**Guided Notes: Position, Distance, and Displacement**

**Big Idea:**

In this lesson, you will distinguish between various terms that describe how an object's position changes and how fast its position and direction change.

**Key Concepts:**

• Distance is how far an object has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

• Displacement is how far an object is from its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ position, in the direction from the starting point to the ending point.

• Speed describes how \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ an object is moving.

• Velocity describes the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an object in a given direction.

• A position-time graph shows the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an object over time.

• On a position-time graph, time is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ variable on the x-axis.

• On a position-time graph, position is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ variable on the y-axis.

• A horizontal line on a position-time graph means the object is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.



**Real World Examples:**

1. If you run one block away from home and one block back, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ you traveled is two blocks. But your \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at the end is zero, since you returned to your original position.

2. When driving in a straight line, your velocity is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. When driving around a curve, your velocity is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Guided Notes: Magnitude and Direction of Force**

**Big Idea:**

In this lesson, you will explain that forces have an extent and direction; they affect the motion of objects.

**Key Concepts:**

• Forces have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

• Magnitude is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or size of a force.

• A stronger push has a greater \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of force.

• A \_\_\_\_\_\_\_\_\_\_ push has a smaller \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of force.

• The direction of a force affects the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an object.

• If forces are balanced, an object's motion \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ change.

• If forces are unbalanced, an object's motion \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ change.

• Newton's Third Law states: For every action, there is an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ reaction.



**Real World Examples:**

1. Kicking the ball harder gives it more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Kicking the ball softer gives it \_\_\_\_\_\_\_\_\_\_speed.

2. Pushing the box harder requires more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Pushing the box gently requires less \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Guided Notes: Forces that Change Motion**

**Big Idea:**

In this lesson, you will describe forces that change an object's motion.

**Key Concepts:**

• A force is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ exerted on an object.

• Balanced forces have a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of zero, so they do not change an object's motion.

• Unbalanced forces do not have a sum of zero, so they \_\_\_\_\_\_\_\_\_\_ an object's motion.

• Unbalanced forces can cause an object at rest to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or cause an object in motion to change \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

• Gravity is an unbalanced \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force that pulls objects downward.

• Momentum is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of motion of an object.

• Momentum is the product of an object's \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.



**Real World Examples:**

1. Throwing a ball applies an unbalanced \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that causes it to start moving. The harder you throw, the greater the ball's \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

2. Pressing the gas pedal provides an unbalanced \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that increases the car's speed. Turning the steering wheel provides an unbalanced \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that changes the car's direction.

**Guided Notes: Newtons First Law**

**Big Idea:**

Newton's First Law of Motion states that an object at rest stays at rest, and an object in motion stays in motion at the same speed and direction unless acted upon by an unbalanced force.

**Key Concepts:**

* Inertia refers to the \_\_\_\_\_\_\_\_\_\_\_\_\_ of an object to a change in its motion.
* An unbalanced force is a force that is not \_\_\_\_\_\_\_\_\_\_\_\_ by an equal opposing force, causing a change in an object's speed and/or direction.
* \_\_\_\_\_\_\_\_\_\_\_ forces can cause an object's speed to increase or decrease.
* \_\_\_\_\_\_\_\_\_\_\_\_ is the speed of an object in a particular direction.
* The net force is the \_\_\_\_\_\_\_\_\_\_\_\_ of all forces acting on an object.
* To calculate net force when forces act in the same direction, you \_\_\_\_\_\_\_ them.
* To calculate net force when forces act in opposite directions, you \_\_\_\_\_\_\_\_ them.
* The unit for force in the net force equation is \_\_\_\_\_\_\_\_\_\_\_\_.
* If all forces on an object are \_\_\_\_\_\_\_\_\_\_\_\_, it will not move or change motion.



**Real World Examples:**

1. When a car stops suddenly, passengers tend to keep moving forward due to \_\_\_\_\_\_\_\_\_. The seatbelt provides the \_\_\_\_\_\_\_\_\_\_\_ force to stop their forward motion.

