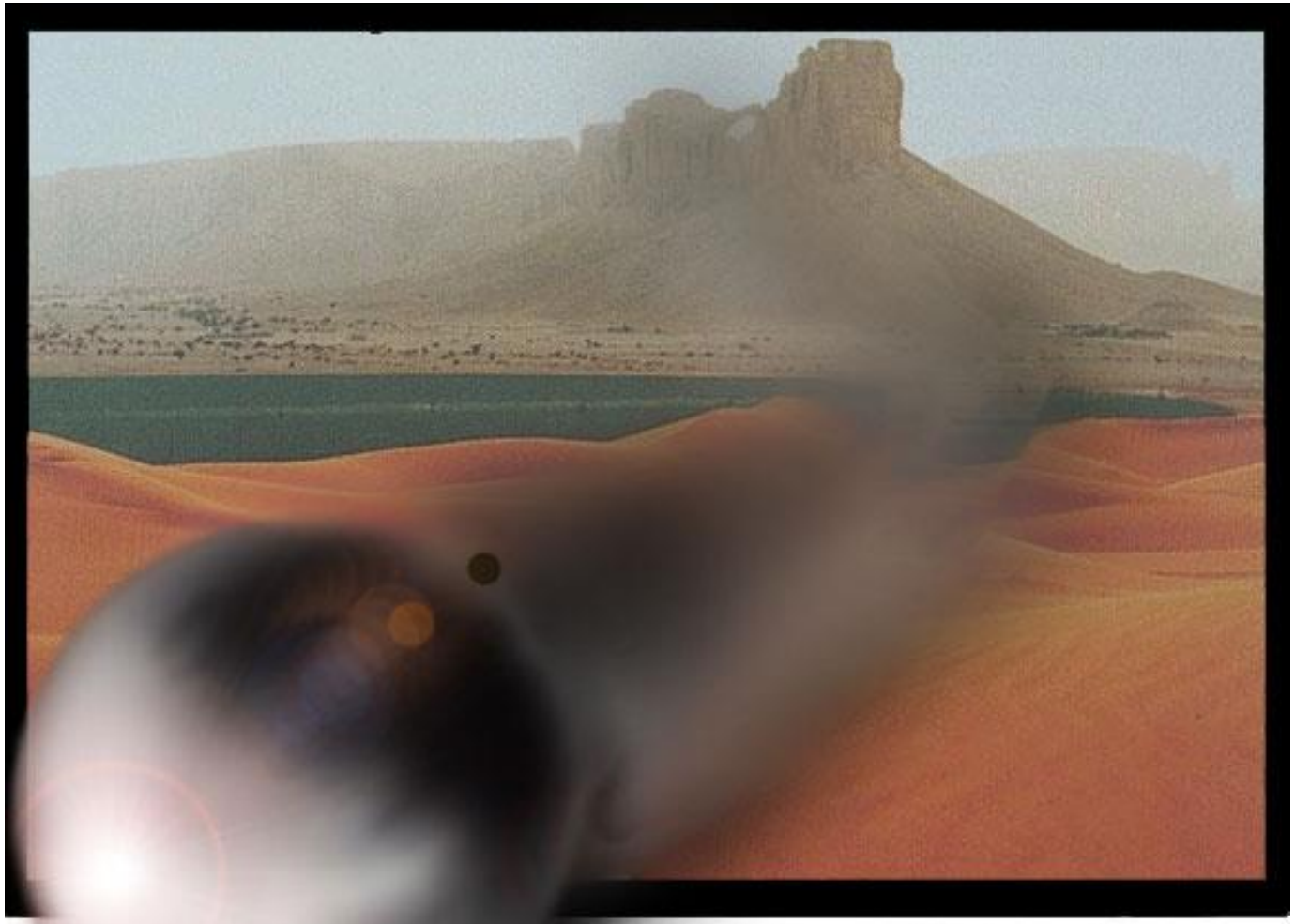
# MOTION NOTES



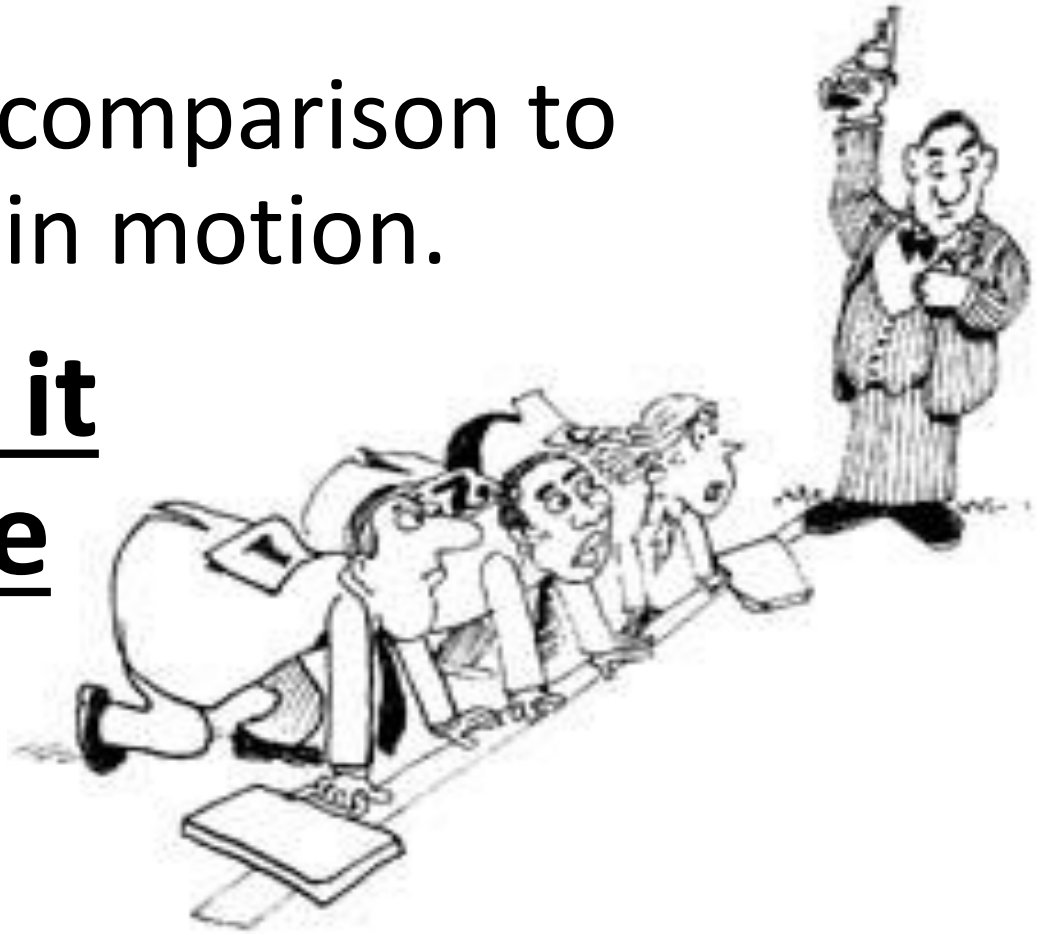
Ball in Motion

# Recognizing Motion

**How can you tell if an object is moving?**

- **Reference Point:**
  - a place or object used for comparison to determine if something is in motion.

**An object is in motion if it changes position relative to a reference point.**



# Recognizing Motion

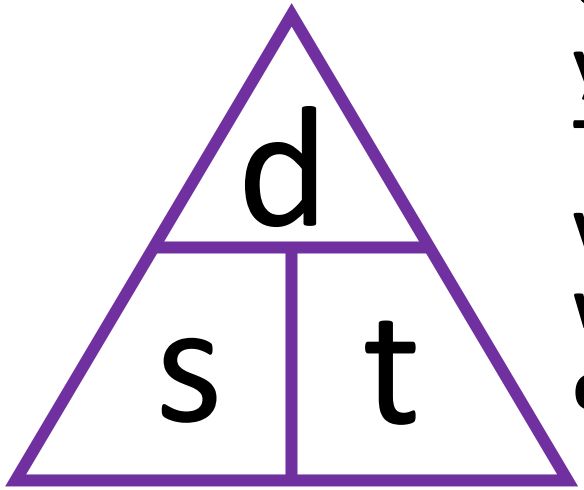
- **Your *PERCEPTION* of "motion" depends on your REFERENCE POINT.**
  - **Ex) Imagine you are sitting in a seat on the train pictured here…**
  - **From the perspective of someone standing outside on the platform, are you moving?**
  - **What about from the perspective of another passenger seated next to you?**
  - **These questions could have different answers!**

