Putting all the Graphs Together

Outcomes:

S2-3-02 Collect displacement data to calculate & graph velocity vs. time for an object accelerating at a constant rate.

S2-3-03 Analyze the relationships among velocity, time and acceleration for an object accelerating at a constant rate.

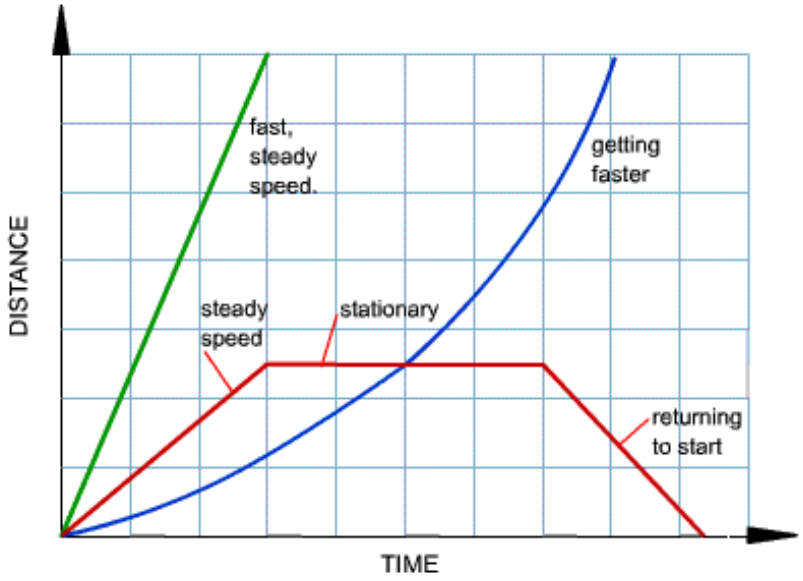
Putting it all together…

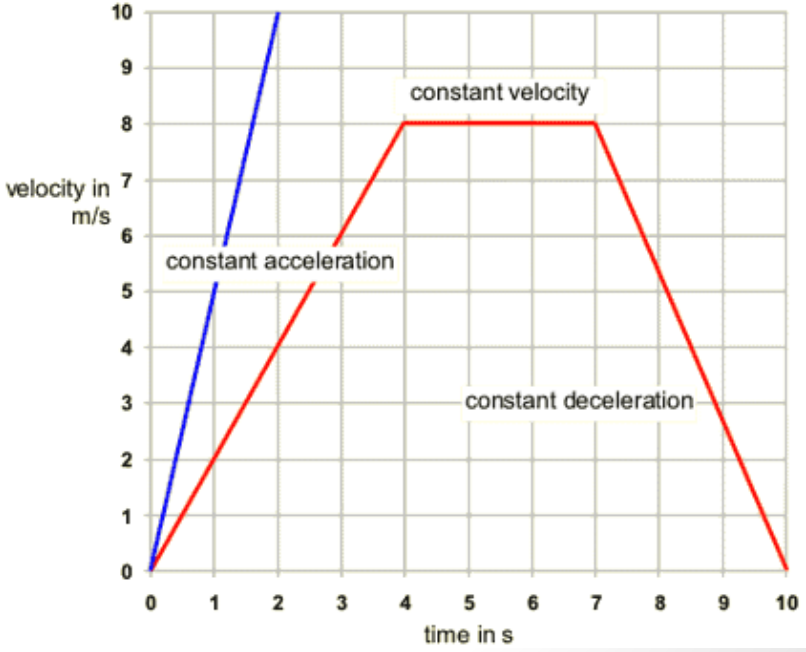
If we have an object in motion, there are two scenarios that we have looked at:

1. The object is **NOT ACCELERATING**
   → moving at a **CONSTANT VELOCITY**.

2. The object is **ACCELERATING** at a **CONSTANT RATE**.
   → Velocity is **INCREASING**

We must be able to recognize and interpret these different types of motion.





