



Physics!

MOTION AND FORCES
CHAPTER 2 & 3



(WRITE DOWN WHITE WRITING)



DISTANCE, DIRECTION AND VELOCITY



DISTANCE VS. DISPLACEMENT

Distance: describes how far an object has moved, regardless of its direction

ex: 40km east + 25km west = 65 total km traveled

Displacement: describes both distance *and* direction

ex: 40 km east + 25 km west = 15 km east

ex: 40 km east + 25 km east = 65 km east



SPEED

- How fast an object is traveling regardless of direction
- Unit: $\frac{\text{m}}{\text{sec}}$ or $\frac{\text{km}}{\text{hour}}$

Described in two ways:

1. Instantaneous speed: measured at a specific instant
 - initial speed and final speed are examples
 - **this is what speedometers measure**
2. Average speed: total distance traveled per unit of time
 - **if an object travels at a constant speed, then the instantaneous and average speed will be equal**
 - **if the object is traveling at varying speeds, then the average speed is calculated as total distance traveled over total time**

VELOCITY

- Describes both the speed of an object *AND* its direction of motion
- Units: speed + direction: 24 $\frac{\text{m}}{\text{sec}}$ north

Measured in two ways:

1. Instantaneous velocity: velocity at a specific instant
2. Average velocity: the total displacement per unit of time

Velocity can change if:

1. the object's speed is changed (increased or decreased)
2. the object's direction can change

V = either velocity or speed

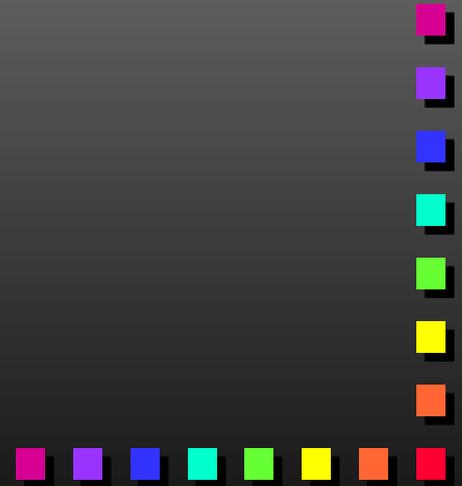
D = distance or displacement

T = time

$$v = \frac{d}{t}$$

Units count!!!!!!!!!!!!!!

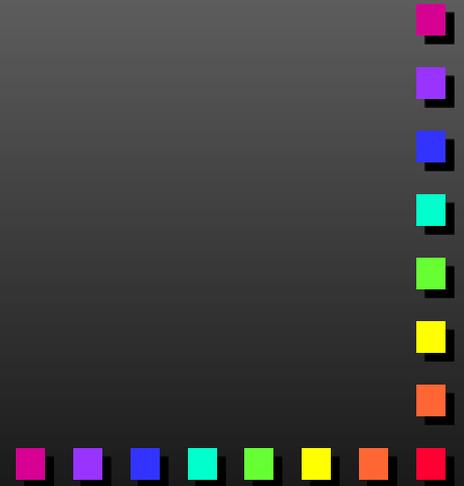
Let's practice!!!!



SAMPLE PROBLEM #1

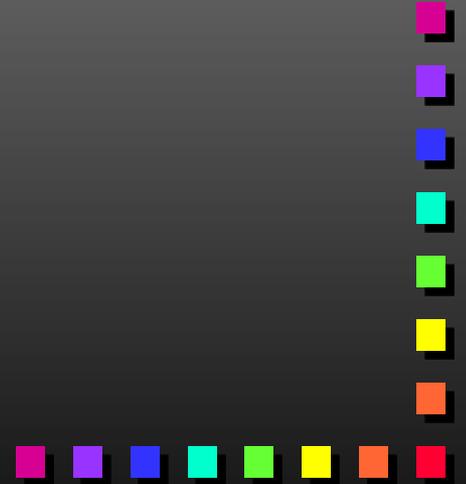
AN ELEVATOR TRAVELS FROM THE 1ST TO THE 60TH FLOOR, A DISTANCE OF 210 METERS IN 35 SECONDS.

WHAT IS THE ELEVATOR'S SPEED?



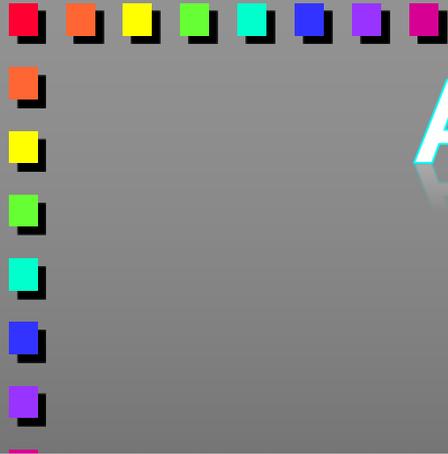
SAMPLE PROBLEM #2

HOW FAR DOES A CAR TRAVEL IN 1.5 HOURS IF IT IS MOVING AT A CONSTANT SPEED OF 88 KM/HR?



