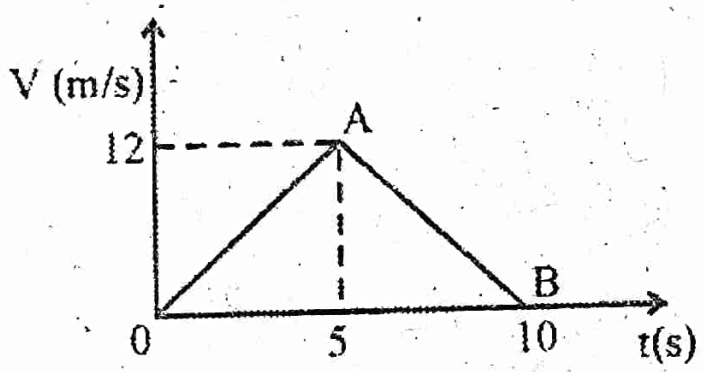
2 mark questions

1. **The speed-time graph for a particle moving along a fixed direction is shown in figure below. Calculate the distance travelled by the particle between t = 0 to t = 10s.**

(Model 2020)



Ans: Distance = Area

$$= \frac{1}{2}\ b \times h = \frac{1}{2} \times 10 \times 12 = 60\text{m}.$$

2.- **A car moving along a straight highway with speed of 35 ms^{-1} is brought to a stop within a distance of 200m. How long does it take for the car to stop?** *(First Term 2019-'20)*

$u = 35$ m/s, $S = 200$ m, $v = 0$, $t = ?$

From the equation $v^2 = u^2 + 2aS$,

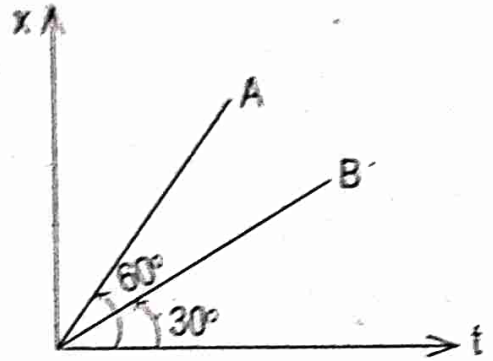
$0 = 35 \times 35 + 2 \times a \times 200$

$400\ a = -35 \times 35$ Or $a = \frac{-35 \times 35}{400}$ m/s^2

From equation $v = u + at$, $0 = 35 + \frac{-35 \times 35}{400} \times t$

Or $t = \frac{35 \times 400}{35 \times 35} = \frac{400}{35} = 11.43$ s.

3. The position - time graph of two objects A and B are shown below.

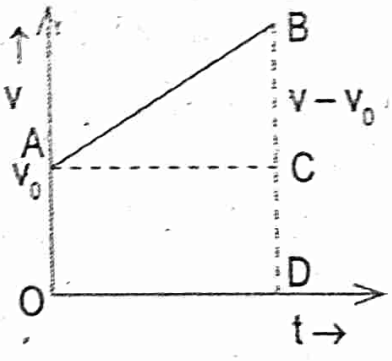


(a) Which body has greater velocity?
(b) Find the ratio of velocities of A and B. *(SAY 2019)*

(a) A

(b) $v = \tan\theta$; $\frac{v_A}{v_B} = \frac{\tan 60}{\tan 30} = \frac{\sqrt{3}}{1/\sqrt{3}} = 3 : 1.$

4. Using a suitable velocity-time graph, derive the relation $x = v_0 t + \frac{1}{2}at^2$. *(March 2018)*



Area between the instants 0 and t = Area of triangle ABC + Area of rectangle OACD.

The area of v – t curve represents the displacement.

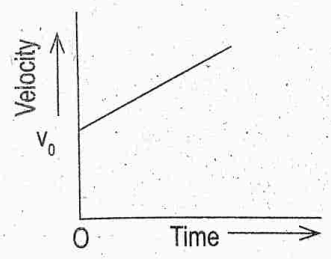
$x = \frac{1}{2}(v - v_0)t + v_0 t$

But $v - v_0 = at$ [$\because$ $v = v_0 + at$]

$\therefore x = \frac{1}{2}at^2 + v_0 t$ Or $x = v_0 t + \frac{1}{2}at^2$.

3 mark questions

5. The velocity - time graph of an object is given below.



(a) The area under this graph gives -----.

(b) Derive the relation $x = v_0 t + \frac{1}{2} at^2$ using the above graph. *(SAY2019)*

(a) Displacement (b) Refer to Qn. No. 4.

6. A body falling under the effect of gravity is said to be in free fall.

a) Draw the velocity-time graph for a freely falling object.

b) Define uniform acceleration.

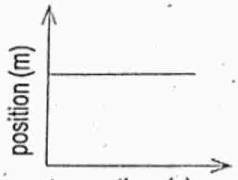


Fig. (1)

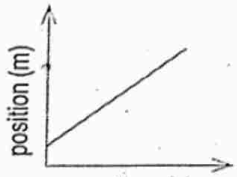


Fig. (2)

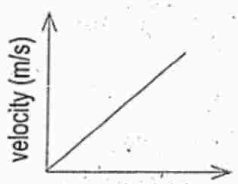


Fig. (3)

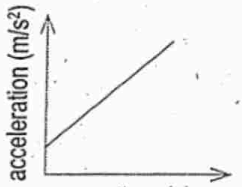
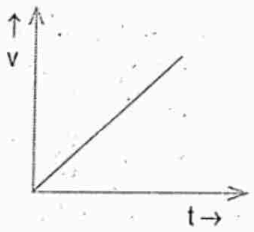


Fig. (4)

c) From the given figures, identify the figure which represents uniformly accelerated motion.

