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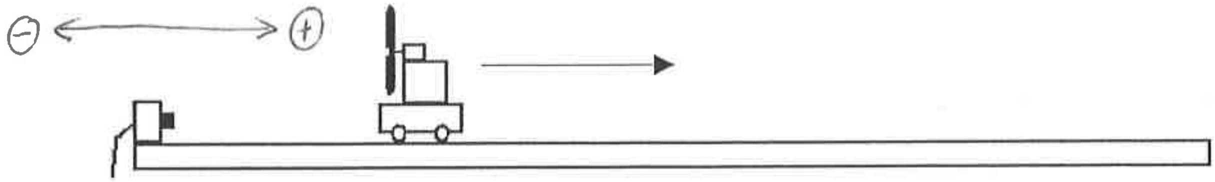
Graphs of Accelerated Motion

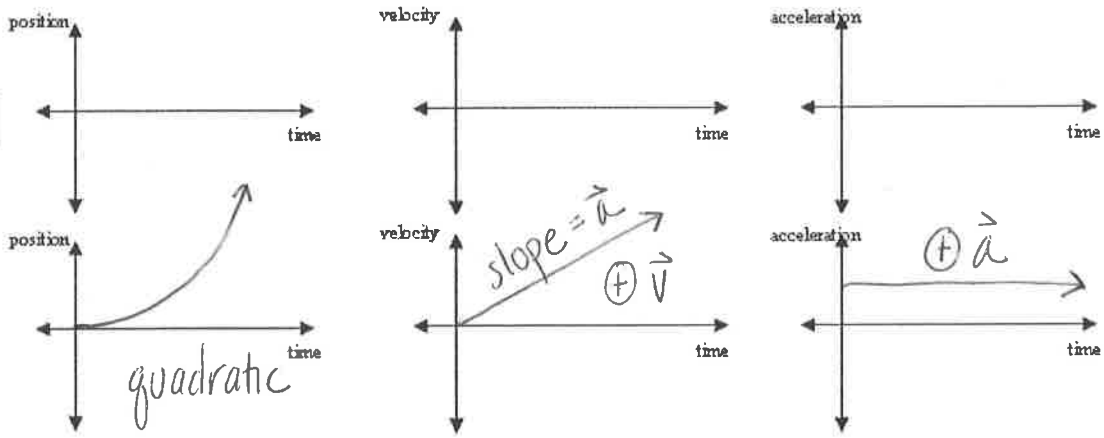
DEMO #1



Sketch below your predictions and the results for the fan-cart moving **away** from the detector and **speeding up** at a steady rate.