- 1. Why do you think some people confuse speed with velocity?**
- 2. Does a speedometer show both speed and velocity?**
- 3. You travel to and from RHHS, which is located 5 mi to the west of your house. What is your distance & displacement?**

- 1. What is the difference between distance and displacement?**
- 2. What is the difference between speed and velocity?**
- 3. Your average walking speed is 0.90 m/sec. What is it in km/hour?**



ACCELERATION AND GRAVITY



ACCELERATION

- The rate of change of an object's velocity over the time it takes for that change to occur
- Equation:
$$a = \frac{(v_f - v_i)}{t}$$
- Unit: m/s/s or m/s² (most common)

However, the unit used for velocity (m/s) and the unit used for time (s) do not necessarily need to be the same:

km/hr per second



ACCELERATION

The change in acceleration may involve a change in speed or direction

Can acceleration be negative???

Yes!!

When you are slowing down at a stoplight, speed is decreasing, so acceleration is opposite of velocity... = negative acceleration



THREE WAYS TO DESCRIBE ACCELERATION:

1. constant acceleration: acceleration is zero because the velocity does not change

ex: walking 2 meters every 15 seconds



2. positive acceleration: the object is speeding up

ex: getting on the interstate in your car



3. negative acceleration: the object is slowing down

ex: pulling into a parking lot to park your car



GRAVITY'S AFFECT ON ACCELERATION

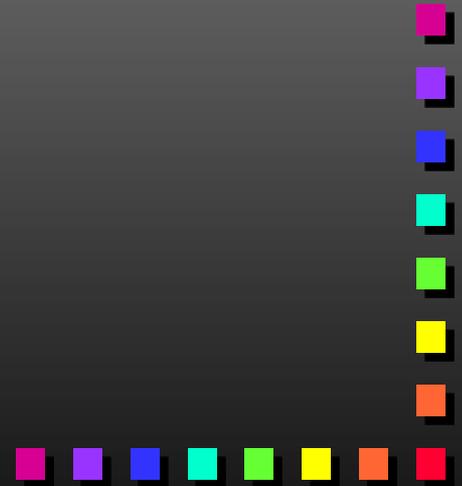
- A. All objects accelerate as they fall because the Earth exerts gravitational force on them
- B. All objects when released accelerate in the direction of the force (downward)
- C. At initial release, the object has an initial velocity of 0.0 m/sec
- D. As it falls, the object accelerates at a constant rate of 9.8 m/s^2
- E. This means the object will travel 9.8 m/sec every second it is falling → as long as there is no air resistance
- F. The value 9.8 m/sec^2 is called the *acceleration of gravity* (a_g).



SAMPLE PROBLEM #1

$$a = \frac{(v_f - v_i)}{t}$$

A jet airliner starts at rest and reached a speed of 80 m/s in 20 seconds. What is it's acceleration?

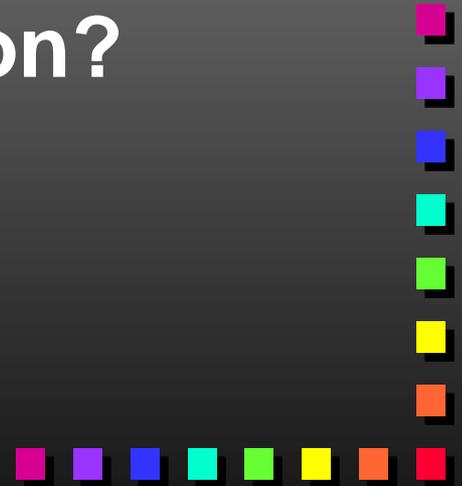


SAMPLE PROBLEM #2

$$a = \frac{(v_f - v_i)}{t}$$

Negative Acceleration: (slowing down)

A skateboarder is moving at a constant speed of 3 m/s and comes to a stop in 2 seconds. What is his acceleration?



Assignments!

Right Now:

pg 51 “Self Check” # 1-4

Self Check

1. **Describe** three ways to change the velocity of a moving car.
2. **Determine** the change in velocity of a car that starts at rest and has a final velocity of 20 m/s north.
3. **Explain** why streets and highways have speed limits rather than velocity limits.
4. **Describe** the motion of an object that has an acceleration of 0 m/s^2 .

- 1. What needs to occur for an object to have acceleration?**
- 2. Which of the following is a proper unit of acceleration?**
 - a. m/km^2**
 - b. km/h**
 - c. m/s^2**
 - d. m^2/s**
- 3. When describing the rate a race car going around a track, should you use the term speed or velocity, why?**
- 4. How long does it take for the sound of thunder to travel 1485 m, if sound travels at 330 m/s?**

- 1. If you ride your bike down a straight road for 500 m then ride back, your distance is ___ your displacement.**

a. greater than b. less than c. equal to
- 2. Acceleration is rate of change of ___.**

a. position b. time c. velocity d. force
- 3. If you ride your bike up a hill, then ride down the other side, your acceleration is ___.**

a. all positive b. first positive, then negative
c. all negative d. first negative, then positive

- 1. How long will it take to reach Bi-Lo 15 km away if traveling at 50 km/hr?**
- 2. How long will it take a whale to travel 200 km swimming at 4 m/s?**
- 3. The value of 9.8 m/sec² is called...**
- 4. What is the acceleration formula?**

1. If an object has an acceleration of 0 m/s^2 , what is it doing?

**2. Ben Johnson ran 200m in 22.31 sec.
What was his speed in mi/hour??**