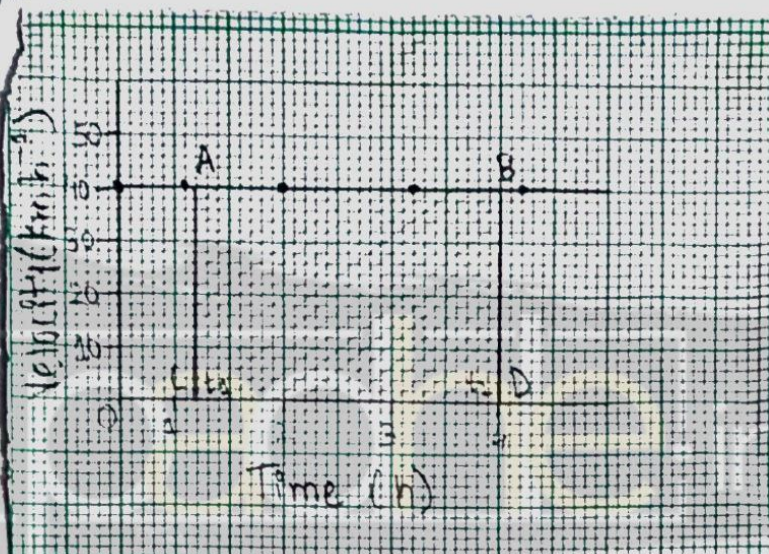Distance-time graph for a car moving with non-moving speed.

Distance (m) vs Time (s)
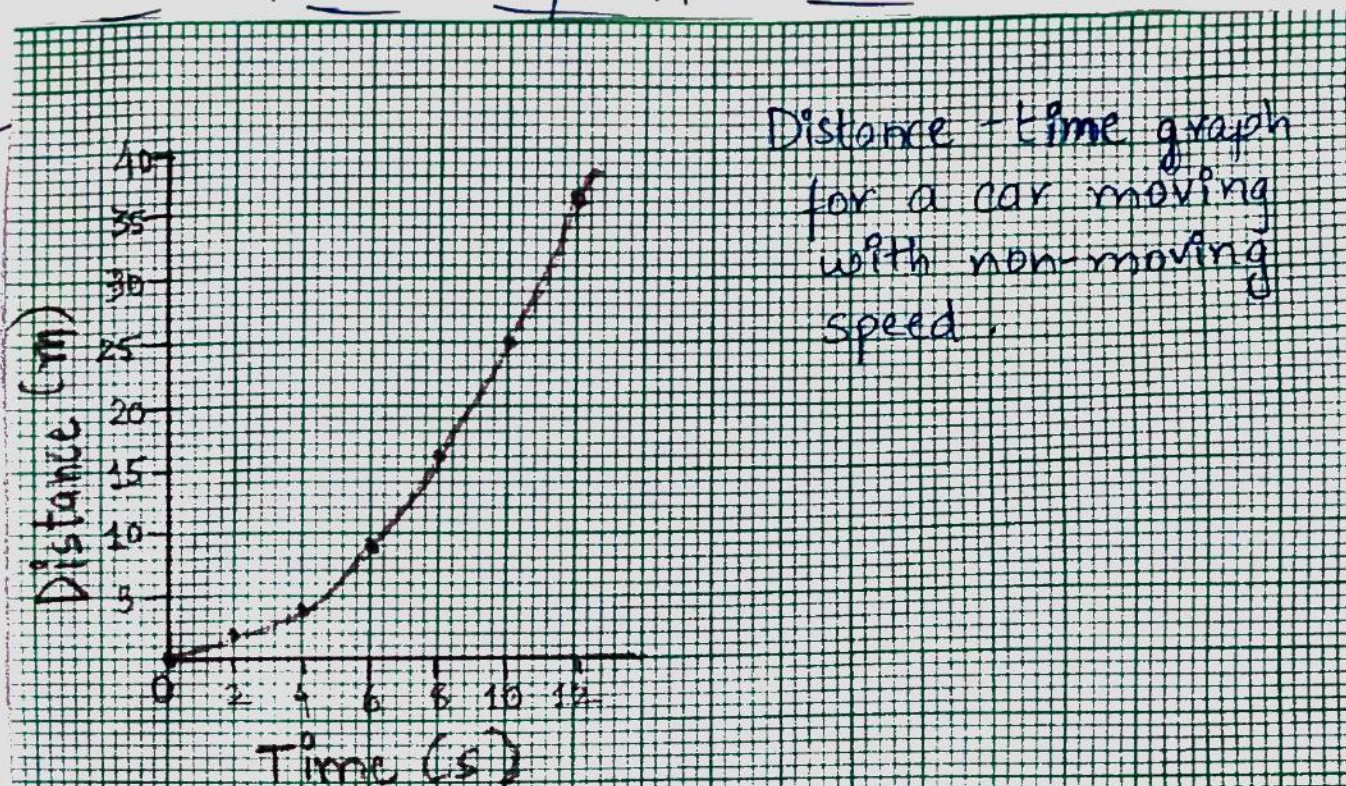
Velocity — Time Graphs :

- Constant velocity - Straight line graph, velocity is always parallel to the x-axis Uniform Velocity/Uniform Acceleration — Straight line graph.
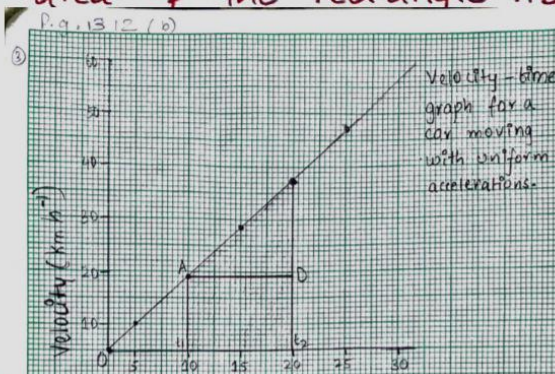
↑ Velocity