(March 2018)

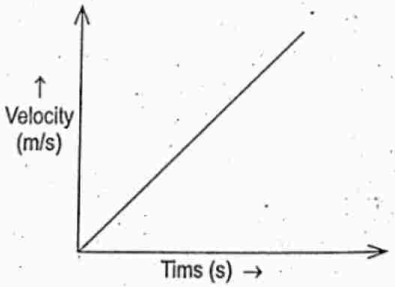
(a)



(b) An object is said to be moving with uniform acceleration if its velocity changes by equal amount in equal intervals of time.

(c) Figure 3.

7. Velocity - time graph of an object is given below.



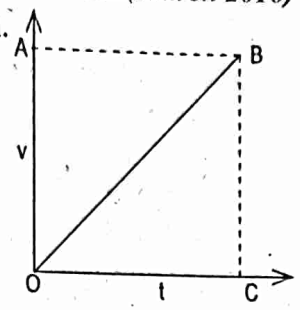
(a) What type of motion is indicated by the above graph?

(b) Derive a relation connecting the displacement and time for this type of motion.

(c) The ratio of velocity to speed of an object is .....
(i) one (ii) greater than one (iii) less than one
(iv) either less than one or equal to one. *(March 2016)*

(a) Uniformly accelerated motion.

(b) For the graph acceleration $a = \frac{BC}{OC} = \frac{BC}{t}$, distance travelled in time S = Area of the ΔOBC



$= \frac{1}{2} OC \times BC = \frac{1}{2} \times t \times at = \frac{1}{2} at^2 \therefore S = \frac{1}{2} at^2 (\because u = 0)$

(c) (iv)

4 mark questions

8. (a) Define instantaneous velocity.
(b) The position of an object moving along x-axis is given by $x = 8.5 + 2.5t^2$.
(i) What is its velocity at t = 2.0 s.
(ii) What is the average velocity between t = 2.0 s and t = 4.0 s? *(First Term 2019-'20)*

(a) The velocity at an instant is called instantaneous velocity.

(b) (i) Velocity $v = \frac{d}{dt}(8.5 + 2.5\,t^2) = 2 \times 2.5 \times t = 5t$

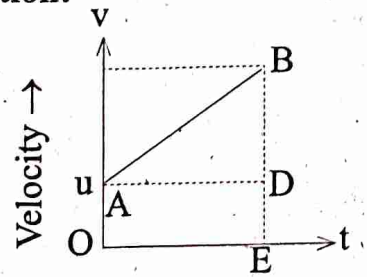
Then velocity at t = 2.0 s, $v_1 = 5 \times 2 = 10$ m/s

(ii) Velocity at t = 4.0 s, $v_2 = 5 \times 4 = 20$ m/s

Average velocity $v_{av} = \frac{(10+20)}{2} = 15$ m/s.

9. A body having an initial velocity 'v_0' has an acceleration 'a'.
(a) Using velocity-time graph, derive an equation for displacement of the above body.
(b) Draw the velocity-time graph and speed-time graph of a body thrown vertically in air. *(Model 2018)*

(a) **Derivation:**



From the graph $a = \frac{BD}{AD} = \frac{BD}{t}$.

Or $BD = a \times t$

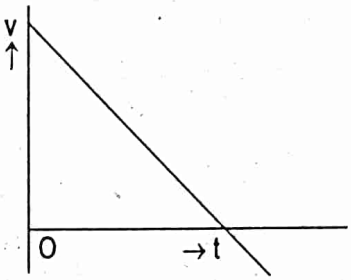
Distance travelled by the body in time t
= Area of the trapezium OABE
= Area of the triangle ADB + Area of rectangle OADE

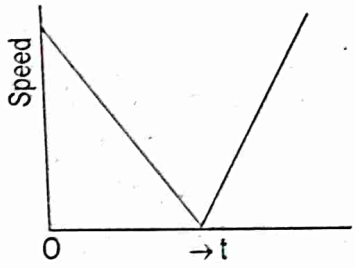
$= \frac{1}{2} BD \times AD + OA \times OE$

$= \frac{1}{2} at \times t + ut$ or $S = ut + \frac{1}{2} at^2$

(Here AD = OE = t, OA = u)

(b)

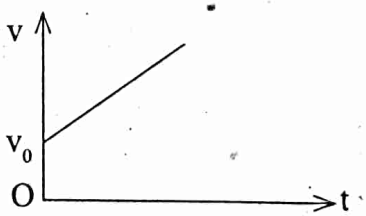




10. Acceleration is defined as the rate of change of velocity.
(a) Is it possible for a body to have acceleration without velocity? Explain.
(b) Draw the velocity - time graph of a body moving with uniform acceleration 'a' and initial velocity v_0.
(c) Using the above graph, obtain the equation for displacement in time 't'. *(March 2014)*

(a) Yes. When a body is thrown up, at the highest point the velocity is zero, but the acceleration is in the downward direction.

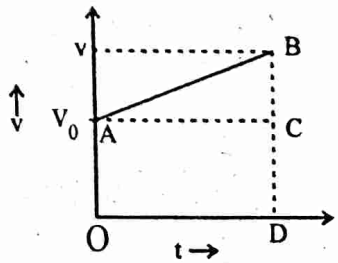
(b)



(c) Area of the graph
$= \square OACD + \Delta ACB$

$= v_0 \times t + \frac{1}{2} \times (v - v_0) \times t$

$= v_0 t + \frac{1}{2} \times \frac{(v - v_0)}{t} t^2$



Displacement, $S = v_0 t + \frac{1}{2} at^2$.