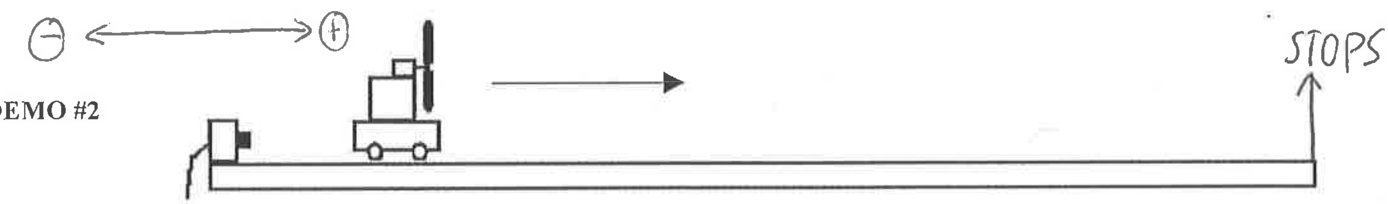
PREDICTION

RESULTS



1. What is the significance of the slope of the velocity-time graph? slope = acceleration

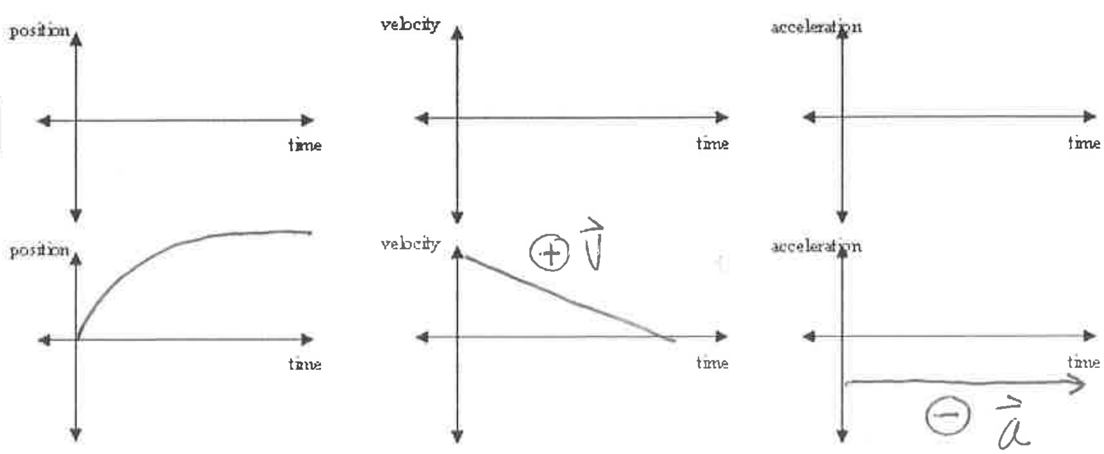
DEMO #2



Sketch below your predictions and the results for the fan-cart moving **away** from the detector and **slowing down** at a steady rate.

PREDICTION

RESULTS



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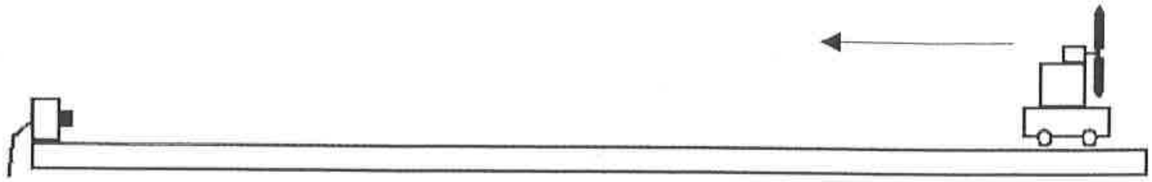
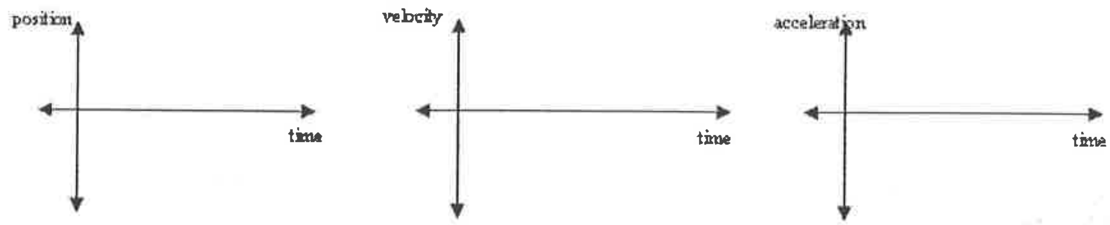
DEMO #3

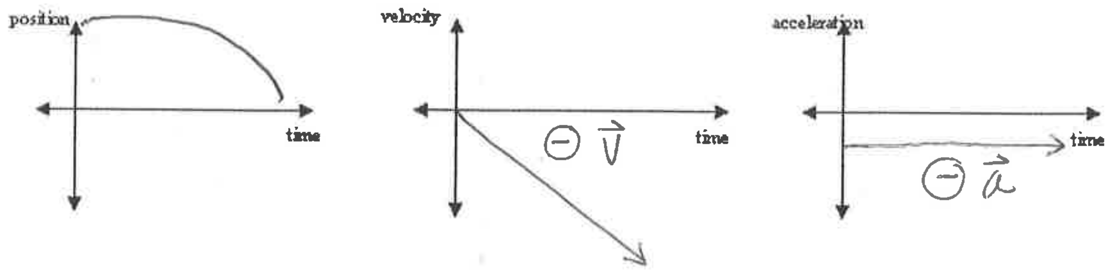


Sketch below your predictions and the results for the fan-cart moving **towards** the detector and **speeding up** at a steady rate.

