Activity: Colliding Fan Carts and buggies

Objects traveling at a constant velocity: $x_f = \bar{v}t + x_i$

Objects traveling with constant acceleration: $x_f = x_i + v_i t + \frac{1}{2}\bar{a}t^2$

A.) If two objects traveling at constant velocities collide at the same position "x_f", you can solve for time by setting their respective position equations equal to one another.

$$x_f = \bar{v}t + x_i$$

$$x_f = \bar{v}t + x_i$$

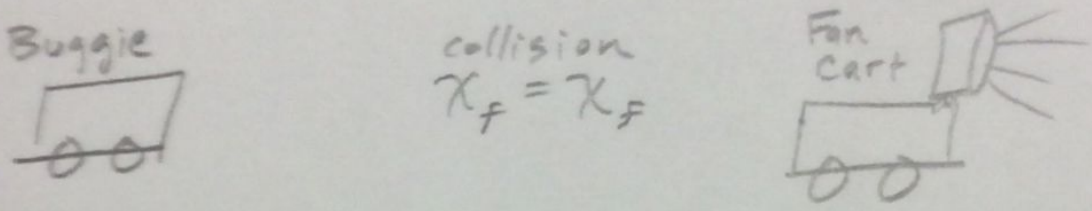
$$x_f = x_f = \text{collision}$$

$$\bar{v}t + x_i = \bar{v}t + x_i$$

You will need to calculate average velocity ($\bar{v}$) for both objects (red and green) using $\frac{\Delta x}{\Delta t} = \bar{v}$ and you will need to know the starting positions of both carts (x_i) relative to the origin. The average velocities and starting positions of the two objects will likely be different. After solving for time (t) using algebra, substitute time into one of the original position equations to solve for x_f.

$$\bar{v}t + x_i = \boxed{x_f}$$

B.) The collision point of a constantly accelerating object and a constant velocity object can similarly be determined by setting two position equations equal to one another and solving for time (t).



$$x_f = \bar{v}t + x_i \qquad x_f = x_i + v_i t + \frac{1}{2}\bar{a}t^2$$

$$\bar{v}t + x_i = x_i + v_i t + \frac{1}{2}\bar{a}t^2$$

- $\bar{v}$: average buggie velocity
- x_i: initial buggie position
- x_i: initial fan cart posity
- v_i: initial fan cart velocity
- $\bar{a}$: acceleration of the fan cart

You will likely need to use the quadratic formula: $t = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ to solve for time.

Remember to place all terms on one side of the equal sign using algebra rules. Example:

$$0 = \underset{a}{4}t^2 + \underset{b}{3}t + \underset{c}{1}$$

Two solutions for time!

After you solve for 't', choose the positive value. Substitute "t" into the original position equation to solve for $x_f = \bar{v}t + x_i$.

C.) Find the constant velocity for your groups buggie using a meterstick and stopwatch. The instructor will tell you the acceleration of the blue fan cart as well as the starting positions of both your buggie and the fan cart.

$\bar{v} = \frac{\Delta x}{\Delta t} =$ _____

You will also be told the initial directions of the fan cart and buggie.

$a_{\text{fan cart}} =$ _____

x_i of blue fan cart: _____

Direction of blue fan cart: _____

x_i of buggie: _____

Direction of buggie: _____

Predict where the blue fan cart and buggie will collide. Use a white board to show your work. When you have a prediction, check your answer with the instructor.

Prediction: _____ $\pm$ _____ error.

Record your results in the above spaces.

D. The instructor will tell you the accelerations of both fan carts along with their starting positions and directions.

Blue Fan Cart:

Acceleration: _____

x_i: _____

Red fan cart:

Acceleration: _____

x_i: _____

Show your work on a white board.

Predict where the two fan carts will collide.

Record your prediction. x_f: _____

Check your prediction with the instructor.

By how much was your prediction off? ____

What are some potential sources of error that caused your prediction to be off? Write a paragraph below: