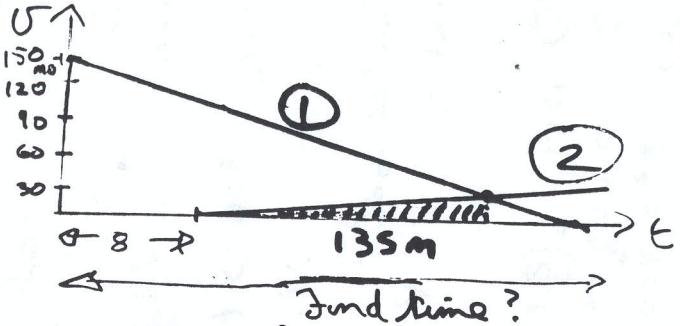
1986 HONS KINEMATICS

(i)



Scale!

i) Need to find a_1 the deceleration so that we can find the time to come to rest.

Find time: for ②: to have speed $30\,ms^{-1}$.

$s = 135$, $u = 0$, $v = 30$, $t = ?$

distance = Area under curve

$s = \frac{1}{2}vt$.

$135 = \frac{1}{2}30t$.

$t = \frac{135}{15}$

$t = 9$ secs

Find a_1: for ①:

$v = 30$, $u = 150$, $t = 8 + 9 = 17$ secs, $a_1 = ?$

$v = u + at$

$30 = 150 + a_1 17$.

$a_1 = \frac{30 - 150}{17}$

$a_1 = \frac{-120}{17}\ ms^{-2}$

Find time for ② to come to rest:

$u = 150$, $v = 0$, $a = -\frac{120}{17}$, $t = ?$

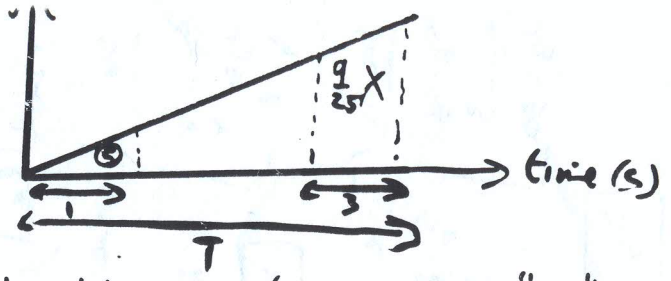
$v = u + at$

$0 = 150 - \frac{120}{17}t$

$\Rightarrow t = \frac{17(150)}{120} \Rightarrow t = \frac{5}{4}(17)$ secs

$t = 21.25$ secs

1986 (b)



Let $X = |PQ|$

Let T = Total time

The key to this problem is to ignore "v" and to find a. and then use $s = ut + \frac{1}{2}at^2$ as shown.

Find a'. $u = 0$, $t = 1$, $s = 5$ ⎫ $s = ut + \frac{1}{2}at^2$

$\Rightarrow 5 = \frac{1}{2}a1^2 \Rightarrow$ **$a = 10\,ms^{-2}$**

⇒ CONSIDER MOTION FROM BEGINNING ←

$u = 0$, $s = X$, $t = T$, $a = 10$ ⎫ $s = ut + \frac{1}{2}at^2$

$\Rightarrow X = \frac{1}{2}(10)T^2$. (A)

But $\frac{9}{25}X$ in last 3 secs $s = \frac{9}{25}X$ then

$u = 0$, $s = \frac{16}{25}X$, Ran $t = T - 3$, $a = 10$ ⎫ $s = ut + \frac{1}{2}at^2$

$\Rightarrow \frac{16}{25}X = \frac{1}{2}10(T-3)^2$

$\Rightarrow X = \frac{250}{32}(T-3)^2$. (B)

(A) and (B) $\Rightarrow \frac{1}{2}10T^2 = \frac{250}{32}(T-3)^2$

$\Rightarrow T^2 = \frac{25}{16}(T-3)^2$

$\Rightarrow 16T^2 = 25(T^2 - 6T + 9)$

$\Rightarrow 0 = 9T^2 - 150T + 225$.

$\Rightarrow 0 = 3T^2 - 50T + 75$

$\Rightarrow 0 = (3T-5)(T-15)$

$\Rightarrow T = \frac{5}{3}$ OR $T = 15$.

Not allowed as $T > 4$.

$3T$, -5; T, -15

∴ Total Time = 15 secs.