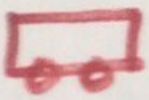
Activity: Colliding Fan Carts and Buggies

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.



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

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

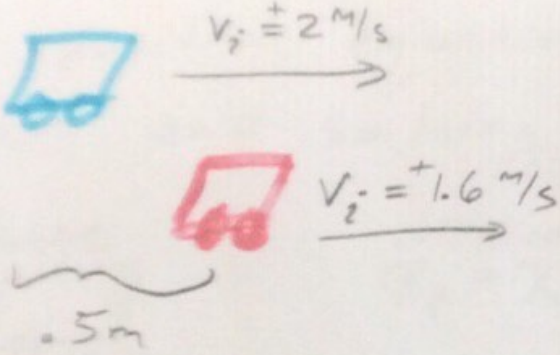
$x_f = x_f$ = collision

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

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.

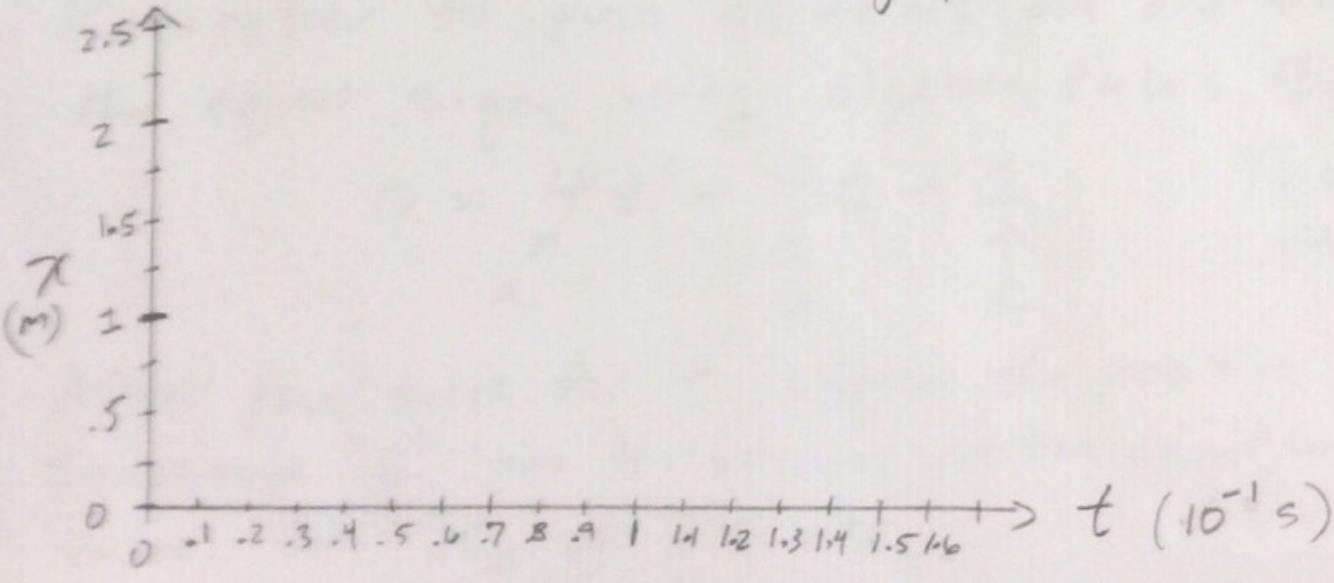
$\bar{v}t + x_i = \boxed{x_f}$

A red buggy begins .5 meters ahead of a blue buggy. Velocities are provided below:

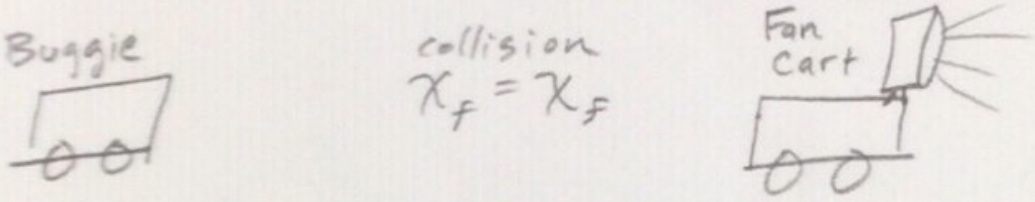


If the blue buggy begins at the origin $x = 0\ m$, at what position will the buggies overlap? Begin by calculating the time when they overlap.

