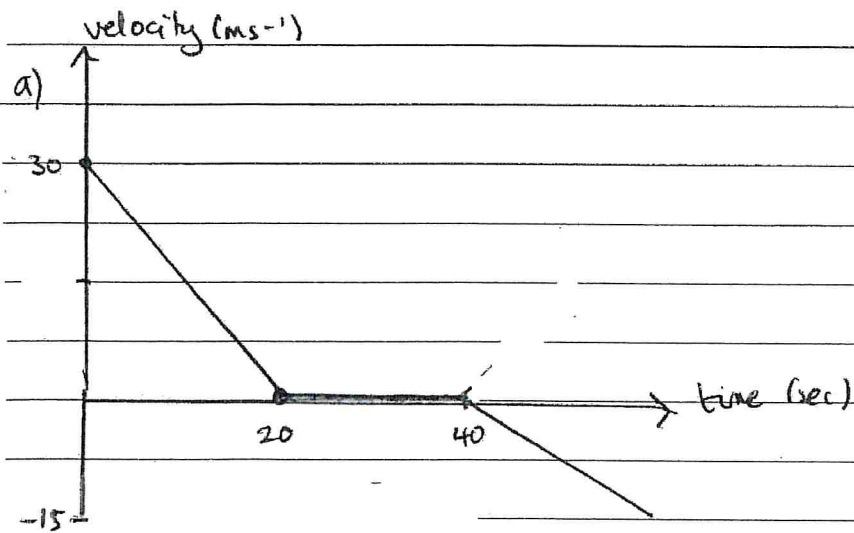


Mechanics 2 "suvat" Equations solutions

Section 1



$$b) \frac{30}{20} = 1.5 \text{ ms}^{-2}$$

$$c) \frac{1}{2} \times 20 \times 30 = 300 \text{ m}$$

$$d) 0.375 = \frac{15}{t} \Rightarrow t = \frac{15}{0.375} = 40 \text{ sec.}$$

Section 2

1) Time t - it is the only variable that does not have a direction. ✓ (2)

2) a) $s = ut + \frac{1}{2}at^2 = 70 \times 10 + \frac{1}{2} \times -3 \times 10^2 = \underline{\underline{550\text{m}}}$ ✓

b) $s = \frac{1}{2}(u+v)t = \frac{1}{2}(15+29) \times 9 = \underline{\underline{198\text{m}}}$ ✓

c) $v = u + at : 38 = 3 + 7a \Rightarrow 7a = 35 \Rightarrow a = \underline{\underline{5\text{ms}^{-2}}}$ ✓

d) $v^2 = u^2 + 2as : 28^2 = 22^2 + 2 \times 6 \times s \Rightarrow 784 = 484 + 12s$
 $12s = 300 \Rightarrow s = \underline{\underline{25\text{m}}}$ ✓

e) $s = vt - \frac{1}{2}at^2 : 0 = -28t - \frac{1}{2}(-7)t^2$

$$0 = -28t + 3.5t^2 \quad \checkmark$$

$$0 = t(-28 + 3.5t)$$

$$\underline{\underline{t=0}} \text{ or } 3.5t - 28 = 0 \Rightarrow \underline{\underline{t=8\text{sec}}} \quad \checkmark$$

(10)

3) $u = 24\text{ms}^{-1} \quad a = 5\text{ms}^{-2}$

a) $v^2 = u^2 + 2as : v^2 = 24^2 + 2 \times 5 \times 10 = 676$ ✓

$$v = \underline{\underline{26\text{ms}^{-1}}} \quad \checkmark$$

b) $v = u + at : 26 = 24 + 5t \Rightarrow t = \underline{\underline{0.4\text{sec}}}$ ✓ (4)

4) $u = 60\text{ms}^{-1} \quad a = -8\text{ms}^{-2} \quad t = 10\text{sec}$

a) $v = u + at = 60 - 8 \times 10 = \underline{\underline{-20\text{ms}^{-1}}}$ ✓

b) $v = 0 \quad t = ?$

$$v = u + at \quad 0 = 60 - 8t \Rightarrow \underline{\underline{t = 7.5\text{sec}}} \quad \checkmark$$

(4)

