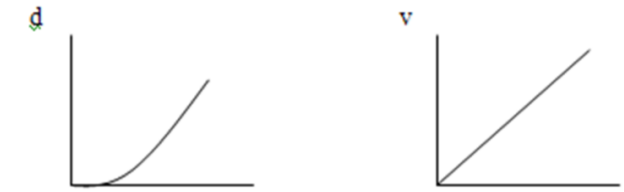
Acceleration

- Accelerated motion occurs any time the speed of an object is changing.
- Acceleration is a vector, given the symbol $\vec{a}$
- Has units m/s^2
- When an object is accelerating, the displacement time graph is a curved line.

Accelerated Motion



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- Accelerated motion can be either uniform or non-uniform.
- We will be looking at uniform acceleration.
- Uniform acceleration is where the acceleration is constant.
- Examples:

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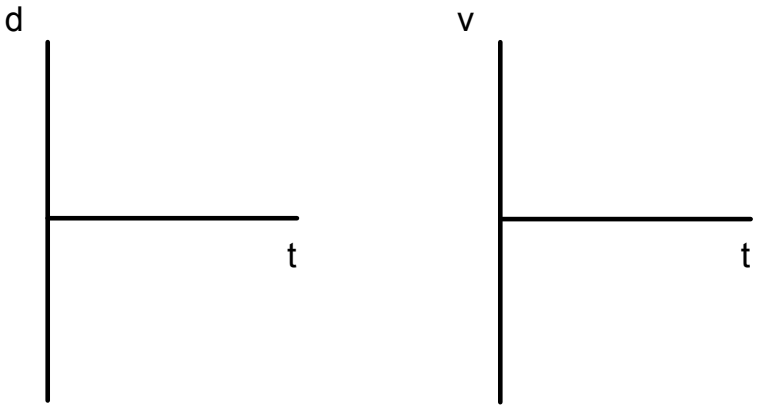
- There are 4 different possibilities for uniformly accelerated motion:

(a) $+\vec{v}$, $+\vec{a}$

moving right and speeding up



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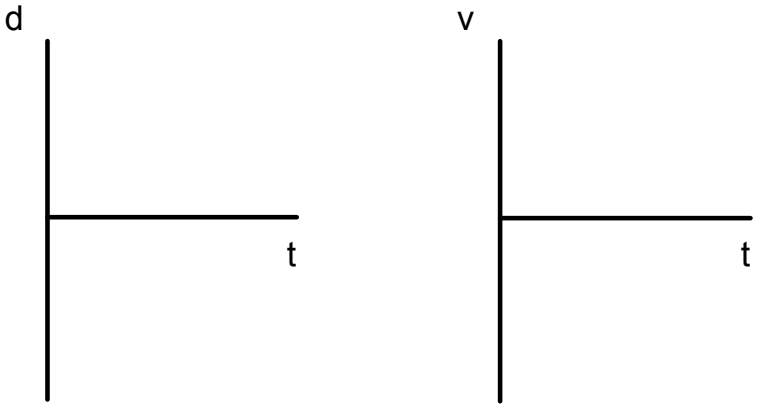
(b) $+\vec{v}$, $-\vec{a}$

moving right and slowing down



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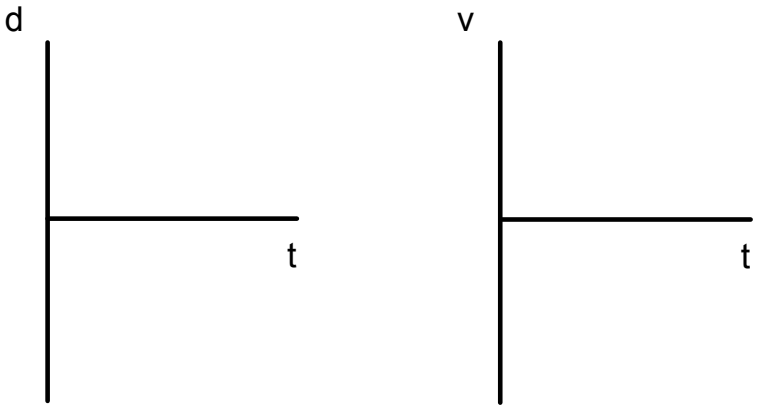
(c) $-\vec{v}, +\vec{a}$