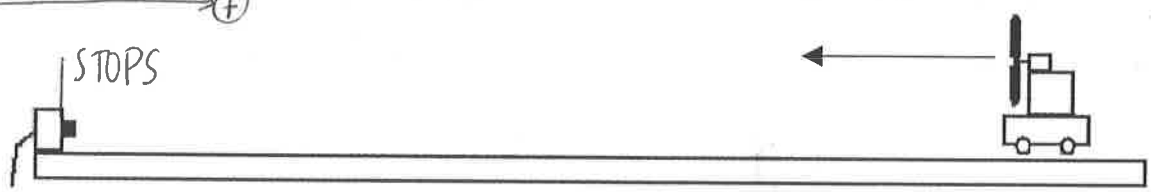
PREDICTION



RESULTS

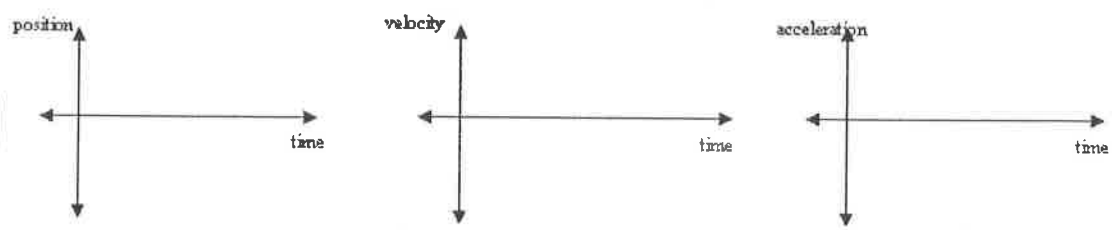


DEMO #4

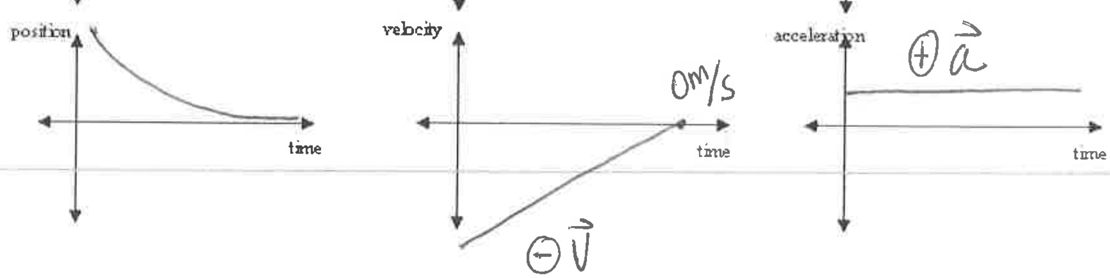


Sketch below your predictions and the results for the fan-cart moving **towards** the detector and **slowing down** at a steady rate.

PREDICTION



RESULTS



2. Complete the following chart by looking back over the four demos to determine which carts:

Were moving in a positive direction	Were moving in a negative direction	Had a positive velocity	Had a negative velocity	Were speeding up	Were slowing down	Had a positive acceleration	Had a negative acceleration
1,2	3,4	1,2	3,4	1,3	2,4	1,4	2,3

3. What does it mean for the cart to have a positive velocity? moving in positive direction

4. What does it mean for the cart to have a negative velocity? moving in negative direction

5. What does it mean for the cart to have a positive acceleration?

slope of the velocity graph has to be positive

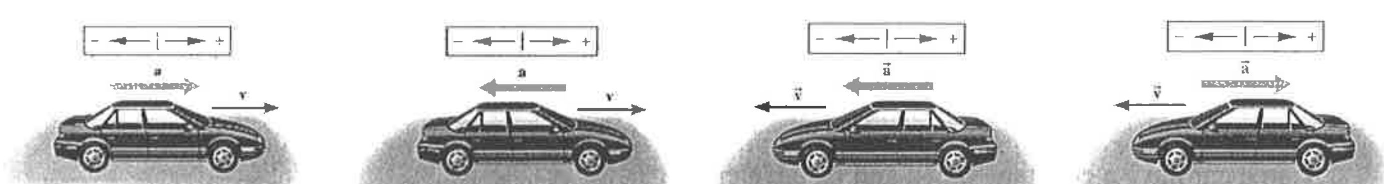
6. If the cart has a positive acceleration, does it have to be speeding up (going faster)? No.

