HW2 Solutions

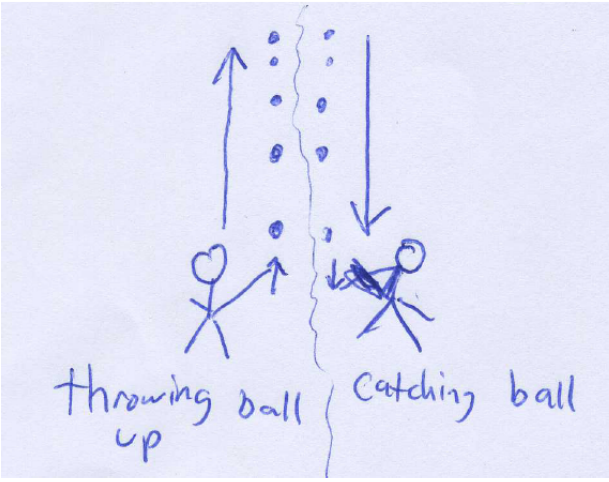
1. a) Gravity is always pulling the ball towards the ground at $10.0m/s^2$. At the maximum height the ball begins to fall back towards the ground, thus at this instant its velocity is zero.

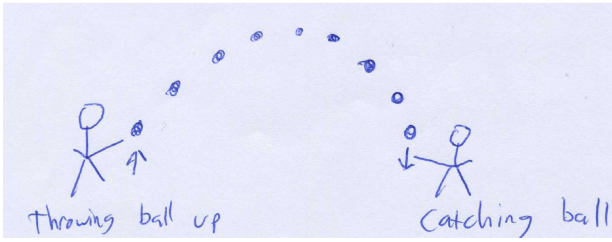
b) still $10.0m/s^2$.

c) In a straight line up and down (see figure)

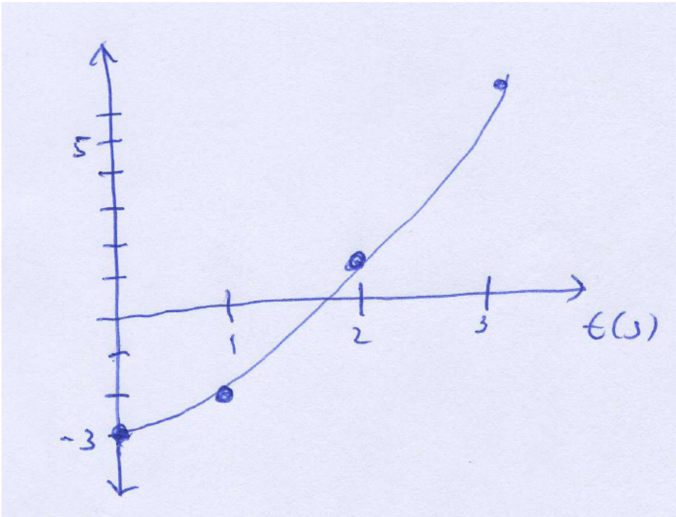
d) In addition to the motion in part c, the ball moves with a constant horizontal velocity w (see figure)

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





2. The equation for position is $x = x_i + \frac{1}{2}at^2 = -3m + t^2$

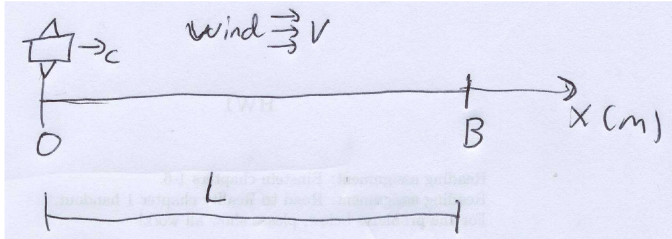


3. 1) Using $v_f = at$ we have $t = v_f/a = 20/2 = 10s$. Then we find $x_f - x_i = v_it + 1/2at^2 = 100m$ where we used $v_i = 0m/s$.

2) With $v_f = v_i + at$ solve for $a = (v_f - v_i)/t = (0 - 20)/10 = -2m/s^2$.

3) While accelerating the seat pushes you forward, and while slowing down the seatbelt pushes you back.

4) You are not inertial. You are accelerating.



4. $Distance = (rate) \times (time)$

Going from O to B we find $L = (c+v)T_1 \rightarrow T_1 = L/(c+v)$. Going from B to O we find $L = (c-v)T_2 \rightarrow T_2 = L/(c-v)$. And so $T_{\text{total}} = T_1 + T_2 = L/(c+v) + L/(c-v) = \frac{L(c-v)+L(c+v)}{(c+v)(c-v)} = \frac{2LC}{c^2-v^2} = \frac{2L}{c(1-v^2/c^2)}$

5. Lets enumerate the different coordinate relationships. K' coordinates in K

$$y' = y \qquad t' = t \qquad x' = x - vt \tag{1}$$

and K" coordinates in K'

$$y'' = y' \qquad t'' = t' \qquad x'' = x' - wt' \rightarrow y' = y'' \qquad t' = t'' \qquad x' = x'' + wt' \tag{2}$$

Now substitute Equations (2) into (1) and solve for K" coordinates in K

$$y'' = y \qquad t'' = t \qquad x'' = x - vt - wt = x - (v+w)t \tag{3}$$

So we must have $v = -w$. For some intuition, imagine a train moving at $10m/s$ to the right as measured by a person standing at the train station. Then a person riding a bike on the top of that train moving at a speed of $10m/s$ to the left, measured by someone on the train, will appear to be stationary when viewed from the train station.

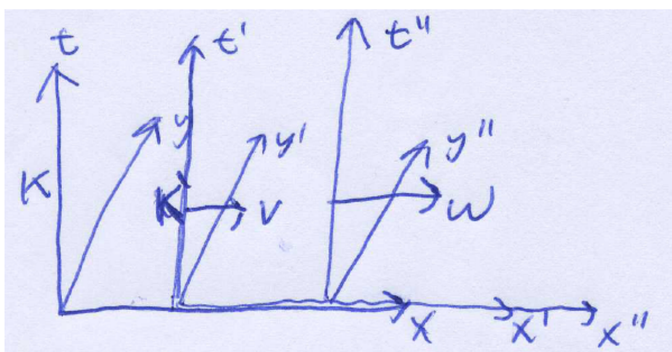


FIG. 1. NOTE: the axis t should be z