# Speed

**The distance an object travels in a certain time**

- **speed = $\frac{\text{distance}}{\text{time}} = \frac{d}{t}$**

**units = (m/s) *or* (km/hr)**




- **Cover the variable you're solving for. The two remaining variables show you whether to multiply or divide!**

# Practice Problems: Speed

**1) At what speed is a plane flying if it travels 1760 meters in 8 seconds?**

$s = d/t$

$s = 1760\ m / 8\ s$

$s = 220\ m/s$

# More Examples:

**2) A car travels 240 kilometers in 3 hours. What is the speed of the car during that time?**

*s = d/t = (240km)/(3hr) = 80 km/hr*

**3) The speed of a cruise ship is 50 km/hr. How far will the ship travel in 14 hours?**

*d = st = (50 km/hr)(14 hr) = 700 km*

**4) A cyclist travels 32 km during the first 2 hours of riding, and 13 km during the next hour. What is the average speed of the cyclist?**

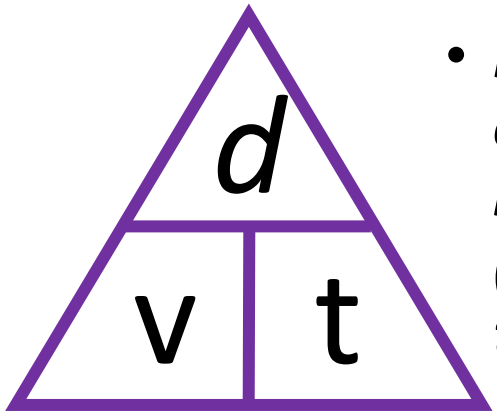
*s = d/t = (32km + 13 km)/(2 hr + 1 hr) = 15 km/hr*

# Velocity

- **speed in a given *direction*.**

**velocity = *displacement*** = $\frac{d}{t}$
**time**

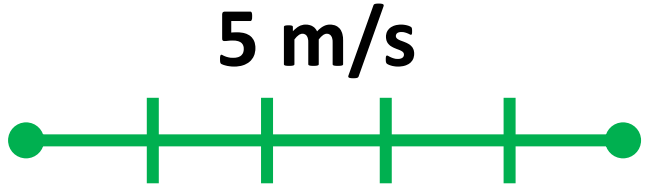
- ***"Displacement" is the distance between the starting point and ending point (different from "distance")***
- ***Note that the velocity equation is VERY similar to the speed equation***




- ***NOTE: calculated just like speed (same units too)!***

# Scalars and Vectors

- Scalar quantities have a ***magnitude*** (number, size) without a specified direction.
- Vector quantities have both ***magnitude AND direction***.
- Speed is a scalar, velocity is a vector.





  - *IMPORTANT*: sometimes in physics, we designate direction as "+" (forward, up) or "–" (backward, down)

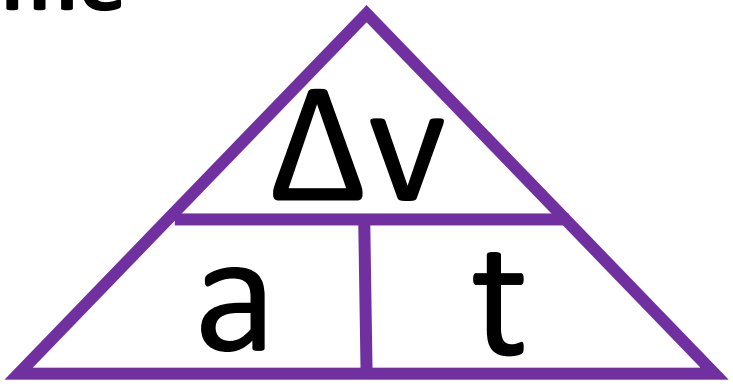
# Acceleration

- **A change in velocity over a certain amount of time.**
  - **increasing speed, decreasing speed, or changing direction**

- **acceleration = $\frac{\text{final velocity - initial velocity}}{\text{time}}$**

