Exercise 2E (odd)

① a)

$u = 0$ m/s

$v = 6$ m/s

$a = \frac{6}{4} = \frac{3}{2} = 1.5$ m/s^2

s = area under graph $= \frac{1}{2} \cdot 4 \times 6 = 12$ m

b)

$u = 2$ m/s

$v = 6$ m/s

$a = 4/4 = 1$ m/s^2

$s = \frac{1}{2} \cdot 4 \cdot (2+6) = 16$ m

c)

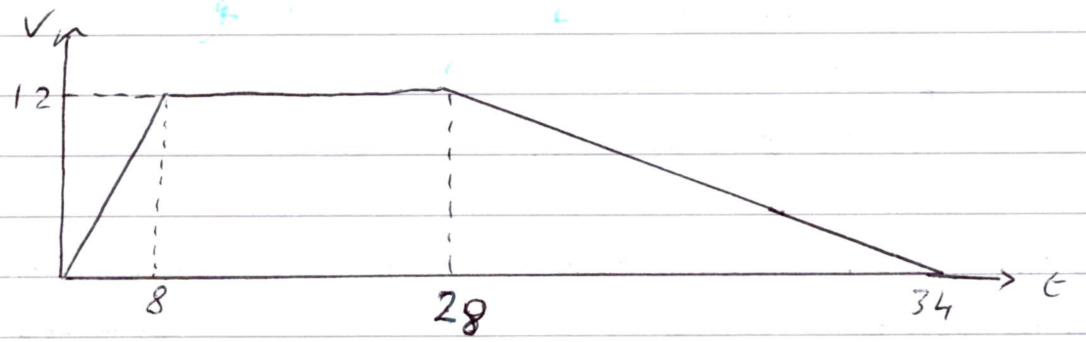
$u = 6$ m/s

$v = 3$ m/s

$a = -\frac{3}{4} = -0.75$ m/s^2

$s = \frac{1}{2}$(height) (Sum of // Sides) $= \frac{1}{2} \cdot 4 \cdot (6+3) = 18$m

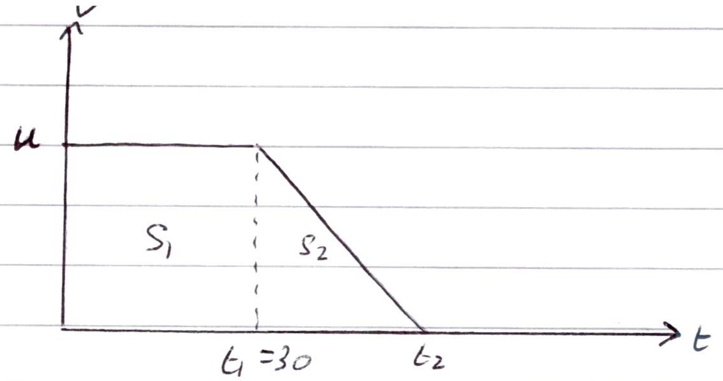
③



a) $a = \frac{12}{8} = 1.5$ m/s^2 ; b) $a = \frac{-12}{6} = -2$ m/s^2

s = area under graph $= \frac{1}{2} \cdot 12 \cdot (20 + 34) = 324$ m

(5)



$S_1 = \frac{3}{5}$ of total S

$S_2 = \frac{2}{5}$ of total S

$S_1 = 0.6\,S = 30\,u$ m (by "$s = v.t$" formula & by distance being area under graph)

$S_2 = 0.4\,S = \frac{1}{2} \cdot u\,(t_2 - 30)$ m

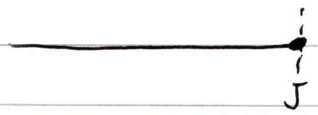
So $\dfrac{S_1}{S_2} = \dfrac{0.6S}{0.4S}$

$= \dfrac{3}{2} = \dfrac{30u}{\frac{1}{2}u\,(t_2 - 30)}$

$\therefore \dfrac{3}{120} = \dfrac{1}{t_2 - 30} \Rightarrow t_2 - 30 = 40$

$\Rightarrow t_2 = 70$ Seconds.

(7)



$t = 1$ min $= 60$ secs

$u = 60$ mph $= 96$ kph $= 26\frac{2}{3}$ m/s

length of 1 car $= 8$ m

Assume length of train is from front of 1st carriage to rear of last carriage

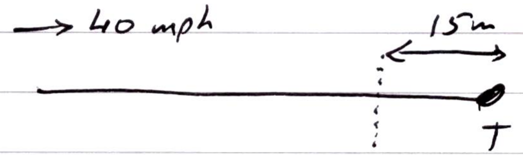
" No gap between carriages

" a is constant

given: $u = 26\frac{2}{3}$ m/s $t = 60$ secs length of 1 car $= 8$ m	want: s

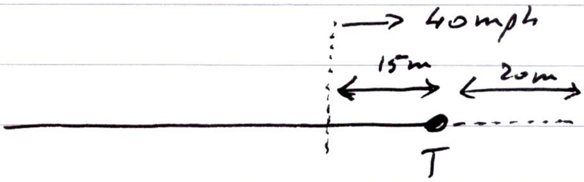
$s = u \cdot t = 26\frac{2}{3} \cdot 60 = 1600$ so $\dfrac{1600}{8} = 200$ m for each car.