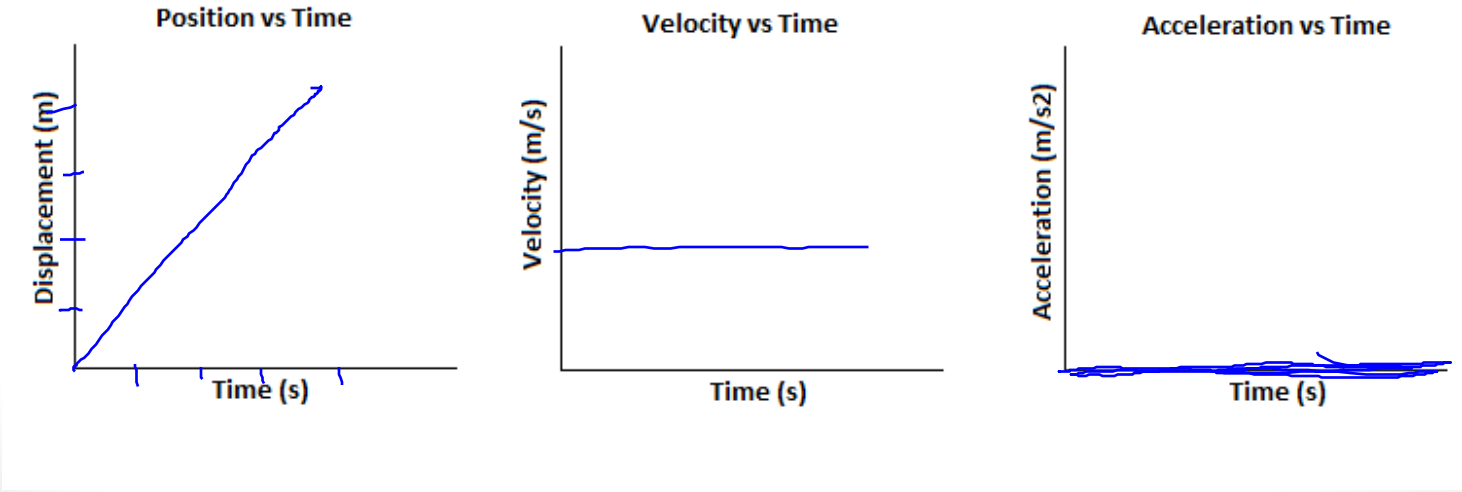
1. Constant Velocity Graphs

If there is constant velocity, there is **NO ACCELERATION**.

Example:

The car below is travelling at **CONSTANT** speed because it's position changes by the **SAME AMOUNT** each time interval:

The graphs of displacement, velocity and acceleration vs. time would look like this:

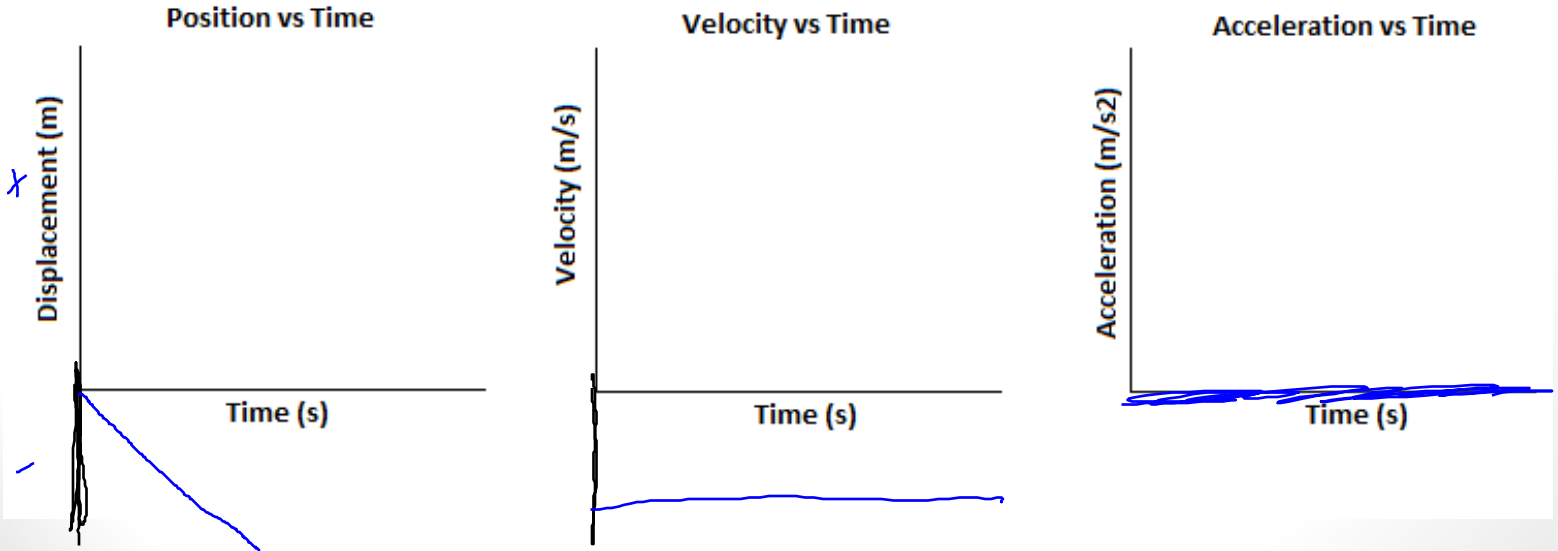


1. Constant Velocity Graphs

What if the object was travelling in the other direction?

