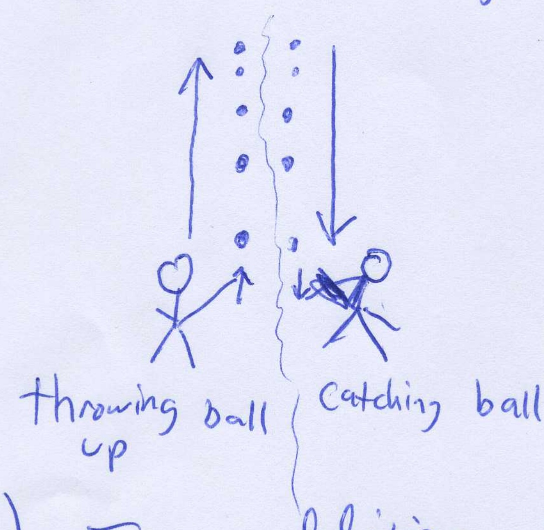
HW 2

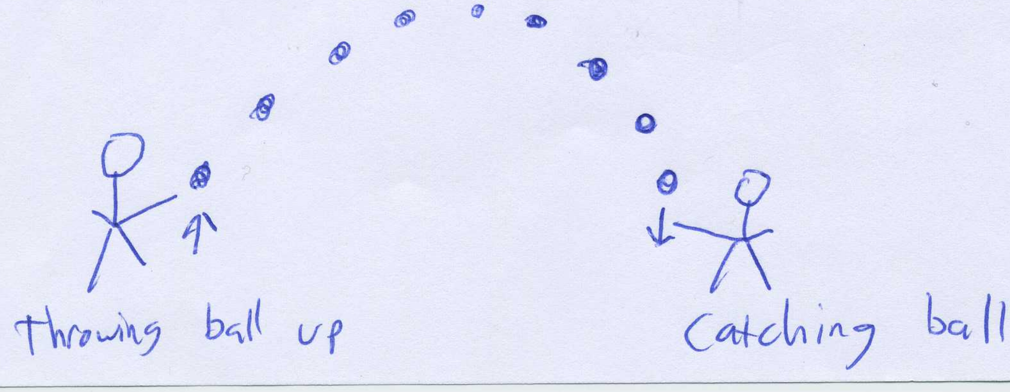
① a) gravity always is pulling the ball towards the ground at 9.8 m/s². At maximum height the ball begins to fall back towards the ground, thus at this instant it's velocity is zero.

b) still 9.8 m/s²

c) In a straight line up and down



d) In addition to the motion in part c, the ball moves with a constant horizontal velocity w.



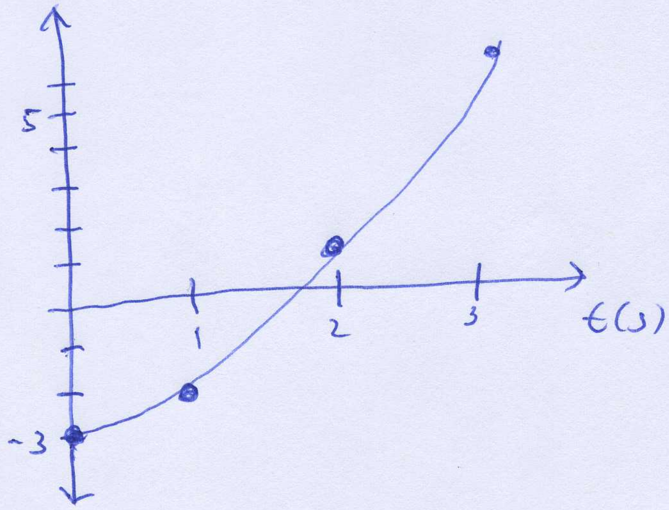
e) Newton's laws of motion are the same, the difference is that the man on the train uses an initial velocity w in the horizontal direction.