(9)



Assume accel is const upto 15m from T Then any decel is const too
" No Friction on The Road & wind Resistance & wind assist
" Road is horizontal.

Now



<u>given</u> $u = 40$ mph $= 64$ kph $= 17\frac{7}{9}$ m/s

$S = 35$m, i.e distance needed to clear the lights

$t = 1.5$ sec, i.e time needed to clear the lights

<u>want</u>: a, i.e want $a = 0$
& want the car to travel 35m in 1.5 sec at $17\frac{7}{9}$ m/s

For the latter case $V = \frac{S}{t} = \frac{35}{1.5} = 23\frac{1}{3}$ m/s

But car is only doing $17\frac{7}{9}$ m/s so car will not clear the lights doing $17\frac{7}{9}$ m/s

So with $u = 17\frac{7}{9}$, $S = 35$, $t = 1.5$ find a:

$\therefore S = ut + \frac{1}{2}at^2 \Rightarrow 35 = (17\frac{7}{9})(1.5) + \frac{1}{2}a(1.5)^2$

$\Rightarrow a = 7.41\ m/s^2$

Ex 2E, P36 (even Qs)

(2) (a) acceleration = gradient from $t=0$ to $t=3$

so $a = \frac{6-0}{3-0} = 2 m/s^2$

Retardation $= \frac{6-0}{-7+9} = +3 m/s^2$

(or acceleration $= -3 m/s^2$)

total distance travelled = area under graph

So distance $= \frac{1}{2} \cdot 6 \cdot (9+4) = 39 m$

(b) acceleration = gradient over $t=0$ to $t=1$

so $a = \frac{4-0}{1-0} = 4 m/s^2$

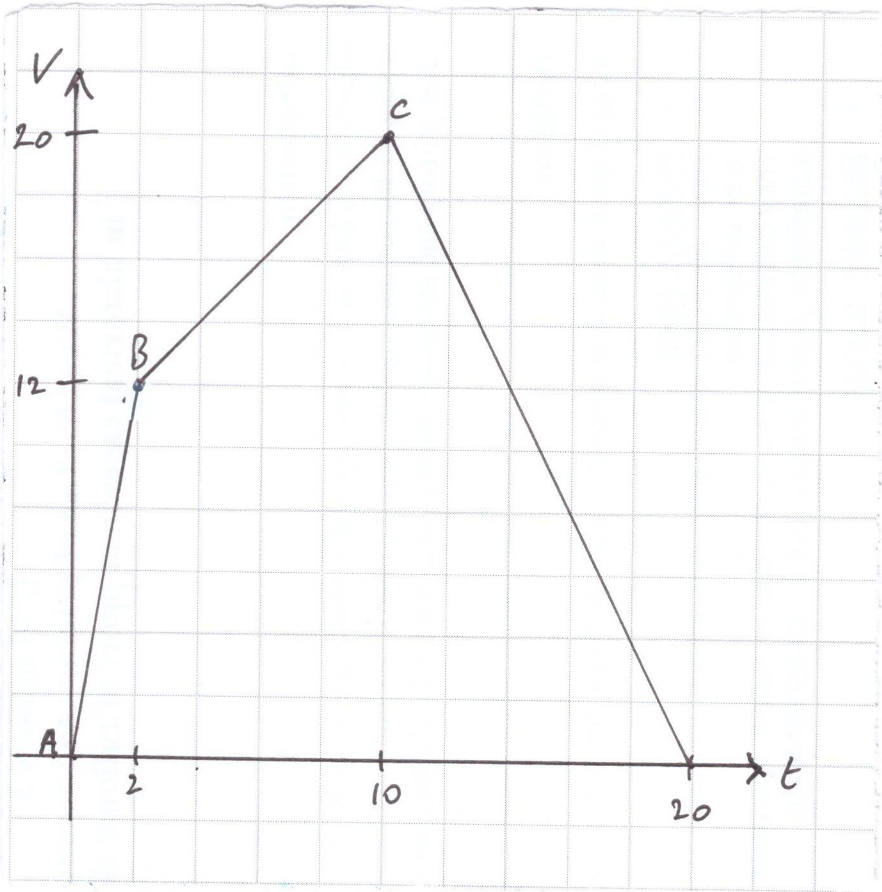
Retardation $= \frac{4-0}{7-4} = \frac{4}{3} m/s^2$

(or acceleration $= -\frac{4}{3} m/s^2$)

total distance travelled = area under graph

So distance $= \frac{1}{2} \cdot 4 \cdot (7+3) = 20 m$

(4)



(a) acceleration from A to B = gradient of AB

$= \frac{12-0}{2-0} = 6 \, m/s^2$

(b) Speed at C = 20 m/s (because a = 1 m/s²

implying an increase in speed of 1 m/s every sec for

8 secs ⟹ speed at C = 12 + 8)