moving left and slowing down



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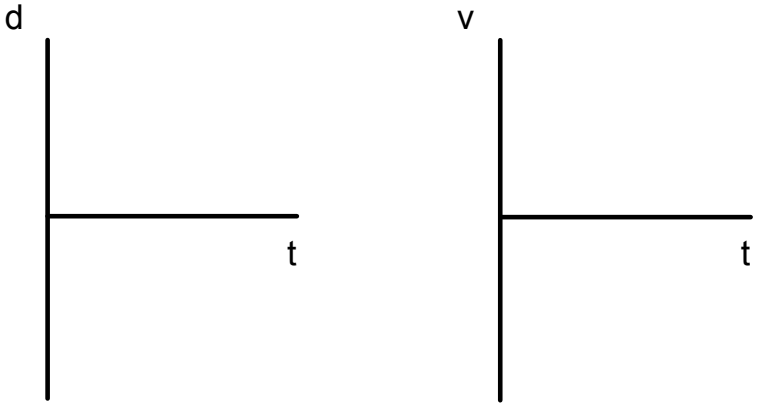
(d) $-\vec{v}, -\vec{a}$

moving left and speeding up



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- With accelerated motion we need to know the instantaneous speed/velocity of the object.

- Instantaneous speed is the speed an object is going at this exact moment.

- still has the symbol v.

- Examples:

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- Recall that the slope of the distance time graph gives speed.

- But how can you find the slope of a curve?

- We use the **tangent line.** You learned about tangent lines last year in math.

- Lines tangent to a curve intersect the curve at a single point.

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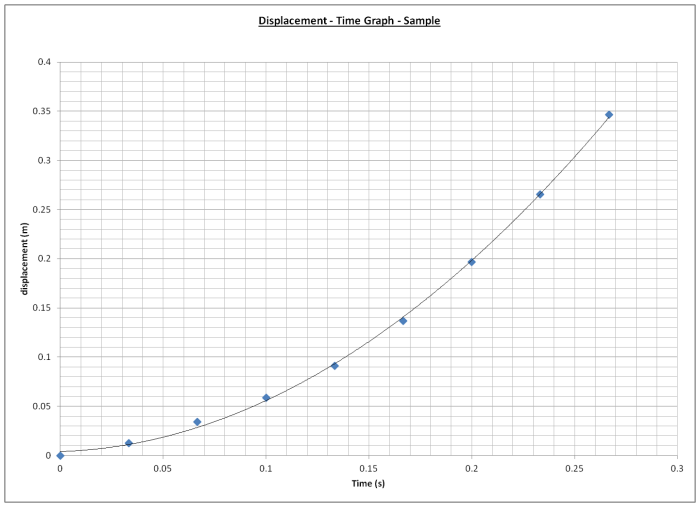
- To find instantaneous speed at a given time, you find the slope of the tangent line at that time.



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- Once you have used tangent lines to calculate the instantaneous velocity at various times, you plot those points to get the velocity time graph.
- The slope of the velocity-time graph gives the acceleration of the object
- The area under the velocity-time graph gives the displacement of the object.
- Remember - do not use the data points - use the line of best fit!

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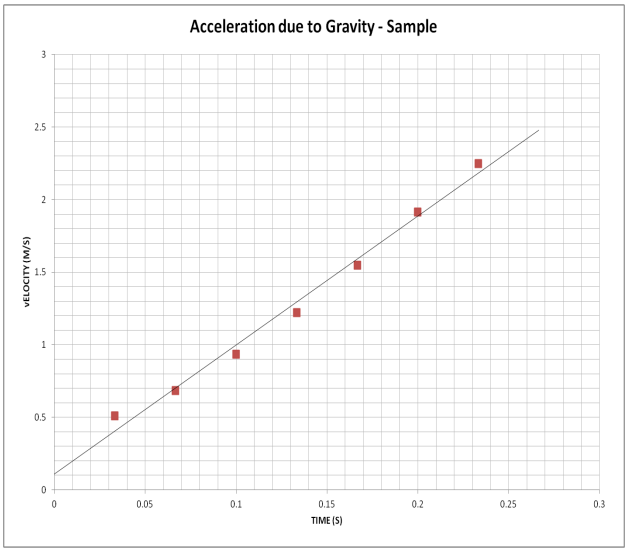

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Mathematically, acceleration is written as:

$$a = \frac{\Delta v}{t}$$

Δ - greek letter delta meaning change in.

Whenever you have Δ in an equation, it means the value at the end - value at the beginning. So,

$$a = \frac{\Delta v}{t} = \frac{v_2 - v_1}{t}$$

Where v_2 = final speed/velocity
v_1 = initial velocity

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Example 1: Calculate the acceleration of a car that accelerates from 2.5 m/s to 7.5 m/s in 3.0s

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Example 2: A plane accelerates from rest to 25 m/s in 4.0s. What is its acceleration?

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Example 3: A truck accelerates from rest at 6.5 m/s^2 for 2.5s. What is its final speed?

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Example 4: A duck accelerates from rest at 2.66 m/s^2. How long does it take to waddle to a speed of 3.02 m/s?

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