V = constant or uniform

→ Time

↑ Velocity
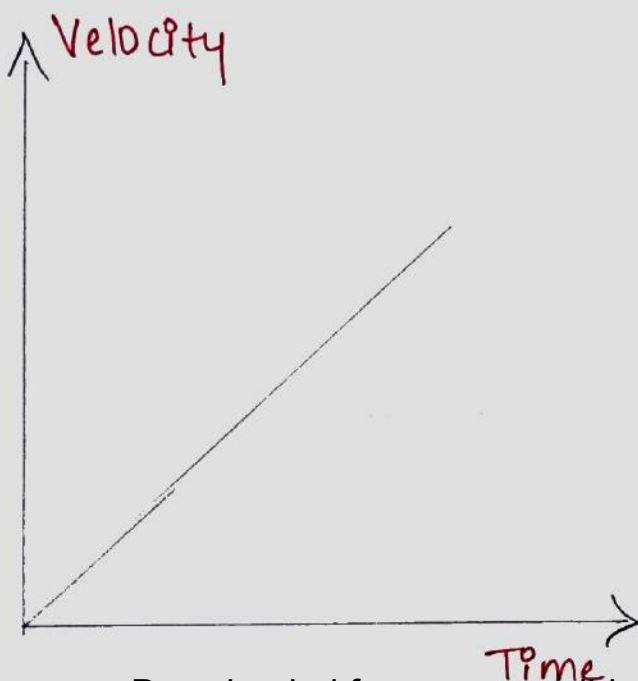
→ Time

- How to calculate <u>displacement through v-t</u> graph?

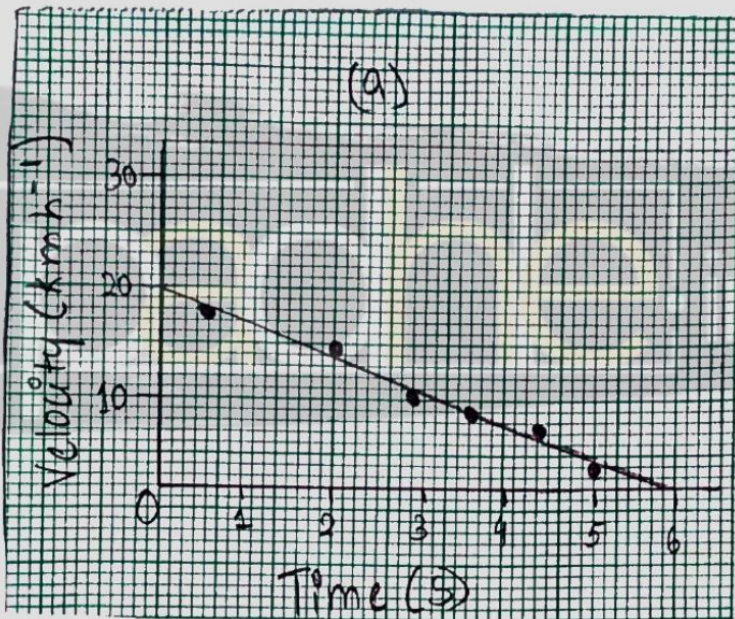- So, the distance s moved by the car in time $(t_2 - t_1)$ can be expressed as

$$S = AC \times CD$$
$$= [(40 \text{ km h}^{-1}) \times (t_2 - t_1) \text{ h}]$$
$$= 40 (t_2 - t_1) \text{ km}$$
$$= \underline{\text{area of the rectangle } ABDC \text{ (shaded)}}$$

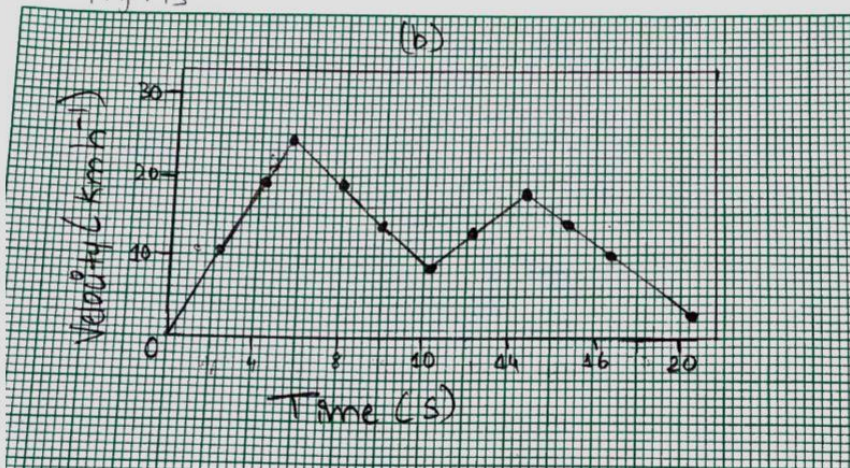Velocity–time graph for a car moving with uniform acceleration.

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S = area ABCDE

= area of the rectangle ABCD + area of the triangle ADE

$= AB \times BC + \frac{1}{2} (AD \times DE)$

(a)

P.g. 13

(b)

- Graph (a) - for decreasing acceleration
Graph (b) - for non-uniform accelerated

motion.

- Equations of Motion by Graphical Method:-

$$V = U + at$$
$$S = Ut + \frac{1}{2}at^2$$
$$2as = V^2 - U^2$$

Here, U = initial velocity
V = final velocity
a = uniform acceleration
S = distance travelled
t = time taken