ws-13· kinematics graphs

Task

(1)

From the graph speed = acceleration × time
= Area of graph

clearly after 2 sec - speed is maximum → B

(2)

Given v-t graphs.

Time cannot be -ve.

In, a, (c) at particular time velocities are negative, at different points, which is not possible

In B, d, there is change in velocity w.r.t. time → C

(3)

clearly up to 6 sec there is increase in displacement w.r.t. to time so

velocity = slope of s-t graph = +ve,

velocity is increasing.

After '6' sec displacement is decreasing

$$\text{slope} = \frac{dx}{dt} = -ve$$

velocity is -ve

→ B is correct

(4)

we know speed = acceleration × time

= Area of the graph

$= \frac{1}{2} b_1 h_1 + l_2 \times b_2 + \frac{1}{2} b_3 h_3 + \frac{1}{2} b_4 h_4$

[0-4sec] [4-10s] [10-12s] [12-14]

$= \frac{1}{2} \times \cancel{4} \times 4 + 6 \times 4 + \frac{1}{2} \times \cancel{2} \times 4 + \frac{1}{2} \times \cancel{2} \times (-2)$

$= 8 + 24 + 4 - 2$

$= 34$ m/s → B

(5)

we know displacement = Area v-t graph

$A_1 = \frac{1}{2} \times b_1 \times h_1$

$= \frac{1}{2} \times 3 \times 6$

$= 6$ m

A_2 = Area of trapezium + Rectangle + trian

$= \frac{1}{2} \times [2+6] + 1 \times 4 + \frac{1}{2} \times 4 \times 1$

$= 10$ m.

Displacement $= A_2 - A_1 = 10 - 6 = 4$ m → D

(6)

x - cordinate of B = 30 cm [From fig]

→ C.

(7)

Distance = Area of v-t graph

$= l_1 \times b_1 + l_2 b_2 + l_3 b_3$

[0, 2sec] [2, 4] [4, 6]

$= 4 \times 2 + 2 \times 2 + 2 \times 2$

$= 16$ m

Displacement = Area of v-t graph

$\Rightarrow l_1 b_1 + l_2 b_2 + l_3 b_3$

$\Rightarrow 4 \times 2 + 2 \times (-2) + 2 \times 2$

$\Rightarrow 8 - 4 + 4 = 8\ m \rightarrow B$

(8)

when a ball dropped from certain height it's velocity increases gradually when it is maximum when it reaches the ground.

After rebounding, it behaves like vertically projected body ~~and become~~ so it's velocity decreases gradually and becomes '0' at max height. It should never be constant at any time

so (I) → velocity

Acceleration a = constant = ±g during upward motion a = -g ; downward a = +g.

so (II) → acceleration

(9)

we know displacement = velocity × time

= Area of ~~veb~~ v-t graph

= From 0 → 8 sec

$S = \frac{1}{2}\times 1\times \cancel{2} + 2\times 2 + \frac{1}{2}\times \cancel{2}^{2}\times 1 + \frac{1}{2}\times 6\times 1 + 1\times(-6) + 2\times 4$

[0-1] [1-3] [2-3] (3-4) [5-6] [6-8]

$= 1 + 4 + 2 + 3 - 6 + 8 - 3$ $+ \frac{1}{2}\,1\times(-6)$ (4→5)

$= 9\,m \rightarrow D$

(10)

From graph Total displacent = 20 m

Total time = 20 sec

$\langle velocity \rangle = \frac{\text{Total displacement}}{\text{Total time}}$

$= \frac{20}{20} = 1\ m/s \rightarrow C$

(14)

If $\vec{V_1}, \vec{V_2}$ are velocities of two bodies then relative velocity of one body w-r-t another body

$\vec{V_{12}} = \sqrt{V_1^2 + V_2^2 \mp 2V_1V_2\cos\theta}$

If $\theta = 0^\circ$ $V_{12} = V_1 \sim V_2$

$\theta = 180^\circ$ $V_{12} = V_1 + V_2$

$\theta = 90^\circ$ $V_{12} = \sqrt{V_1^2 + V_2^2}$ → C.

(15)

Here for both stones acceleration

$a_1 = +g$ [downward] $a_2 = -g$ [upward]

relative acceleration $= a_1 + a_2 = 0$

For 2nd stone Time of fall $= \frac{u}{g} = \frac{20}{10} = 2$ sec.

For Ist stone Time of fall $= \frac{2u}{g} = 2 \times 2 = 4$ sec

Since 2nd stone is thrown after 2' sec of Project of Ist stone, By that time Ist stone is at same position as that of 2nd stone, so both will reach the ground at a time.

relative velocity $= u_1 + u_2 = 20 + 20 = 40$ m/s

it is constant.

D → is correct.

(16) (17) (18)

$$\vec{V}_{AB} = \sqrt{V_A^2 + V_B^2 - 2V_AV_B\cos\theta}$$

$\theta = 0°$

$$\vec{V}_{AB} = \sqrt{V_A^2 + V_B^2 - 2V_AV_B\cos 0} = \sqrt{V_A^2 + V_B^2 - 2V_AV_B}$$

$$|\vec{V}_A - \vec{V}_B| = V_A - V_B \text{ (or) } V_B - V_A \rightarrow A \text{ or } D$$

$\theta = 180°$ $|\vec{V}_A - \vec{V}_B| = \sqrt{V_A^2 + V_B^2 - 2V_AV_B\cos 180°} = \sqrt{V_A^2 + V_B^2 + 2V_AV_B}$

$$= V_A + V_B \rightarrow C.$$

$\theta = 90°$ $|\vec{V}_A - \vec{V}_B| = \sqrt{V_A^2 + V_B^2 - 2V_AV_B\cos 90°}$

$= \sqrt{V^2 \ldots^2}$

(20)

speed = acceleration × time

$= \frac{1}{2} \times 10 \times 11 = 55$ m/s

<u>+Task</u>

(11)

In portion OA, slope of x-t graph is decreasing

∴ Velocity is decreasing

⇒ Acceleration = −ve

In AB → displacement = constant

$V = 0$

$a = 0$

In BC → slope is increasing ∴ V is increasing

$a = +ve$.

