2007

1 **(b)** A train accelerates uniformly from rest to a speed v m/s.

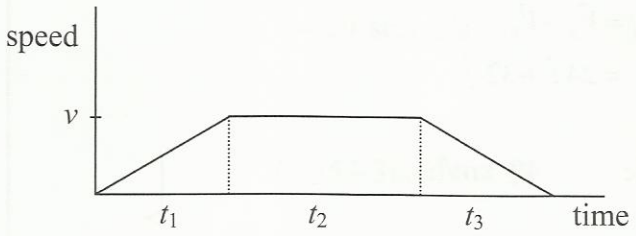
It continues at this speed for a period of time and then decelerates uniformly to rest.

In travelling a total distance d metres the train accelerates through a distance pd metres and decelerates through a distance qd metres, where $p < 1$ and $q < 1$.

(i) Draw a speed-time graph for the motion of the train.

(ii) If the average speed of the train for the whole journey is $\frac{v}{p+q+b}$, find the value of b.

(i)



5

(ii)

$\frac{1}{2}t_1 v = pd$ 5

$t_2 v = d - pd - qd$ 5

$\frac{1}{2}t_3 v = qd$ 5

$$\text{Average speed} = \frac{d}{t_1 + t_2 + t_3}$$

$$= \frac{d}{\frac{2pd}{v} + \frac{d - pd - qd}{v} + \frac{2qd}{v}}$$ 5

$$= \frac{v}{p+q+1}$$ 5

$\Rightarrow \quad b = 1$

30