7. What does it mean for the cart to have a negative acceleration? decreasing velocity and the slope of the velocity graph is negative

8. If the cart has a negative acceleration, does it have to be slowing down (going slower)? No

NO! = ~~deceleration~~: (+) or (−) acceleration

9. In each case below, decide whether the car is speeding up or slowing down.



(+) $\vec{v}$ + (+) $\vec{a}$ speeding up | (+) $\vec{v}$ + (−) $\vec{a}$ slowing down | (−) $\vec{v}$ + (−) $\vec{a}$ speeding up | (−) $\vec{v}$ + (+) $\vec{a}$ slowing down

10. Compare the car's velocity and its acceleration when it is speeding up.

$\vec{v}$ + $\vec{a}$ have the same sign

11. Compare the car's velocity and its acceleration when it is slowing down.

$\vec{v}$ + $\vec{a}$ have opposite sign

Acceleration

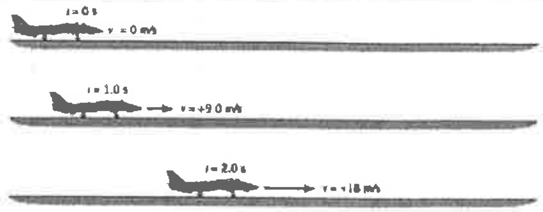
Acceleration: rate of change of velocity

Units: $\frac{m}{s^2}$

Formula: $\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{t_f - t_i} = \frac{\Delta \vec{V}}{\Delta t} = \vec{V}_f = \vec{V}_i + \vec{a}t$

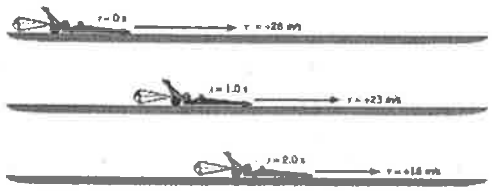
Type: vector

1. Calculate the acceleration of the plane.



$$\frac{18\frac{m}{s} - 0\frac{m}{s}}{2.0s} = 9.0\frac{m}{s^2}$$

2. Calculate the acceleration of the racecar.

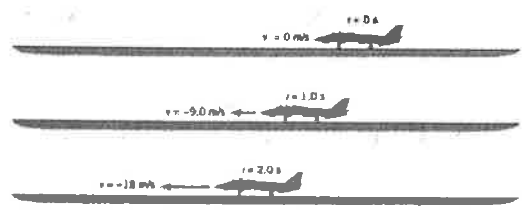


$$\frac{18\frac{m}{s} - 28\frac{m}{s}}{2.0s} = -5.0\frac{m}{s^2}$$

If an object has a negative acceleration, does that mean it is ~~decelerating~~? slowing down? NO

negative acceleration: velocity is decreasing if velocity is positive to begin

3. Calculate the acceleration of the plane.



$$-18\frac{m}{s} - 0\frac{m}{s} \Big/ 2.0s = -9.0\frac{m}{s^2}$$

Can an object have a negative acceleration and be speeding up? YES!

Velocity has both magnitude (speed) + direction.

Turning

1. What are the three ways an object can accelerate?

   a) $\vec{V}$ increases b) $\vec{V}$ decreases c) change direction

2. Can a car have a constant speed (magnitude) and be accelerating? Yes, if direction is changing.

3. Can a car have a constant velocity (magnitude + direction) and be accelerating? No. If $\vec{v}$ does not change, then there is no acceleration.

4. Is it possible for a car to have velocity but no acceleration? Explain and give an example.

   Moving at a constant speed in same direction.

5. Is it possible for a ~~car~~ ball to have acceleration but no velocity? Explain and give an example.

   Ball toss - when $\vec{v} = 0m/s$ at peak $\vec{a}$ is constant at $-9.8 m/s^2$