(c) acceleration $= \frac{0-20}{20-10} = -2 \, m/s^2$

So retardation = $2 \, m/s^2$

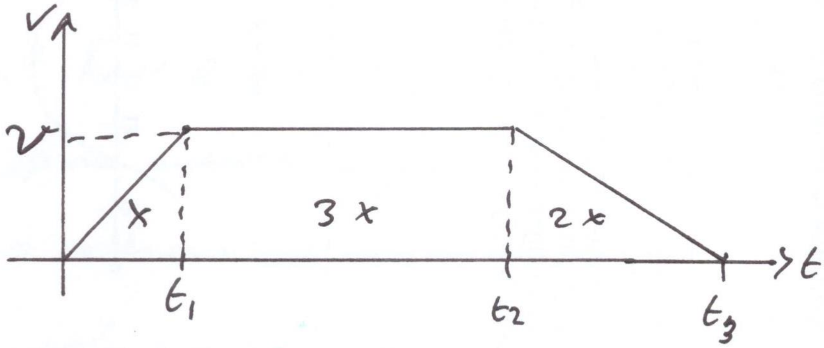
(d) distance travelled = area under curve

$$= \text{area under } AB + \text{area under } BC + \text{area under } CD$$

$$= \tfrac{1}{2} \cdot 2 * 20 + \tfrac{1}{2} \cdot 8(20+12) + \tfrac{1}{2} \cdot 10 * 20$$

$$= 240 \text{ m}$$

(6)



Area under v-t graph = distance, hence the labels.

use areas to find t_1, t_2, t_3, Then find total time.

So $x = \frac{1}{2} t_1 \cdot v \Rightarrow t_1 = \frac{2x}{v}$

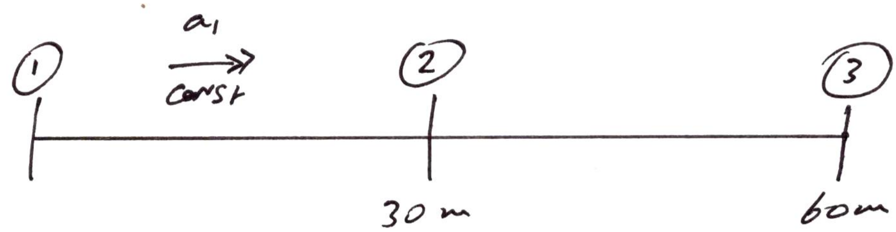
$3x = v(t_2 - t_1) \Rightarrow t_2 - t_1 = \frac{3x}{v}$

$2x = \frac{1}{2}(t_3 - t_2) \cdot v \Rightarrow t_3 - t_2 = \frac{4x}{v}$

Now total time: $(t_3 - t_2) + (t_2 - t_1) + t_1 = t_3 = \frac{4x}{v} + \frac{3x}{v} + \frac{2x}{v}$

So $t_3 = T = \frac{9x}{v}$ ✓

(8)



u_1	u_2
v_1	v_2
$s_1 = 30$	$s_2 = 30$
$t_1 = 3$	$t_2 = 2.2$
$v_1 = u_2$	

We don't have enough info to use one equation to give us an answer. So we will set up two equations in two unknowns & see what happens.

Ultimately we are looking for v_1 $(= u_2)$ so our decision about what algebra & equations to do will be guided by this.

<u>From (1) → (2)</u>: $s_1 = \left(\frac{u_1 + v_1}{2}\right) t_1 \Rightarrow 30 = \left(\frac{u_1 + v_1}{2}\right) * 3$

So $20 = u_1 + v_1$ (*)

<u>From (2) → (3)</u>: $s_2 = \left(\frac{u_2 + v_2}{2}\right) t_2 \Rightarrow 30 = \left(\frac{u_2 + v_2}{2}\right)(2.2)$

But $u_2 = v_1$ & by (*) $v_1 = 20 - u_1$. So

$$30 = \left(\frac{20 - u_1 + v_2}{2}\right)(2.2)$$

$$\Rightarrow v_2 - u_1 = 7.27. \quad (**)$$

we still can't solve for V_1 ($=u_2$) so set up a third equation:

From ① → ③ : $s = \frac{u+v}{2} \cdot t \Rightarrow 60 = \left(\frac{u_1 + V_2}{2}\right)(5.2)$

(Note that total distances and times are used)

So $u_1 + V_2 = 23.08$. (***)

Now we have enough info: Do (**) + (***). So

$$\begin{array}{rl} V_2 - u_1 &= 7.27 \\ + \quad V_2 + u_1 &= 23.08 \\ \hline 2V_2 &= 30.35 \end{array} \Rightarrow V_2 = 15.17\,m/s$$

By (**) or (***) : $u_1 = 7.9\,m/s$.

Then $S_1 = \left(\frac{u_1 + V_1}{2}\right) \cdot t_1 \Rightarrow 30 = \left(\frac{7.9 + V_1}{2}\right) \cdot 3$

So $V_1 = 12.1\,m/s = 43.56\,km/h = 27.2\,mph$

So John is not breaking the speed limit.