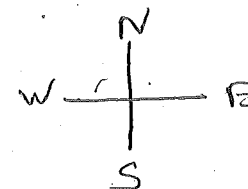
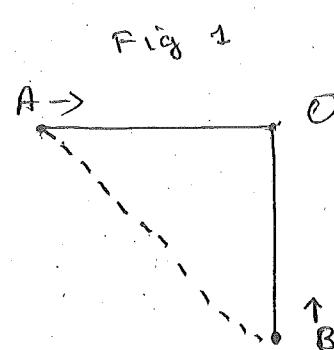


Solutions

1)



Car A accelerates at  $6 \text{ m/s}^2$  till a speed of  $55 \text{ m/s}$  is reached  
 Car B accelerates at  $5 \text{ m/s}^2$  till a speed of  $72 \text{ m/s}$  is reached  
 and travels at top speed for  $4.7$  seconds.

Car B: Time taken to reach speed of  $72 \text{ m/s}$  from 0

$$\begin{aligned} V &= 72 \text{ m/s} \\ u &= 0 \\ a &= 5 \text{ m/s}^2 \\ t &= ? \end{aligned}$$

$$V = u + at$$

$$t = \frac{V - u}{a} = \frac{72 - 0}{5} = 14.4 \text{ s}$$

$$\text{Total time taken} = 14.4 + 4.7 = 19.1 \text{ s}$$

(a) Each car travels for  $19.1 \text{ s}$  before they meet.

Car A: Time taken to reach speed of  $55 \text{ m/s}$  from 0

$$\begin{aligned} V &= 55 \text{ m/s} \\ u &= 0 \\ a &= 6 \text{ m/s}^2 \\ t &= ? \end{aligned}$$

$$t = \frac{V - u}{a} = \frac{55}{6} = 9.1667 \text{ s} = t_1$$

$$\text{Time traveled at top speed} = 19.1 - 9.1667 = 9.933 = t_2$$

total distance traveled

$$\begin{aligned} S &= S_1 + S_2 = (ut + \frac{1}{2}at^2) + (vt_2) \\ &= \frac{1}{2} \times 6 \times (9.1667)^2 + 55 \times 9.933 \\ &= 252.09 + 546.315 = 798.405 \text{ m} \end{aligned}$$

(b) Answer is  $798.405 \text{ m}$

Total distance B travelled:

$$t_1 = 14.4 \quad t_2 = 4.7$$

$$v = 72 \text{ m/s}, u = 0, a = 5 \text{ m/s}^2$$

$$S = S_1 + S_2 = (ut_1 + \frac{1}{2}at_1^2) + (vt_2)$$

$$= \frac{1}{2} \times 5 \times (14.4)^2 + 72 \times 4.7$$

$$= 518.4 + 338.4 = 856.8 \text{ m}$$

(c) Answer is 856.8 m

In figure 1 AOB forms a right angled triangle

$$\text{So } AB^2 = AO^2 + OB^2 = (798.405)^2 + (856.8)^2$$

$$= 637450.54 + 734106.24$$

$$= 1371556.78$$

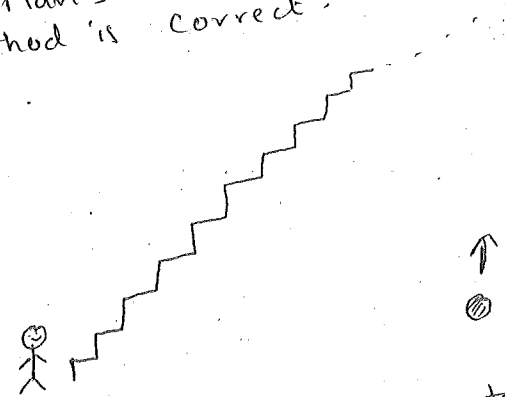
$$AB = 1,171.13 \text{ m}$$

(d) Answer is 1,171.13 m

Full Marks will be awarded for rounded off answers also if method is correct.

Q. 2.

2.



$$\uparrow$$

$$u = 250 \text{ m/s}, a = -g$$

Usain Bolt's climbs 10m tall flight of stairs in 3 sec.

$$u_b = \frac{10}{3} \text{ m/s}$$

He will have to lean out and catch the ball when both Bolt and ball are at the same height at same time

now

$$h_1 = \frac{10}{3}t \quad (\text{height of Bolt at time } t)$$

$$h_2 = ut + \frac{1}{2}at^2 = 250t - \frac{9.8}{2}t^2$$

$$h_1 = h_2 \Rightarrow ut + \frac{1}{2}at^2 = \frac{10}{3}t$$

$$250t - \frac{9.8}{2}t^2 = \frac{10}{3}t$$

$$\frac{9.8}{2}t = 250 - \frac{10}{3} \Rightarrow t = 50.34 \text{ s}$$

(a) So rounding off  $h_1$  to 160, Bolt will have climbed  
 $\frac{160}{10} = 16$  flights of stairs before catching the ball.

(b)  $v = u + at = 250 - 9.8 \times 50.34 = -243.33 \text{ m/s}$  (direction is downwards)

Please see the graph for better understanding.

For any questions/clarifications please contact <sup>Gopi</sup>  $\text{gopu90@unm.edu}$