Try this one…

Sketch a displacement-time, velocity-time and an acceleration time graph (just like in the previous example) for the following car:

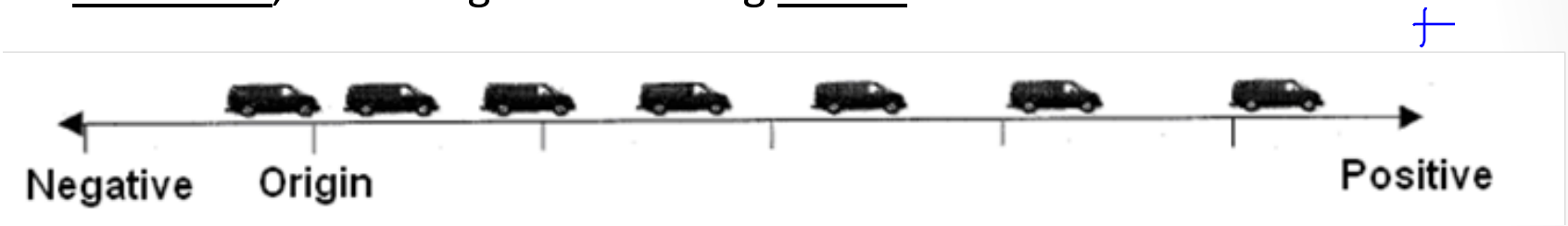


2. Non-Constant Velocity Graphs

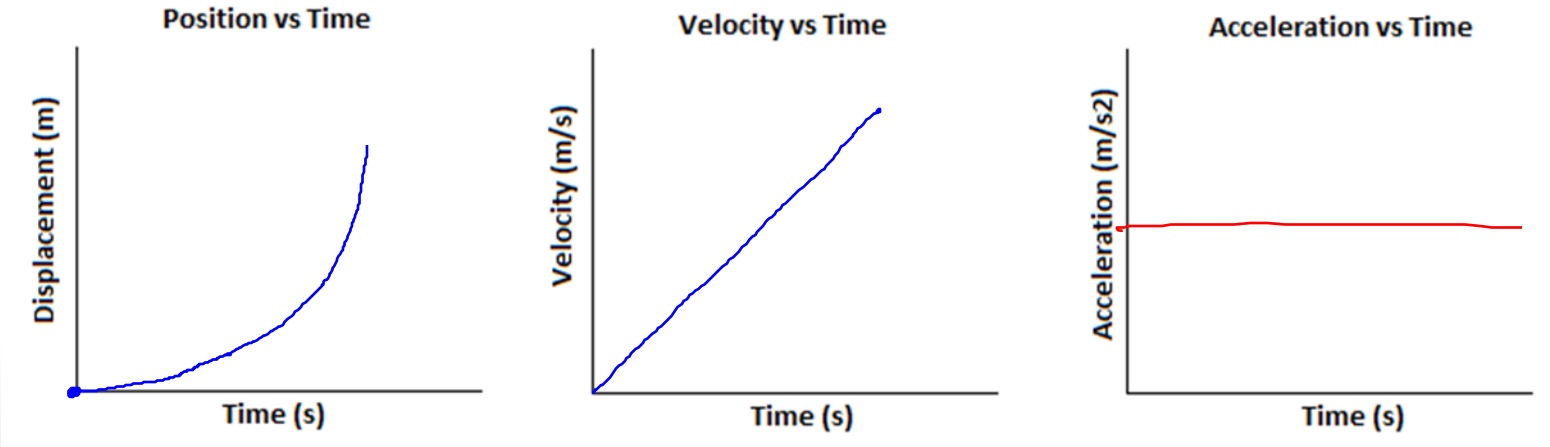
If velocity is **INCREASING** or **DECREASING**, then there must be **ACCELERATION**!

Example:

The car below is **ACCELERATING** because its **POSITION** is **INCREASING** during each **INTERVAL**, indicating an increasing **SPEED**.