Sketch the position - time graphs of both buggies:



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).



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

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

- $\bar{v}$: 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: $t = \dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$ 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 $x_f = \bar{v}t + x_i$.

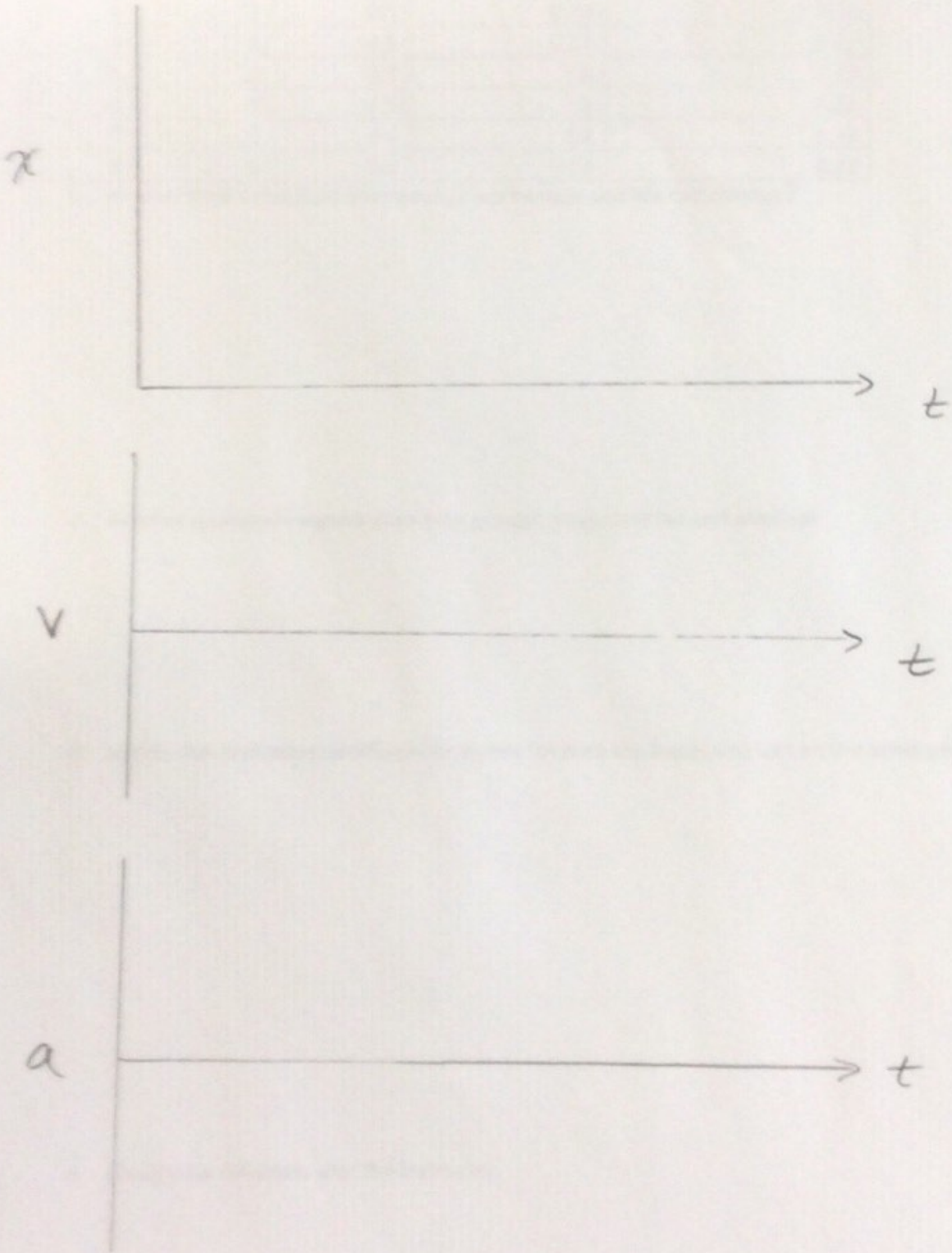
Suppose a constantly accelerating fan cart travels 2 meters from rest in a time of $t = 4.87$ seconds. What is its acceleration?