- **$a = \frac{\Delta v}{t}$** $\Delta$ = change in…

**Units: $m/s^2$**




# Practice Problems: Acceleration

**5) A car is traveling at 6 m/s. It accelerates to 16 m/s in 5 seconds. What is the acceleration of the car?**

$a = \Delta v / t = (16 m/s - 6 m/s) / 5s = 2\ m/s^2$

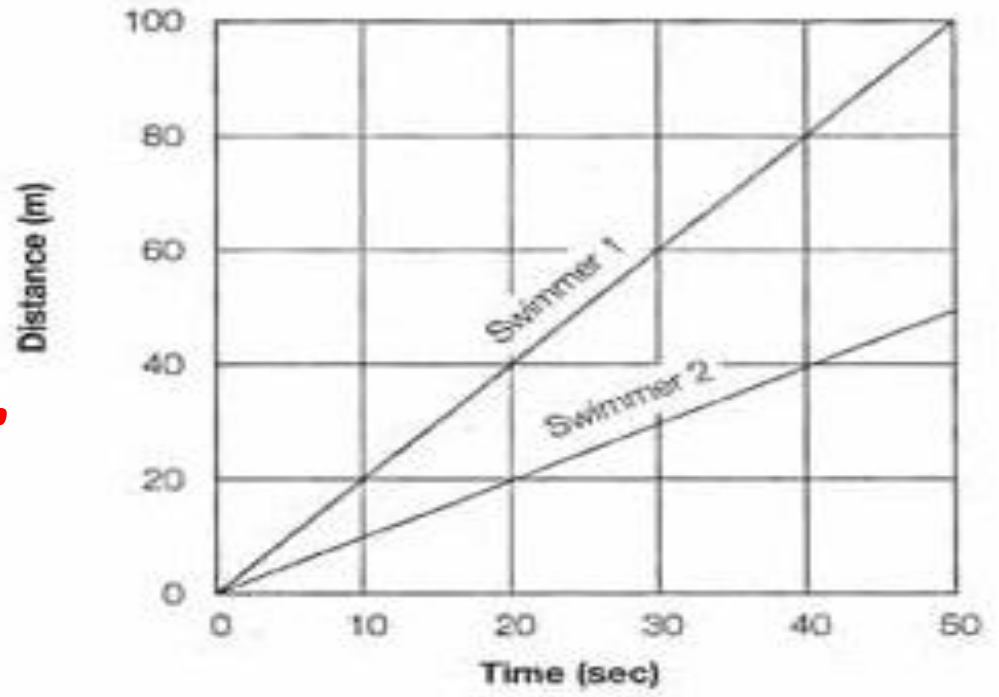
**6) A roller coaster is moving at 25 m/s at the bottom of a hill. Three seconds later it reaches the top of the next hill, moving at 10 m/s. What is the acceleration of the roller coaster?**

$a = \Delta v / t = (10 m/s - 25 m/s) / 3s = -5\ m/s^2$

*IMPORTANT: The negative sign indicates the object is slowing down!*

# Graphing Motion

- **distance vs. time graph**
  - **displacement on the y-axis**
  - **time on the x-axis**
- ***The slope tells you the speed.***
  - **SLOPE = "steepness" of the line**
  - **slope = $\frac{\text{rise}}{\text{run}} = \frac{y_2-y_1}{x_2-x_1}$**

