

Unit 2: Kinematics in 1D
3 - Uniform Accelerated Motion

® Acceleration: the rate of change of velocity over time

➤ Acceleration is a vector.

Anytime an object's...

velocity is changing, it is accelerating whether it is speeding up or slowing down.

The acceleration of an object can be found with:

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

Where: a = acceleration

ΔV = change in velocity = $V_f - V_i$

t = time

- 1) A sprinter starts from rest and reaches a speed of 12 m/s in 4.25 s. Find his acceleration.

$$V_i = 0 \text{ m/s}$$

$$V_f = 12 \text{ m/s}$$

$$t = 4.25 \text{ s}$$

$$a = ?$$

$$a = \frac{\Delta V}{t} = \frac{V_f - V_i}{t} = \frac{12 - 0}{4.25} = \boxed{2.8 \text{ m/s}^2}$$

- 2) A car starts from rest and accelerates at 15 m/s² for 3.0 s. What is its top speed?

$$V_i = 0$$

$$a = 15 \text{ m/s}^2$$

$$t = 3.0$$

$$V_f = ?$$

$$t \cdot a = \frac{\Delta V}{t} \cdot t \quad \Delta V = at = (15 \text{ m/s}^2)(3.0 \text{ s}) = 45 \text{ m/s}$$

$$\Delta V = V_f - V_i = \boxed{45 \text{ m/s}}$$

- 3) If a snowboarder is traveling at 8.0 m/s how long will it take her to reach 36.0 m/s if she can accelerate at a rate of 3.5 m/s²

$$V_i = 8.0 \text{ m/s}$$

$$V_f = 36.0 \text{ m/s}$$

$$a = 3.5 \text{ m/s}^2$$

$$t = ?$$

$$\begin{aligned} \Delta V &= V_f - V_i \\ &= 36.0 - 8.0 \\ &= 28.0 \text{ m/s} \end{aligned}$$

$$t \cdot a = \frac{\Delta V}{t} \cdot t$$

$$\frac{at}{a} = \frac{\Delta V}{a}$$

$$t = \frac{\Delta V}{a} = \frac{28.0 \text{ m/s}}{3.5 \text{ m/s}^2} = \boxed{8.0 \text{ s}}$$

Remember that all vectors include... *direction*.

➤ Up or to the right are... *positive*

➤ Down or to the left are... *negative*

An object's velocity and acceleration can...

be in opposite directions

	Velocity	Acceleration
A car sitting at a stop light hits the gas	+	+
From rest you back out of your driveway	-	-
A plane lands and comes to a stop	+	-
You drop a rock off a cliff	-	-
You throw a rock straight up	+	-

Sketch v vs. t graphs of the following situations:

1) A hockey player skates at full speed then comes to a sudden stop.



2) A football is kicked straight up and then falls back down.



3) A swimmer swims the length of a pool at a constant speed, quickly turns around and swims back.



4) A skydiver jumps from a plane, speeds up to terminal velocity, falls for awhile then pulls the chute, slowing down.