2. When pouring water into a glass, the water initially keeps moving downward due to \_\_\_\_\_\_\_\_\_. The glass provides the \_\_\_\_\_\_\_\_\_\_\_ force that stops the water's downward motion.

**Guided Notes: Newton’s Second Law**

**Big Idea:**

Newton's Second Law of Motion describes the relationship between an object's mass, the force applied to it, and the resulting acceleration.

**Key Concepts:**

* \_\_\_\_\_\_\_\_\_\_\_\_ is the rate of change in velocity of an object.
* \_\_\_\_\_\_\_\_\_\_\_\_ is a push or pull exerted on an object.
* \_\_\_\_\_\_\_\_\_\_\_\_ is the measure of the amount of matter in an object.
* The net force is the \_\_\_\_\_\_\_\_\_\_\_\_ of all forces acting on an object.
* A \_\_\_\_\_\_\_\_\_\_\_\_ is the unit of force required to cause a 1 kg mass to accelerate at $1\frac{m}{s^{2}}$.
* The force (F) acting on an object equals its mass (m) times its \_\_\_\_\_\_\_\_\_\_\_\_ (a).

**Real World Examples:**

1. A batter needs to apply more \_\_\_\_\_\_\_\_\_\_\_\_ to hit a baseball farther for a home run.

2. \_\_\_\_\_\_\_\_\_\_ force is required to accelerate a heavy couch compared to a light chair.

**Guided Notes: Newton’s Third Law**

**Big Idea:**

Newton's Third Law of Motion states that for every action force, there is an equal and opposite reaction force.

**Key Concepts:**

* Newton's Third Law states that for every \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ there is an equal and opposite \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_.
* A \_\_\_\_\_\_\_\_ is the force that drives an object forward or upwards.
* Even if the forces are equal, the \_\_\_\_\_\_\_\_ of the objects may differ depending on their masses.
* The reaction force is equal in \_\_\_\_\_\_\_\_ but opposite in \_\_\_\_\_\_\_\_\_ to the action force.
* Newton's Third Law applies to objects at \_\_\_\_\_\_\_ and objects in \_\_\_\_\_\_\_\_.



**Real World Examples:**

1. The exhaust gases from the rocket engine provide the \_\_\_\_\_\_\_\_ force that propels the rocket upwards.

2. When a boxer's glove hits an opponent with a force, the opponent's body exerts an equal \_\_\_\_\_\_\_\_ force back on the glove.

**Guided Notes: Collision Forces**

**Big Idea:**

Collision forces can be calculated using Newton's laws of motion, which relate an object's mass, acceleration, and the forces acting on it.

**Key Concepts:**

* An \_\_\_\_\_\_\_\_\_\_\_\_ force is a force that changes an object's motion.
* According to Newton's Second Law, force (F) equals \_\_\_\_\_\_\_\_\_\_\_\_ times \_\_\_\_\_\_\_\_\_\_\_\_.
* Newton's Third Law states that for every action force, there is an equal and opposite \_\_\_\_\_\_\_\_\_\_\_\_ force.
* The reaction force is equal in \_\_\_\_\_\_\_\_\_\_\_\_ but opposite in \_\_\_\_\_\_\_\_\_\_\_\_ to the action force.

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**Real World Examples:**

1. If a 1500 kg car hits a wall at 14 $\frac{m}{s^{2}}$, the force of the car hitting the wall is \_\_\_\_\_\_\_\_\_\_\_\_. The wall will exert an equal \_\_\_\_\_\_\_\_\_\_\_\_ force back on the car.

2. If a 0.15 kg baseball is hit with a force of 200 N, it will accelerate in the direction of the \_\_\_\_\_\_\_\_\_\_\_\_ force. The ball will exert an equal 200 N \_\_\_\_\_\_\_\_\_\_\_\_ force back on the bat.