5.) $t = 40 \text{ sec}$ $a = 0.5 \text{ ms}^{-2}$ $u = 0$

a) $v = u + at = 0 + 0.5 \times 40 = 20 \text{ ms}^{-1}$ ✓

b) $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 0.5 \times 40^2 = 400 \text{ m}$ ✓ (4)

6) $u = 5 \text{ ms}^{-1}$ $a = 3 \text{ ms}^{-2}$ $s = 84 \text{ m}$ $t = T$

$s = ut + \frac{1}{2}at^2$: $84 = 5T + \frac{1}{2} \times 3 \times T^2$ ✓

$\times 2$: $168 = 10T + 3T^2$

$\Rightarrow 3T^2 + 10T - 168 = 0$ as required, ✓

Solving quadratic equation: $T = 6$ or $(-28/3)$ ✓ (3)

7.) $60 \text{ kmh}^{-1} = \frac{60 \times 1000}{3600} = \frac{50}{3} \text{ ms}^{-1}$ ✓

$u = 0$ $v = \frac{50}{3} \text{ ms}^{-1}$ $t = 8 \text{ sec}$ $s = ?$

$s = \frac{1}{2}(u+v)t = \frac{1}{2} \left(0 + \frac{50}{3}\right) \times 8 = \frac{200}{3} \text{ m}$ ✓

a) Distance remaining for $200 \text{ m} = 200 - \frac{200}{3} = \frac{400}{3} \text{ m}$

Time at steady speed = $\frac{400}{3} / \frac{50}{3} = 8 \text{ sec}$.

Total time = $8 + 8 = 16 \text{ sec}$. ✓

b) Distance remaining for $1 \text{ km} = 1000 - \frac{200}{3} = \frac{2800}{3} \text{ m}$

Time at steady speed = $\frac{2800}{3} / \frac{50}{3} = 56 \text{ sec}$.

Total time = $8 + 56 = 64 \text{ sec}$ ✓ (4)

8) A : $u=0$ $a=6\text{ms}^{-2}$ $s=x$
 B : $u=0$ $a=2\text{ms}^{-2}$ $s=100-x$

$s=ut + \frac{1}{2}at^2$: $x=3t^2$ ✓

$100-x=t^2$ ✓

① + ② $100=4t^2 \Rightarrow t^2=25 \Rightarrow t=5\text{sec}$

$\Rightarrow x=3 \times 5^2 = 75\text{m}$

a) 75m ✓

b) 5 sec ✓

c) A : $v=u+at = 0+5 \times 6 = 30\text{ms}^{-1}$ ✓ } taking direction of A
 B : $v=u+at = 0-2 \times 5 = -10\text{ms}^{-1}$ ✓ } as positive. (6)

9) $u=13\text{ms}^{-2}$ $a=-2\text{ms}^{-2}$ $s=\pm 30\text{m}$ ✓

$s=ut + \frac{1}{2}at^2$: $30=13t - t^2 \Rightarrow t^2 - 13t + 30 = 0$ ✓

$t=3\text{sec}$ or 10sec ✓

$-30=13t - t^2 \Rightarrow t^2 - 13t - 30 = 0 \Rightarrow t=15\text{sec}$ (or -2) ✓

$t=3, 10$ or 15

Extension Question

RL : $a=0.15\text{ms}^{-2}$ $v=9\text{ms}^{-1}$ $s=240\text{m}$ $u=?$

$v^2 = u^2 + 2as$: $9^2 = u^2 + 2 \times 0.15 \times 240$

$\Rightarrow u^2 = 9 \Rightarrow u = 3\text{ms}^{-1}$

(velocity at restaurant)

$v=u+at$: $9=3+0.15t \Rightarrow t=40\text{sec}$

\Rightarrow Time for garage \rightarrow restaurant = 20 sec.

GR : $a=0.15\text{ms}^{-2}$ $t=20\text{sec}$ $v=3\text{ms}^{-1}$ $s=?$

$s=vt - \frac{1}{2}at^2$

$= 3 \times 20 - \frac{1}{2} \times 0.15 \times 20^2 = 30\text{m}$

Total distance garage \rightarrow library = $30 + 240 = 270\text{m}$