MiSP Force and Gravity Worksheet #1, L3

Name _____ Date _____

FORCE AND ACCELERATION

Your teacher will demonstrate some principles of force and motion. After watching the demonstration, answer the questions below.

1. When the cars were placed on the desk, why didn't they move by themselves?

   _____

   _____

2. What happened to the small car when your teacher pushed it gently?

   _____

3. Why did this happen?

   _____

   _____

4. What happened when your teacher gently pushed the larger car?

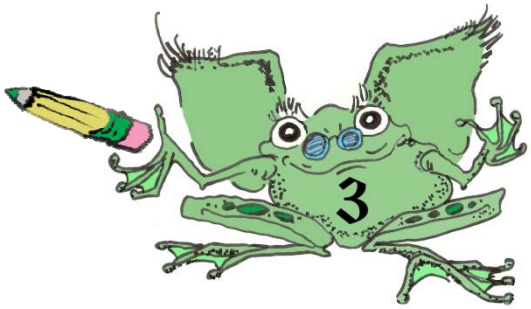
   _____

   _____

5. Why did this happen?

   _____

   _____



6. Why did the small car stop moving after it was pushed?

_____

7. The cars behaved according to Newton's first law of motion. Explain Newton's law in your own words.

_____

_____

_____

_____

_____

8. What happened when the large car was placed on an incline and released without pushing?

_____

_____

Why did this happen?

_____

_____

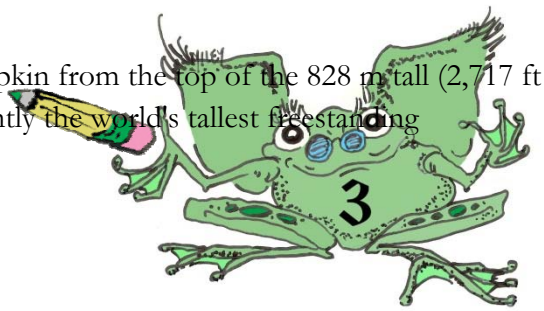
9. The force that caused the large car to move on the incline is called *gravity*.
Gravity is an attractive force between any two objects that depends on the mass of each object and the distance separating the centers of gravity. The mass of Earth is much greater than that of the car (or you or your school); therefore, the car is pulled toward Earth.

In the demonstration, the toy cars were pushed once. What would happen if a constant force were applied to the cars?

_____

_____

Gravity is a constant force. Suppose you dropped a pumpkin from the top of the 828 m tall (2,717 ft tall) Burj Khalifa in Dubai, United Arab Emirates (currently the world's tallest freestanding

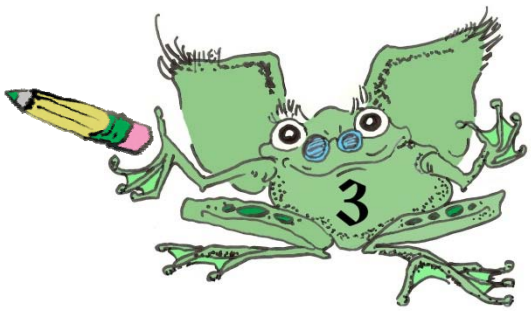


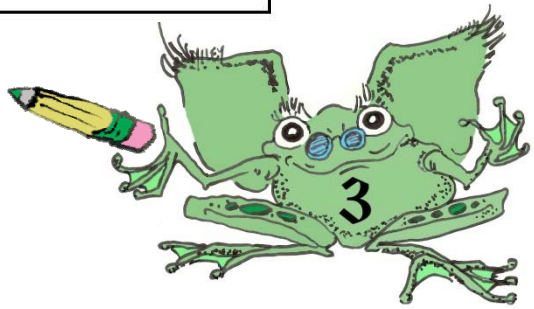
structure). The velocity at which the pumpkin would be falling toward Earth at the end of each second (ignoring air resistance) is given below.

Time (seconds)	Velocity (ft/sec) No resistance
1	32
2	64
3	96
4	128
5	160
6	192
7	224
8	256
9	288
10	320

Graph this data:

1. Label the *x*- and *y*-axes.
2. Decide on an appropriate interval for both the *x*- and *y*-axes.
3. Plot the data.
4. Draw a line connecting the points on your graph.

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Analysis:

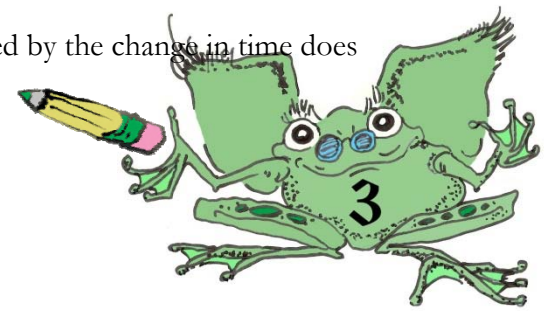
1. Pick two points along the line and calculate the change in velocity over that time period.

Data Points used for calculation (x_1, y_1) (x_2, y_2)	Difference in Velocity (ft/sec) $y_2 - y_1$ Δy	Difference in Time (seconds) $x_1 - x_2$ Δx	Difference in Velocity (ft/sec) ——— Difference in Time (sec) $\Delta y / \Delta x$

2. Pick two different points along the line and calculate the change in velocity over that time period.

Data Points used for calculation (x_1, y_1) (x_2, y_2)	Difference in Velocity (ft/sec) $y_2 - y_1$ Δy	Difference in Time (seconds) $x_1 - x_2$ Δx	Difference in Velocity (ft/sec) ——— Difference in Time (sec) $\Delta y / \Delta x$

3. You should notice that the change in distance divided by the change in time does not change.



$$\frac{\Delta \text{ velocity (ft/sec)}}{\Delta \text{ time (seconds)}} = \frac{\Delta y}{\Delta x} = \textbf{Unit rate of change (slope)}$$

4. What does this unit rate of change represent? _____

5. By how much does the velocity of the falling pumpkin increase during each second of falling?

_____

6. The general equation for a line is $\boldsymbol{y = mx + b}$ where m represents the constant rate of change and b represents the value of y when $x = 0$ (also called the y-intercept). For the particular relationship we are working with here, we know that a time of 0 seconds will yield a velocity of 0 km. Therefore, the y-intercept on the graph will always be at the origin (0, 0).

7. Use the equation for a line to calculate the y-intercept. The equation for a line is

   $y = mx + b$
   where m is the unit rate of change (slope) and
   b is the y-intercept

Y-Intercept
$m =$ Ordered pair $(x, y) = (\_\_\_, \_\_\_)$ $y = mx + b$ Solve for b:

Summary and Preview of Day 2 Concept

A change in velocity per unit of time is known as acceleration ($a = \Delta v/\Delta t$).
Near the surface of Earth, the gravitational force is strong enough to cause an unsupported object to accelerate at a rate of 9.8 m/sec/sec (9.8 m/sec^2) or 32 ft/sec/sec (32 ft/sec^2). This means that gravity will cause an object to fall at a velocity that will increase by 32 ft/sec every second that it is

falling. This acceleration is called *acceleration due to gravity* (g). The speed of a falling object will continue to increase unless some opposing force—like air resistance—limits its speed. Air resistance can change acceleration significantly. Before opening a parachute, a skydiver accelerates at less than 32 ft/sec^2 because of air resistance. Eventually the air resistance causes a skydiver to fall at a constant speed rather than continuing to accelerate. This is known as *terminal velocity*.