The graphs of displacement, velocity and acceleration vs. time would look like:

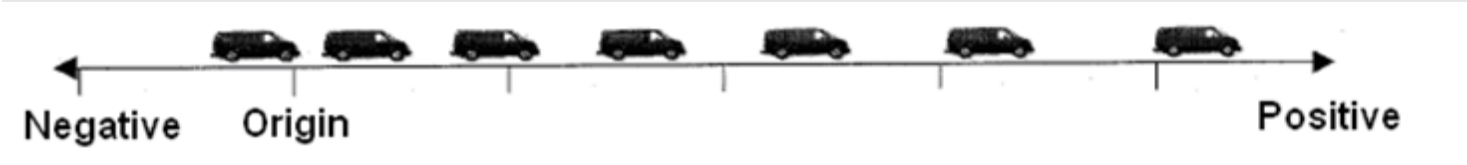


2. Non-Constant Velocity Graphs

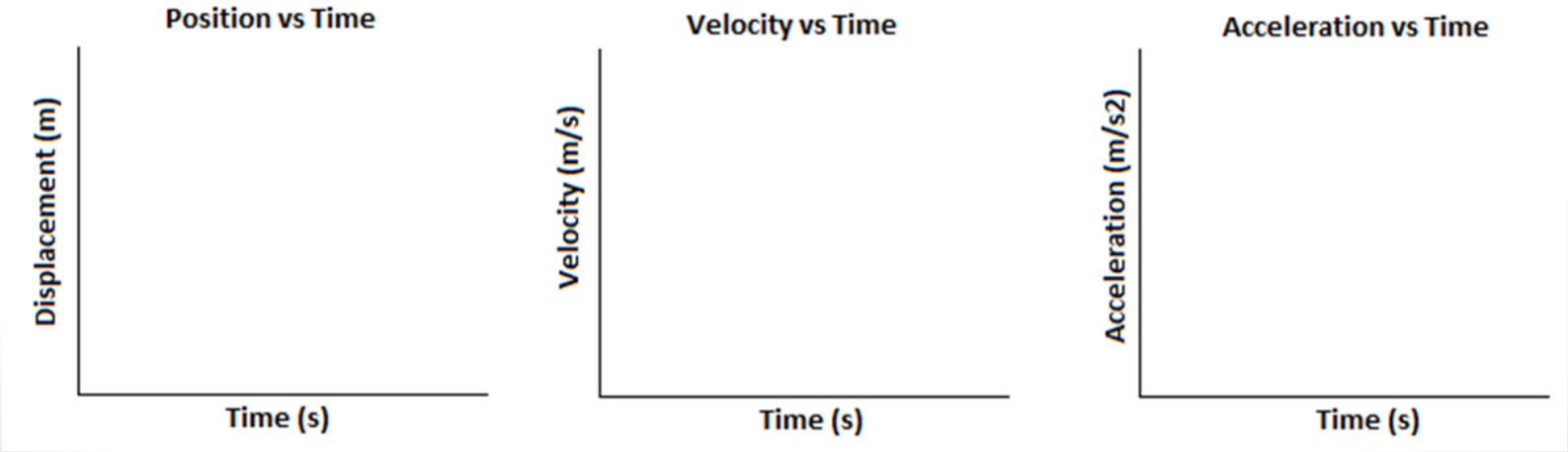
If velocity is **INCREASING** or **DECREASING**, then there must be **ACCELERATION**!

Example:

The car below is **ACCELERATING** because its **POSITION** is **INCREASING** during each **INTERVAL**, indicating an increasing **SPEED**.

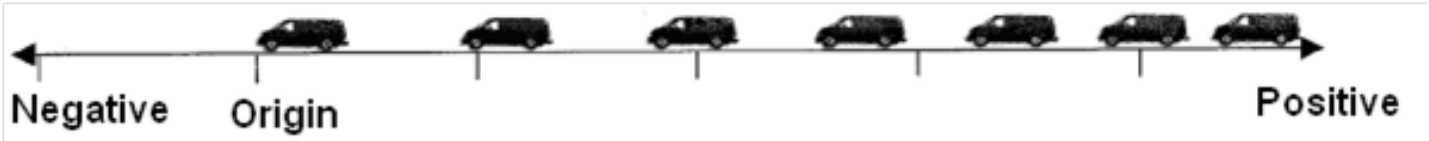


The graphs of displacement, velocity and acceleration vs. time would look like:

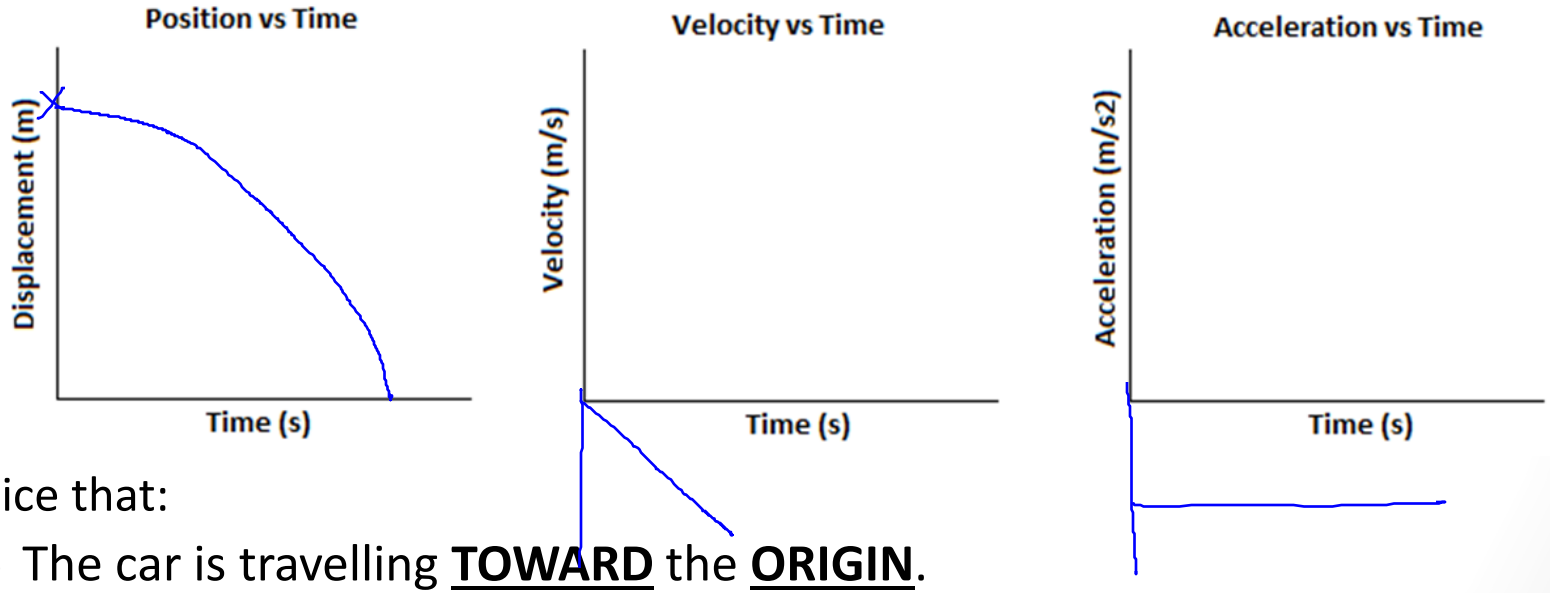


2. Non-Constant Velocity Graphs

Acceleration can occur in the opposite direction as well:



The graphs of displacement, velocity and acceleration vs. time would look like:



Notice that:

- The car is travelling **TOWARD** the **ORIGIN**.
- Displacement is **DECREASING** at an **INCREASING** rate.
- Velocity is **INCREASING** (acceleration) in the **NEGATIVE** direction.
- Acceleration is still **CONSTANT**, and **NEGATIVE**.

The Meaning of the Sign for Acceleration

When we used directions (+/-) for displacement and velocity it told us which way the object travelled.

However, with acceleration the **SIGN** tells us the direction in which the **ACCELERATION ACTS**.

- A **POSITIVE** acceleration acts to the **RIGHT**,
- A **NEGATIVE** acceleration acts to the **LEFT**.

A positive acceleration does **NOT** always mean that an object is speeding up. **SOMETIMES** an object with a **POSITIVE** acceleration is **SLOWING DOWN**.

To make **SENSE** of the **SIGN** of **ACCELERATION** and whether an object is **SPEEDING** up or **SLOWING** down, you must also consider the **SIGN OF VELOCITY**.

The Meaning of the Sign for Acceleration

The following table summarizes the different situations that can occur.

Sign (direction) of Velocity	Sign (direction) of Acceleration	What you see:
+ (right)	+ (right)	Moving right, speeding up
+ (right)	- (left)	Moving right, slowing down
- (left)	- (left)	Moving left, speeding up
- (left)	+ (right)	Moving left, slowing down.

At first, the table may look very confusing. It is better to remember a simple rule.

If **VELOCITY** and **ACCELERATION** have the **SAME** sign, the object will be **SPEEDING UP**.

→ Acceleration is acting in the **SAME** direction as the **MOTION**

If **VELOCITY** and **ACCELERATION** have **OPPOSITE** signs, the object will be **SLOWING DOWN**.

→ Acceleration is acting in the **OPPOSITE** direction of the **MOTION**.