Suppose a constant velocity buggy and the constant acceleration fan cart begin at rest at the same initial position. $V_{buggy} = .2\ m/s$ $x_i = 0m$

1. At what time will the two overlap again?

2. At what position will the two overlap again?

Sketch the qualitative kinematic graphs for the buggy & fan cart. Use two different colors.



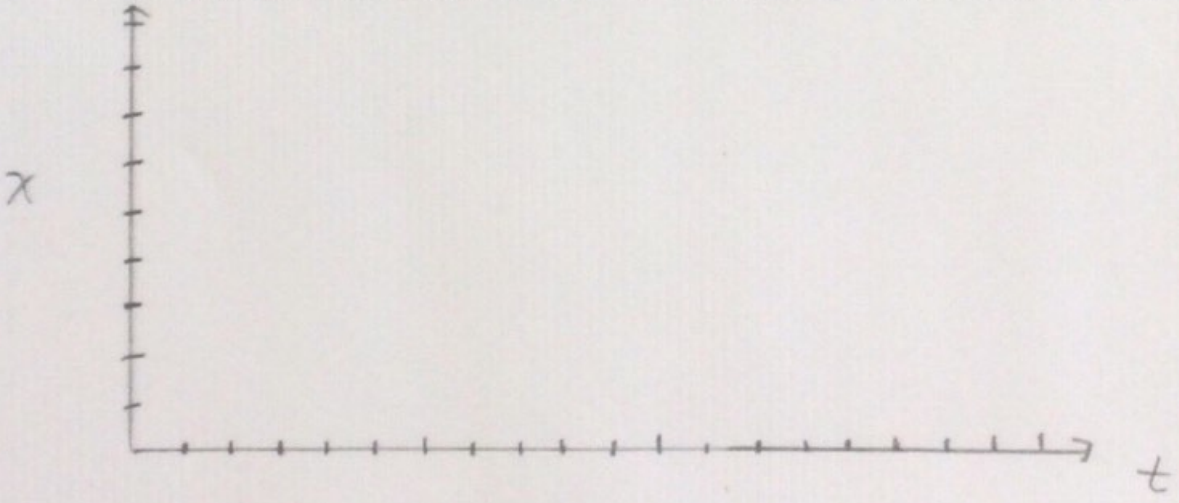
Buggy and Fan Cart Group Activity

	Meters	Meters	m/s	m/s/s
Group	Xi Fan Cart	Xi Buggy	Buggy Velocity	Fan Cart Acceleration
1	0	0.5	0.33	0.23
2	0	0.5	0.22	0.23
3	0	0.5	0.24	0.23
4	0	0.5	0.17	0.23
5	0	0.5	1.8	0.23
6	0	0.5	2	0.23
7	0	0.5	2.2	0.23
8	0	0.5	0.28	0.23

1. At what time in seconds does your group's buggy and fan cart overlap?

2. At what position in meters does your group's buggy and fan cart overlap?

3. Sketch the qualitative position-time curves for both the buggy and cart on the same graph:



4. Check your solutions with the instructor.