Name _____ **Date** _____

Forces and Motion

Key Words		
force	motion	movement
friction	gravity	magnetism
inertia	weight	acceleration

Have you ever thought about how your skateboard works when you are riding on it? You have to push off with one foot to make it start moving. When you do this, you provide a force that can change an object's motion. Many things around us move in various ways. But what makes these objects move or stop moving? Forces affect the ways these things move. A **force** is a push or a pull exerted by one object on another. Forces cause changes in **motion**, or **movement.** Motion is a change in an object's position.

Just as it takes a force to start movement, it also takes a force to stop or slow down motion. **Inertia** is the tendency of a moving object to keep moving or an object at rest to remain at rest. Think about riding in a car. If you are sitting in the front seat of the car and the driver stops quickly, your body continues to move forward until stopped by the seat belt. That is an example of inertia. Another example of inertia is a bowling ball. It takes a lot of effort and force to get the ball rolling down the lane. But once the ball begins to roll, it is hard to stop. This is because of the ball's inertia.

The amount of inertia an object has is determined by its mass. The greater the mass of the object, the more inertia it has. Remember, inertia causes objects to stay still or keep moving until a force is again applied to them.

A long time ago, a scientist named Isaac Newton stated three laws to describe the motion of objects. Newton's first law of motion is often called the inertia law: an object at rest tends to stay at rest and a moving object tends to keep moving until an outside force acts on it. Newton's second law of motion states that an object's **acceleration** (increase or decrease in speed) depends on the mass of the object and the size and direction of the force acting on it. Objects with more mass take more force

to change position. Newton's third law of motion is sometimes called the action/reaction law: for every action, there is an equal and opposite reaction. If a force is applied in one direction, then the object will move in the opposite direction with the same amount of force.

Three major forces that affect objects on the Earth are friction, magnetism, and gravity. These forces overcome an object's inertia, causing it to move, stop, or change direction.

Friction opposes, or acts against, motion when two surfaces rub against each other. Rough surfaces produce more friction than smooth surfaces. For example, it is very hard to roller skate on a carpeted surface because the wheels rubbing on the carpet provide enough force to stop the skates from moving. However, skating on ice is very easy because there is very little friction between the ice and the skates. Friction is also the force that allows your feet to grip the ground or the floor when you walk. A dry floor has much more friction than a wet floor. That is why you can walk more easily on a dry floor, but your feet slip and slide when you try to walk on a wet floor.

A second force, **magnetism**, repulses (pushes) or attracts (pulls) objects. Magnetism is the ability of an object to exert a force on other magnets and on objects that contain steel or iron.

A third force that affects objects on Earth is **gravity**, which pulls all objects towards the center of the Earth. Gravity is the force that pulls all objects in the universe towards one another. The strength of the gravitational force depends on the mass of the two objects and the distance between them. Large objects that are close together have greater gravitational pull than those that are smaller and far apart. **Weight** measures the gravitational force that one object exerts on another. The Earth's gravitational force on your body mass is your weight on Earth. People walk with their feet on the ground because Earth's gravity is attracting them. Objects thrown into the air eventually fall down to the Earth's surface due to gravity.

We use tools to measure how forces affect objects. A scale measures the force of gravity—the weight of an object. A meter stick can measure the distance that an object moves after a force has been applied. Pulling on a spring scale attached to an object can measure how much force is needed to move that object.

1. An object in motion is—

A always moving upward
B changing its position
C moving from left to right
D moving very quickly

2. Inertia causes—

A an object to remain at rest or keep moving
B motion in the same direction
C an object to change direction and speed
D motion to start and stop

3. What kind of force is friction?

A A pulling force
B A pushing force
C A gravitational force
D A rubbing force

4. Gravity is a(n)—

A repelling force
B attracting force
C pushing force
D rubbing force

5. What is the main idea of paragraph 6?

A There is less friction on icy surfaces.
B Rough surfaces allow objects to move easily.
C The lack of friction on a wet floor makes you slip and slide.
D Friction opposes motion when two objects rub together.

