Understanding Mechanics : Sadler and Thorning

Chapter 2 : Distance, velocity & acceleration (* kinematics *)

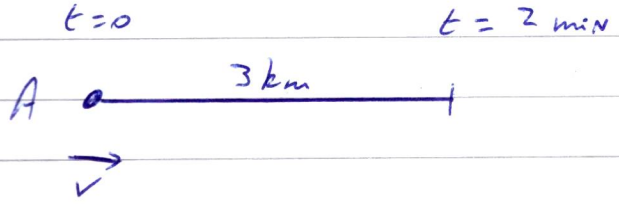
Exercise 2A

(1) $36 \text{ km/h} = \dfrac{36000 \text{ m}}{3600 \text{ s}} = 10 \text{ m/s}$

(3) $35 \text{ m/s} = \dfrac{35/1000 \text{ km}}{1/3600 \text{ h}} = 126 \text{ km/h}$

(5) $6 \text{ km/min} = \dfrac{6000 \text{ m}}{60 \text{ s}} = 100 \text{ m/s}$

(7)

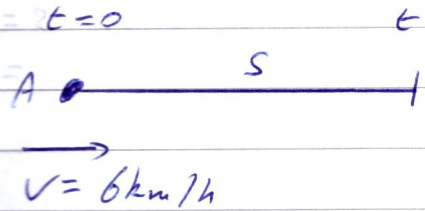


$\nearrow \quad Vt = S$

$\text{or} \quad V = \dfrac{S}{t}$

Now, $t = 2\text{min}$, $S = 3\text{km}$, $V = ?$; So $V = \dfrac{3000}{2 \times 60} = 25 \text{ m/s}$

(9)



$Vt = S \quad \text{or} \quad V = \dfrac{S}{t}$

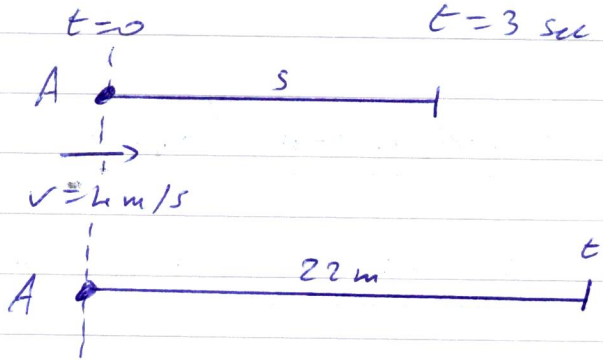
Here we have $t = 2\text{min}$

$V = 6 \text{ km/h}$

$S = ?$

So $S = \dfrac{6000}{3600} \cdot (2 \times 60) = 200 \text{ m}$

(11)

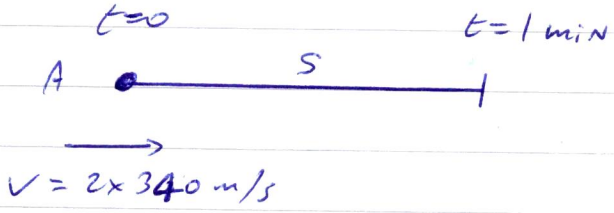


Formulae : (a) ; $V = \frac{S}{t}$ or $Vt = S$; (b)

For (a) : $t = 3$, $V = 4$, $S = ?$, Hence $S = 4 \times 3 = 12$ m

For (b) : $t = ?$, $V = 4$, $S = 22$, Hence $t = \frac{22}{4} = 5\frac{1}{2}$ s

(13)

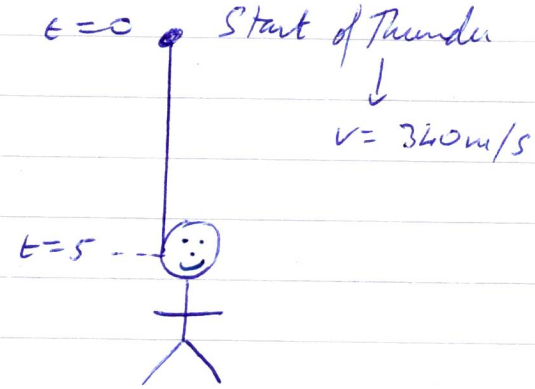


Formulae : $V = \frac{S}{t}$ or $Vt = S$

Now, $t = 1$ min, $V = 680$, $S = ?$

So $S = 680 \times 60 = 40\,800$ m $= 40.8$ km

(15)