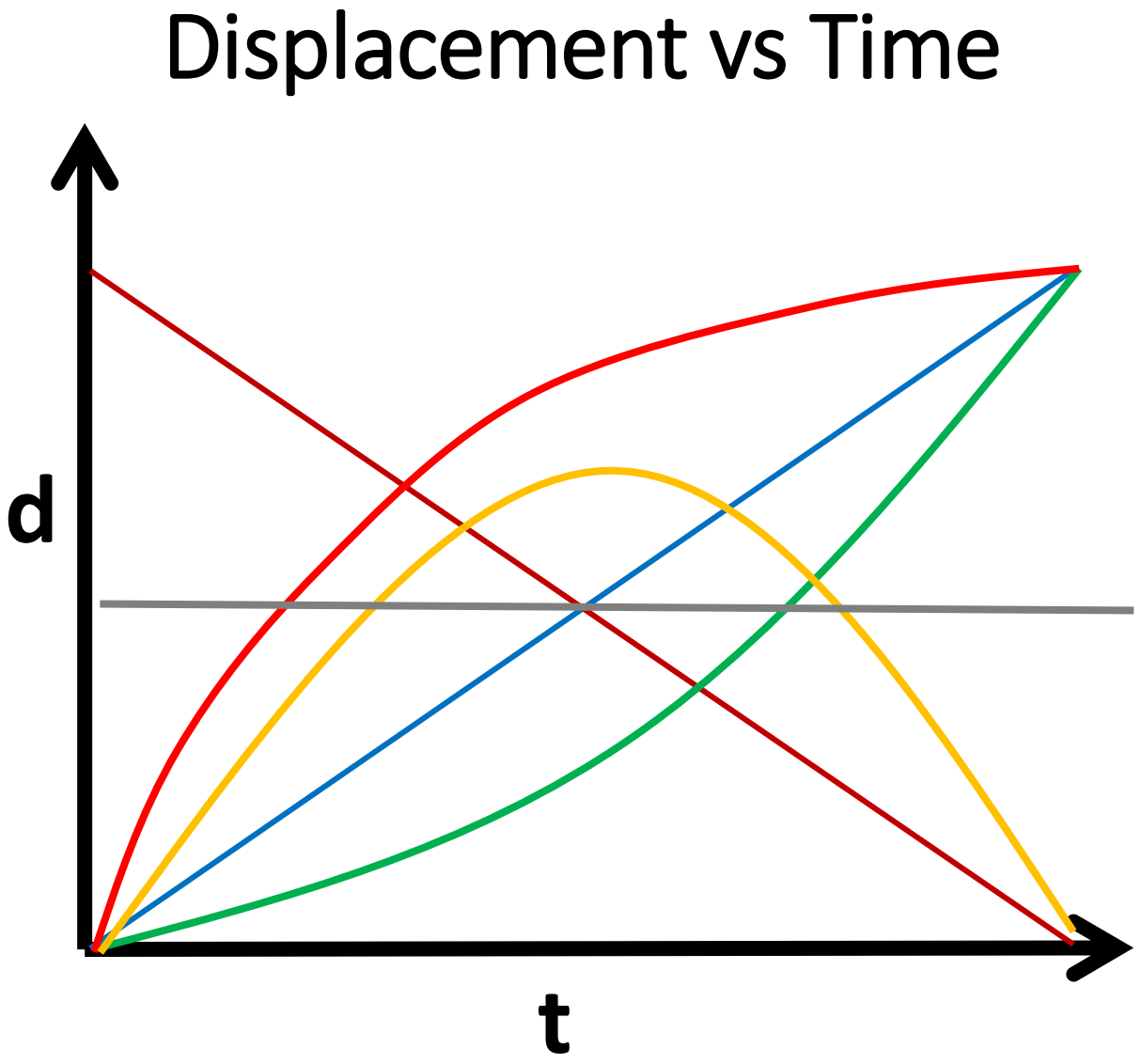



- In this graph, you can tell that swimmer 1 is faster because the motion of swimmer 1 produces a steeper slope (***steeper slope = faster***)
- You can calculate swimmer 1's speed by calculating the slope:

  *slope = $(y_2-y_1)/(x_2-x_1)$ = (100-0m)/(50-0s) = 2 m/s*

# Graphing Motion

7) Constant Forward Motion
8) Constant Backward Motion
9) Speeding Up
10) Slowing Down
11) Changing Direction
12) No Motion



# Practice Problems: Motion

**13) Plane A is flying East at 880 km/hr and plane B is traveling North at 880 km/hr. Do they have the same speed? The same velocity? Explain.**

*Plane A and B have the same speed (880 km/hr) but different velocities because they're travelling in different directions.*

**14) A swimmer speeds up from 1.1 m/s to 1.3 m/s during the last 20 seconds of her workout. What is her acceleration during this interval?**

$a = \Delta v / t = (1.3 - 1.1 \text{ m/s}) / 20 \text{ s} = 0.01 \text{ m/s}^2$

**15) Which is going faster, a boy who runs 40 m in 8 s or a girl who runs 55 m in 10 s?**

*Boy: s = d/t = 40m/8s = 5 m/s*

*Girl: s = d/t = 55m/10s =* ***5.5 m/s***