2.57) Let S be the distance of the Earthquake from the seismic station.

$$\frac{S}{6.5} + 33 = \frac{S}{3.5} \Rightarrow \frac{S+214.5}{6.5} = \frac{S}{3.5} \Rightarrow 3.5(S+214.5) = 6.5S \Rightarrow 3S = 750.75 \Rightarrow S = 250.25 \text{ km}$$

2.58) $S = vt - \frac{1}{2}at^2$ *

$$\left.\begin{aligned} 40.0 &= v(1) - \tfrac{1}{2}(9.81)(1)^2 \\ v &= 44.905 \end{aligned}\right\} \text{1st 1.00 sec}$$

$\downarrow = +ve$

$$\begin{aligned} * \quad S &= ut + \tfrac{1}{2}at^2 \\ &= (v-at)t + \tfrac{1}{2}at^2 \\ &= vt - at^2 + \tfrac{1}{2}at^2 \\ &= vt - \tfrac{1}{2}at^2 \end{aligned}$$

$$\left.\begin{aligned} S &= ut + \tfrac{1}{2}at^2 \\ &= (44.905)(1.00) + \tfrac{1}{2}(9.81)(1.00)^2 \\ &= 49.81 \text{ m} = 49.8 \text{ m} \end{aligned}\right\} \text{Next 1.00 sec}$$

2.59) (a) $\langle v \rangle = \frac{1.00 \times 10^3 - 63}{4.75} = 197 \text{ ms}^{-1}$

(b) $\langle v \rangle = \frac{1.00 \times 10^3}{5.90} = 169 \text{ ms}^{-1}$

2.60) $S_1 = \frac{1}{2}(1.60)(14.0)^2 = 156.8 \text{ m} \Rightarrow$ Final $v = (1.60)(14.0) = 22.4 \text{ ms}^{-1}$

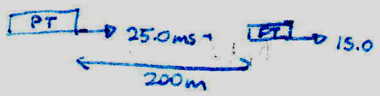
$\therefore S_2 = (22.4)(70.0) = 1568 \text{ m}$

$\cancel{S_3 = vt - \frac{1}{2}at^2}$ $\quad V_3^2 = u_3^2 + 2a_3S_3 \Rightarrow S_3 = \frac{V_3^2 - u_3^2}{2a_3} = \frac{0^2 - (22.4)^2}{2(-3.50)} = 71.68 \text{ m}$

Total $S = S_1 + S_2 + S_3 = 156.8 + 1568 + 71.68 = 1796.48 \text{ m} = 1.80 \times 10^3 \text{ m}$

2.62) Relative velocity of the passenger train wrt. freight train $= 25.0 - 15.0 = 10 \text{ ms}^{-1}$

(a)



$\rightarrow +ve$

$S_{\text{relative to FT}} = \frac{v^2 - u^2}{2a} = \frac{0^2 - (10.0)^2}{2(-0.100)} = 500 \text{ m}$ required for PT to slow to ~~stop.~~ same speed as FT

$\because$ 500m > 200m

$\therefore$ There will be a collision.

(b) $S_{\text{relative to FT}} = 200 = ut + \frac{1}{2}at^2 \Rightarrow 200 = 10.0t + \frac{1}{2}(-0.100)t^2$

$-0.05t^2 + 10t - 200 = 0$

$t = 22.54\text{s}$ OR 177.46 s (N/A)

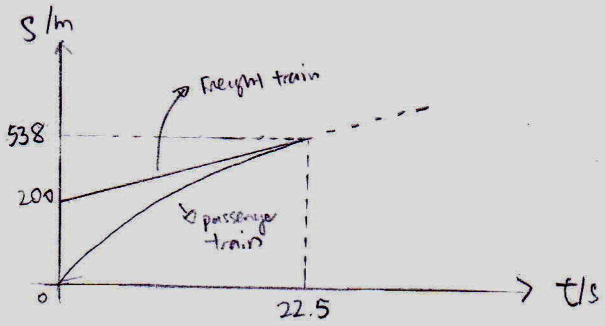
* Reference for S is from Passenger train.

* Calculations assume FT is stationary.

$\therefore S_{\text{relative to } x=0}$ of collision $= ut + \frac{1}{2}at^2 = (25.0)(22.54) + \frac{1}{2}(-0.100)(22.54)^2$

$= 538.097 \text{ m} = 538 \text{ m}$ (3sf)

(c)



2.73. (a) $v_f^2 = (0)^2 + 2(35.0)(64.0 \times 10^{-2})$

$v_f = \sqrt{44.8} = 6.693 \text{ ms}^{-1} = 6.69 \text{ ms}^{-1}$ (3sf.)

(b) $v_{highest}^2 = v_{initial}^2 + 2(-9.81)(S_{highest})$

$\Rightarrow S_{highest} = \dfrac{v_{highest}^2 - v_{initial}^2}{2(-9.81)} = \dfrac{0^2 - (\sqrt{44.8})^2}{2(-9.81)} = 2.283 \text{ m}$

$\therefore$ Highest $= 2.283 + 2.20 = 4.48$ m above ground //

(c) $2.20 - 1.83 = 0.37$

$\therefore \quad -0.37 = (\sqrt{44.8})t + \frac{1}{2}(-9.81)t^2$

$\Rightarrow \quad t = 1.42\text{s}$ // OR -0.0532s (N/A)

2.74 ~~v_{top}~~

$S_{window} = v_{top}t + \frac{1}{2}(9.81)t^2$

$v_{top} = \dfrac{-\frac{1}{2}(9.81)t^2 + S_{window}}{t}$

$= \dfrac{-\frac{1}{2}(9.81)(0.380)^2 + 1.90}{0.380}$

$= 3.1361 \text{ ms}^{-1}$

$v_{top}^2 = v_{initial}^2 + 2(9.81)S_{distance}$

$\therefore S_{distance} = \dfrac{v_{top}^2 - v_{initial}^2}{2(9.81)} = \dfrac{(3.1361)^2 - 0^2}{2(9.81)} = 0.501 \text{ m}$ //

2.62 ALT) $S_{FT} = 200 + 15.0t$

$S_{PT} = 25t - \frac{1}{2}(0.100)t^2$

$\vdash\!\rightarrow$ When collision occurs $S_{FT} = S_{PT}$

$\vdots$