6. Which of the following objects would have the greatest gravitational force?

A A table
B The moon
C The Earth
D The sun

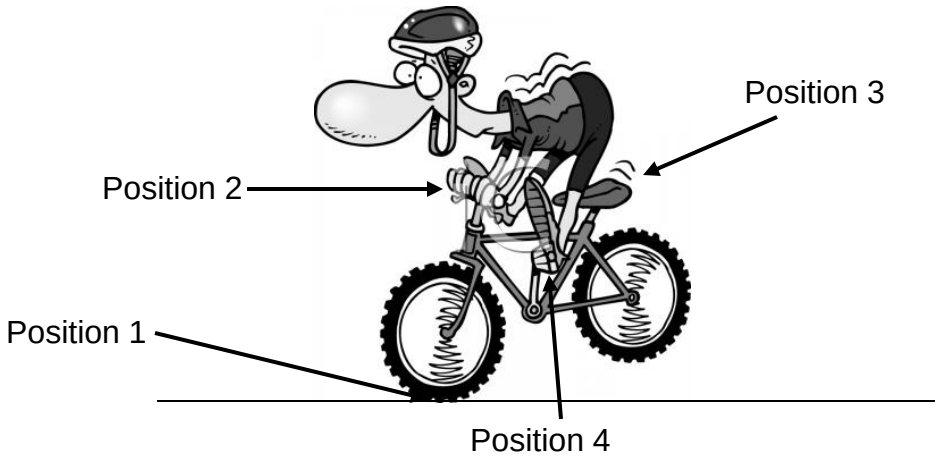
7. As a rocket was taking off from a launch pad, it began to slow down and fall back toward the launch pad. Which statement best describes what happened to make the rocket change direction?

A The pull of gravity was greater than the push of the rocket engines.
B The push of gravity was less than the pull of the rocket engines.
C The pull of gravity got stronger as the rocket got higher in the air.
D Gravity caused the rocket to get heavier as it went higher in the air.

8. What is the meaning of the word *opposes* in paragraph 6?

A More easily
B Rubbing force
C Acts against
D Rough surfaces

Use the illustration below to answer questions 9-10.



9. Where is the force of friction the greatest in the illustration above?

A Position 1
B Position 2
C Position 3
D Position 4

10. When the bicycle is in motion, which forces are acting on it?

A Gravity only
B Friction and inertia
C Friction, gravity, and inertia
D Gravity, magnetism and friction

force	oppose
inertia	direction
gravity	push
motion	meter stick
acceleration	position

$1,500	**$100**
$2,000	**$2,500**
$200	**$400**
$300	**$100**
$5,000	**$7,000**

effort	friction
mass	motion
tool	weight
illustration	movement
pull	magnetism

$1,000	**$7,000**
$1,500	**$2,000**
$400	**$200**
$2,500	**$5,000**
$300	**$100**

Word Bank, Set 1		Word Bank, Set 2	
acceleration	meter stick	effort	motion
direction	motion	friction	movement
force	oppose	illustration	pull
gravity	position	magnetism	tool
inertia	pull	mass	weight

Word Bank, Set 1		Word Bank, Set 2	
acceleration	meter stick	effort	motion
direction	motion	friction	movement
force	oppose	illustration	pull
gravity	position	magnetism	tool
inertia	pull	mass	weight

Word Bank, Set 1		Word Bank, Set 2	
acceleration	meter stick	effort	motion
direction	motion	friction	movement
force	oppose	illustration	pull
gravity	position	magnetism	tool
inertia	pull	mass	weight

Word Bank, Set 1		Word Bank, Set 2	
acceleration	meter stick	effort	motion
direction	motion	friction	movement
force	oppose	illustration	pull
gravity	position	magnetism	tool
inertia	pull	mass	weight

Word Bank, Set 1		Word Bank, Set 2	
acceleration	meter stick	effort	motion
direction	motion	friction	movement
force	oppose	illustration	pull
gravity	position	magnetism	tool
inertia	pull	mass	weight