HW 2

(2) Equation for position is

$$x = x_i + \frac{1}{2}at^2$$

$$= -3m + t^2$$



HW 2

(3) $V_f = at$

$\rightarrow 20\,m/s = 2\,\frac{m}{s^2}\,t$

So $\boxed{t = 10s}$

$X_f = X_i + V_i t + \frac{1}{2}at^2$

$\rightarrow \boxed{X_f - X_i = \left(\frac{1}{2}\right)\left(2\,\frac{m}{s^2}\right)(10s)^2 = 100m}$

to stop the truck in 10s

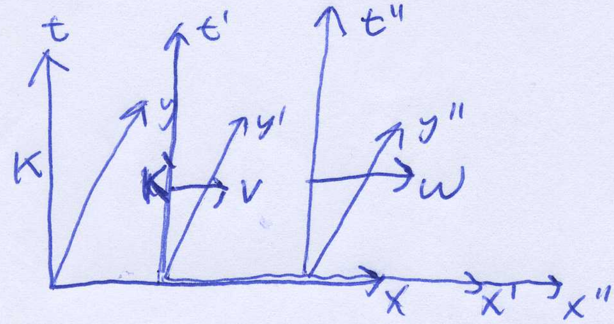
$V_f = V_i + at$

$\rightarrow 0 = 20\,m/s + a(10s)$

So $\boxed{a = -2\,m/s^2}$

HW 2

(4)



K' coordinates in K

$$y' = y$$
$$t' = t$$
$$x' = x - vt$$

(A)

K' coordinates in K''

$$y'' = y'$$
$$t'' = t'$$
$$x'' = x' - wt'$$

gives

$$y' = y''$$
$$t' = t''$$
$$x' = x'' + wt'$$

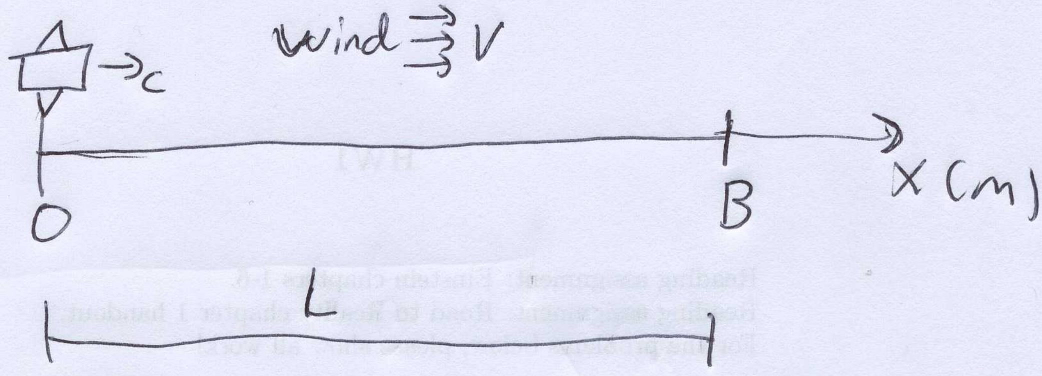
plug this into equations (A)

$$y'' = y$$
$$t'' = t$$
$$x'' = x - vt - wt = x - (v+w)t$$

So we must have $v = -w$

HW 2

(5)



Distance = (rate) · (time)

$O \to B$

$$L = (c+v)T_1 \quad \to \quad T_1 = \frac{L}{c+v}$$

$B \to O$

$$L = (c-v)T_2 \quad \to \quad T_2 = \frac{L}{c-v}$$

$$T_{total} = T_1 + T_2 = \frac{L}{c+v} + \frac{L}{c-v} = \frac{L(c-v) + L(c+v)}{(c+v)(c-v)}$$

$$= \frac{2Lc}{c^2 - v^2} = \frac{2Lc}{c^2\left(1 - \frac{v^2}{c^2}\right)} = \frac{2L}{c\left(1 - \frac{v^2}{c^2}\right)}$$