In CD slope $= 0 \Rightarrow V = 0 \Rightarrow a = 0$

correct → A

(12) → B is correct

Here the particle starts with maximum velocity and slowly it's velocity is decreasing

so slope is −ve ⇒ a = −ve = acceleration

After some time velocity is increasing

so slope is +ve ⇒ a = +ve & here a = constant

(13)

Displacement = $v \times time$ = area of graph

$= \cancel{\frac{1}{2}(11+5)\times t}$

on-X-axis each line is = 2.5 sec

Y-axis each line is = 5 m

Displacement $= \frac{1}{2}\times(-5)\cancel{(2.5)} + \frac{1}{2}\times\cancel{2.5}\times 5$

$+ 2.5\times 5 + \frac{1}{2}\times 2.5\times 10 + \cancel{\frac{1}{2}}\,2.5\times 15\times$

$+ \frac{1}{2}\times 15\times 2.5 - \frac{1}{2}\times 5\times 2.5$

$= 12.5 + 12.5 + \frac{37.5}{\cancel{2}} - \frac{12.5}{2} + \frac{37.5}{2}$

$\Rightarrow 75\,m \rightarrow c$

(14)

height = Displacement = $v \times time$

= Area of $v t \rightarrow$ graph

$\Rightarrow \frac{1}{2}\times b_1 h_1 + b_2 h_2 + \frac{1}{2}\times b_3 \times h_3$

$[0-2]$; $[2-10]$; $[10-12]$

$= \frac{1}{2}\times 2\times 3.6 + 8\times 3.6 + \frac{1}{2}\times 2\times 3.6$

$\Rightarrow 2\times 3.6 + 28.8$

$\Rightarrow 7.2 + 28.8$

$\Rightarrow 36\,m \rightarrow C$

(15) From graph Area given displacement

$\therefore$ Displacement $= \frac{1}{2} \times b \times h$

For OAC $=$ $S_1 = \frac{1}{2} \times OA \times OA \tan 60^\circ$ $[h = OA \tan 60^\circ]$

Time $\Rightarrow OA = \frac{h}{\tan 60^\circ}$ $S_1 = \frac{1}{2} [OA]^2 \tan 60^\circ$ (or) $\frac{1}{2} \frac{h}{\tan 60^\circ} \times h$.

$\therefore$ $\langle velocity \rangle = \frac{\text{Total distance}}{\text{Total time}} = \frac{\frac{1}{2} \times \frac{h^2}{\tan 60}}{\frac{h}{\tan 60}}$

$= \frac{h}{2}$

For ACB Displacement $S_2 = \frac{1}{2} \times b \times h = \frac{1}{2} (AB) \times h$

$[\tan 30^\circ = \frac{h}{AB}$ $S_2 = \frac{1}{2} \frac{h}{\tan 30} \times h$

$\Rightarrow AB = \frac{h}{\tan 30}]$ time $AB = \frac{h}{\tan 30}$

$\therefore$ ~~$S_2 = \frac{1}{2}$~~ $\langle velocity \rangle = \frac{S_2}{time}$

$= \frac{\frac{1}{2} \frac{h}{\tan 30} \times h}{\frac{h}{\tan 30}} = \frac{h}{2}$

For OA & AB $\langle$velocities$\rangle$ are same $= 1 : 1 \rightarrow A$

(16), (20), (19)

For a vertically Projected body, the velocity decreases with increase in time and becomes 0 at Max height. During it's return journey the velocity increases with time and reaches the ground with same velocity of Project but in opposite direction ~~so options (B) correct~~

Displacement $= 0$ after 't' sec

(17)

For uniformly accelerated motion

the displacement in n^{th} second increases every second

$a =$ constant

$$a = \frac{dv}{dt} = \text{constant}.$$

$$\int dv = k \int dt$$

$$\Rightarrow v = kt$$

$$\frac{dx}{dt} = kt \Rightarrow \int dx = k \int t \, dt$$

$$\Rightarrow x = \frac{kt^2}{2} \Rightarrow x \propto t^2$$

so graph is Parabola. $\boxed{S_n = u + \frac{a}{2}(2n-1)}$

(24)

(b) Retardation = −ve acceleration

$$= \frac{\text{velocity}}{\text{time}} = -\text{ve}.$$

(a)

For vertically Projected body

we know $v = u - gt$

$$a = \text{constant} \Rightarrow \frac{dv}{dt} = g$$

$$\Rightarrow dv = g\,dt \Rightarrow \int_u^v dv = \int g\,dt$$

$$\Rightarrow v - u = gt$$

$$\Rightarrow v = u + gt$$

so $v \propto t$ graph is straight line

(c) If a body moving with constant velocity (i.e.) No change in velocity w.r.t time. so graph is st. line