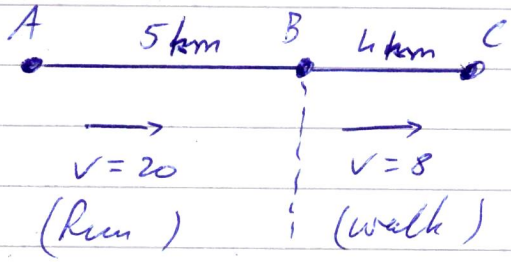
$t = 5$ s , $V = 340$ m/s

$S = ?$

So $S = Vt \Rightarrow S = 5 \times 340$

$= 1700$ m

(17)(a) Note that v is not constant over whole journey $A \to C$. So Analyse this problem in two stages: one stage for $v = 20$ & one stage for $v = 8$.



From $A \to B$: $s_1 = 5$, $v_1 = 20$, $t_1 = ?$

So $t_1 = \frac{5}{20} = \frac{1}{4}$ h

From $B \to C$: $s_2 = 4$, $v_2 = 8$, $t_2 = ?$

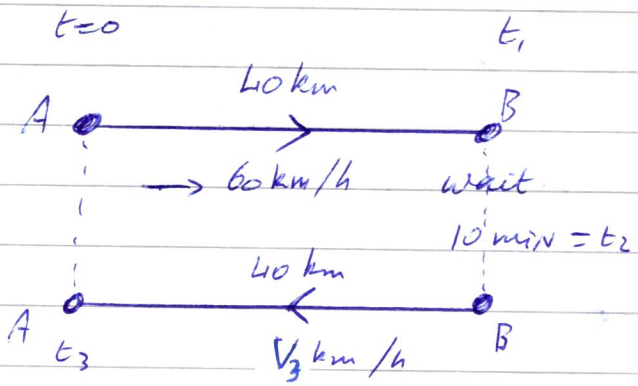
So $t_2 = \frac{4}{8} = \frac{1}{2}$ h

$\therefore$ Total time $t = t_1 + t_2 = \frac{1}{4} + \frac{1}{2} = \frac{3}{4}$ h $= 45$ mins.

(b) here $v = \frac{s}{t}$, So $v = \frac{5+4}{3/4} = 12$ km/h

In this question we can leave everything in km & h since the original v & s values are expressed consistently in km & h.

(19)



Do This Problem in Three Stages because Speed is Not constant over whole Journey : V=40 Then V=0 Then V=40

For A → B : $S_1 = 40$ km , $V_1 = 60$ km/h , $t_1 = ?$

So $t_1 = \frac{40}{60} = \frac{2}{3}$ h $= 40$ min

At B : "Stay at B for 10 min" means : $t_2 = 10$, $V = 0$, $S = 0$

For B → A : $S_3 = 40$ km , $V_3 = ?$, $t_3 = ?$

But we know total Average $V = 60$ km/h

So $$\text{total } V = \frac{\text{total } S}{\text{total } t} = \frac{40 + 0 + 40}{\frac{2}{3} + \frac{1}{6} + t_3} = 60$$

$$\text{So } t_3 = (80 - 60 \times \tfrac{2}{3} - 60 \times \tfrac{1}{6}) / 60 = \tfrac{1}{2} \text{ h}$$

So For B → A : $S_3 = 40$, $t_3 = \frac{1}{2}$ h , $V_3 = ?$

$$\therefore V = \frac{40}{\frac{1}{2}} = 80 \text{ km/h}$$

(b) Average Velocity $= \dfrac{\text{total displacement}}{\text{total time}} = \dfrac{40 + (-40)}{\text{time}} = 0$

Note : velocity has direction : A → B = + 40 km ; B → A = − 40 km