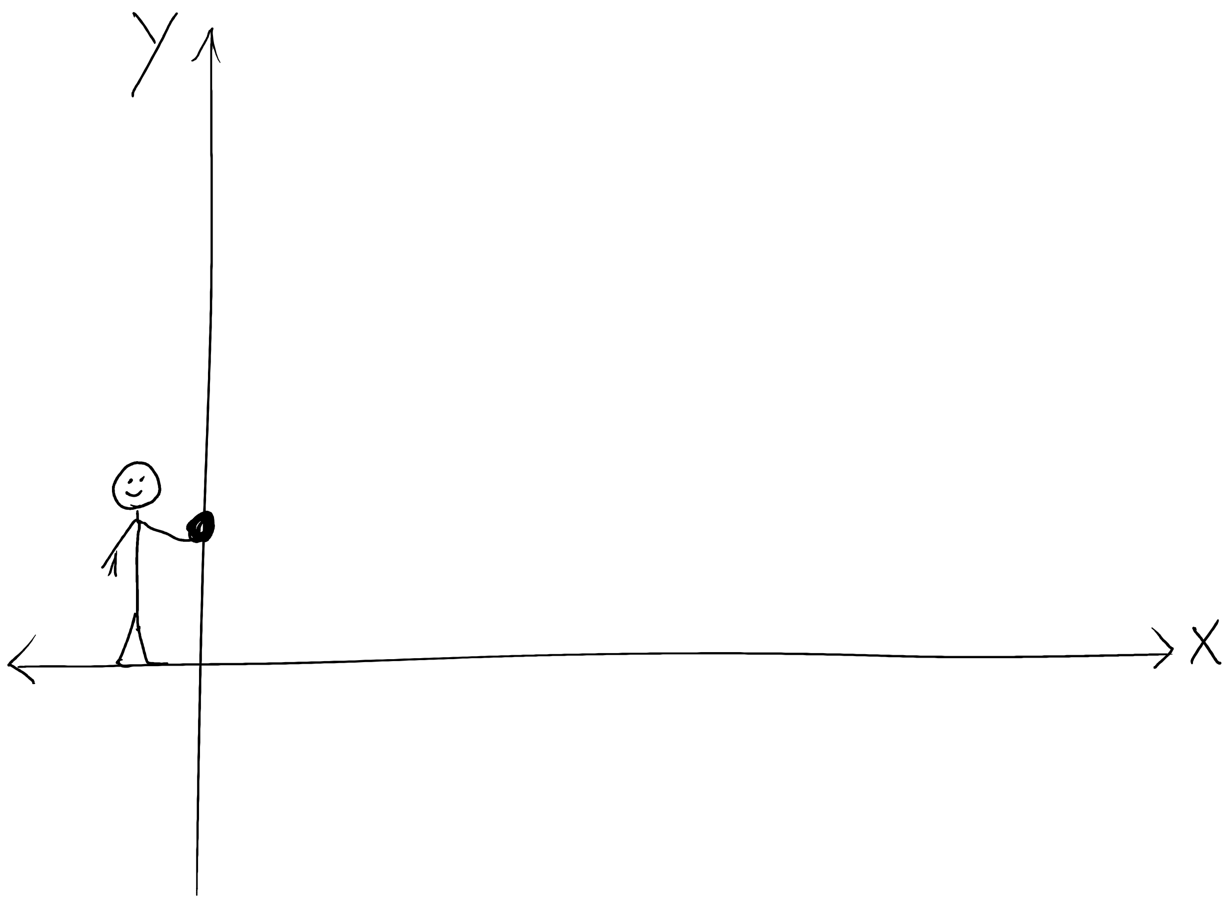
Physics Worksheet: Frames of Reference

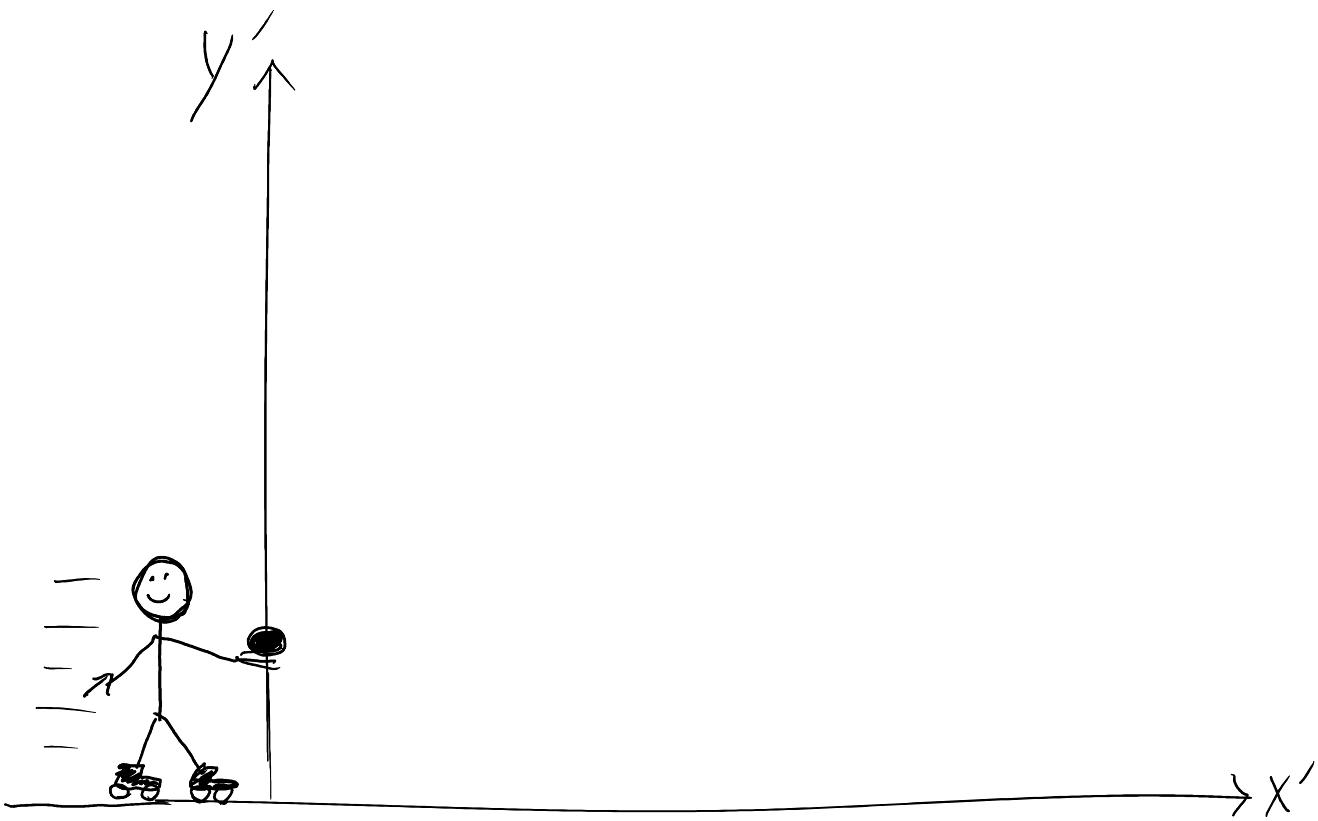
Question 1

Mark tosses a ball 2m straight up in the air (relative to himself) and catches it again. If Mark is at location x=0, sketch the trajectory of the ball on the graph below which shows horizontal and vertical coordinates in Mark's frame of reference.



Question 2

In the scenario of the previous question, Mark was actually moving relative to the Science One classroom. If the graph below shows horizontal and vertical coordinates fixed relative to the Science One classroom (i.e. in the classroom's frame of reference), and if Mark is at x'=0 when he throws the ball, draw Mark and the ball at the times when the ball is released, when the ball is at its maximum height, and at the time when the ball is caught.



Sketch the trajectory (flight path) of the ball in this frame of reference.

Question 3

For each quantity below, say whether this quantity is the same or different in the two reference frames:

a) The x position of the ball when it is released

b) The x position of the ball when it is caught

c) The maximum height of the ball

d) The x-momentum of the ball at its maximum height

e) The y-momentum of the ball at it maximum height

e) The kinetic energy of the ball at its maximum height

Question 4

If you answered "Different" for some of the above, does this contradict the principle of relativity?

Question 5

Suppose the trajectory of the ball in Mark's frame of reference is $(x(t),y(t))$. What is the trajectory of the ball in the frame of reference of the classroom? *Answer in terms of x(t), y(t), t, and Mark's speed v.*

$x'(t) =$

$y'(t) =$

Question 6

In Mark's frame of reference, the ball's motion satisfies Newton's 2nd Law $dv_x/dt = 0$, $dv_y/dt = -m\,g$. Using your answer to question 5, show that the ball's motion in the frame of reference of the classroom also satisfies Newton's 2nd Law.