* Make sure you have the correct units

A bowling ball rolled with a force of 15N and accelerates at a rate of 3 m/s^2. What is the mass of the bowling ball?

$m = \frac{F}{a} = \frac{15N}{3m/s^2} = 5kg$

Herbert has a mass of 50 kg. George pushes Herbert across the ice. Herbert accelerates on his ice skates at a rate of 5 m/2^2. How much force did George exert?

$F = m \cdot a = 50kg \cdot 5m/2^2 = 250N$

Bubba the alien was pushed through space by a rocket pack with a force of 396 N. Bubba's mass is 75 kg. What is Bubba's acceleration?

$a = \frac{F}{m} = \frac{396N}{75kg} = 5.28 \ m/s^2$

Read the force worksheets. Answer the questions about the reading

A force is a push or a pull

How can a force affect motion? Causes a change in motion if the forces are unbalanced

Force is measured in Newtons

What is Net Force? difference between two forces

Balanced forces do/ do not cause a change in motion.

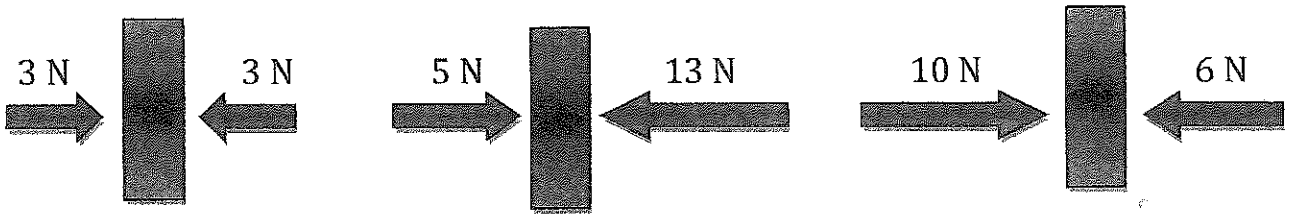
A change in the object's motion can only happen when an unbalanced force is applied.

Which examples below that show a balanced force?

a. A tug of war game where the rope does not move
b. Arm wrestling when both people are using the same amount of force.
c. Opening a bottle of soda
d. A car driving a steady speed of 65 mi/hr down I-380
e. A book setting on your desk

Unbalanced forces cause a change in motion of an object.

What is the Net Force of the objects below?



A. Net Force 0N

B. Net Force 8N

C. Net Force 4N

Which of the force diagrams above show an unbalanced force? B & C

Which force diagrams above show a balanced force? A

Which force diagram shows acceleration? B and C

What is mass? amount of matter in an object

Name _____ Date _____

Second Law of Motion

Newton's second law of motion states that acceleration is produced when a force acts on a mass. The greater the mass of the object to be accelerated the greater the amount of force needed to accelerate the object. Each of the following situations demonstrates Newton's second law. Describe how the difference in mass will affect the acceleration in each situation.

1. Amy weighs 78 pounds and her dad weighs 187 pounds. They are rollerskating. Amy challenges her dad to a race. They stand poised at a starting line. Her dad yells, "Go!"

Amy has less mass. so she will need less force to accelerate. Amy's dad will need more force to accelerate

2. Tony and Jose play on the football team. Since Tony is older, he weighs more and is taller than Jose. During practice, Tony and Jose practice blocking on a tackle dummy. Both boys start from the same place and position. Each tackle dummy has the same mass. At the same time, the boys run forward into the dummy.

Tony has more mass (he weighs more and is taller) so he will have more force on the dummy.

3. Two vehicles are broken down on the side of the road. One is a small sports car. The other is a delivery truck. The drivers need to push the vehicles forward and onto the shoulder of the road. Both drivers are about the same size. Each driver stands at the back of his vehicle and pushes.

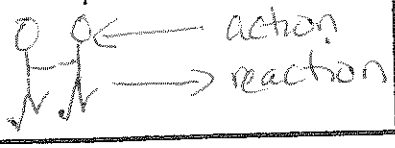
The person with the smaller car will be able to move it because you need less force to move a smaller mass.

Name Key Date

Third Law of Motion

Newton's third law states that for every action, there is a separate but equal reaction. For each situation describe the action and the reaction.

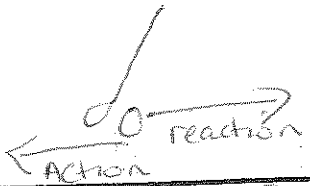
1 Two children on roller skates stand facing each other. The child on the right puts her arms out and pushes away from her partner.



Action: Child pushing on her friend

Reaction: The child who is pushing also goes back

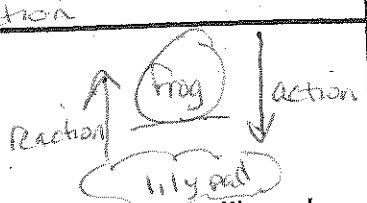
2 A golfer swings her club down to hit a golf ball on a tee.



Action: The ball hits the club *or* The club hits the ball

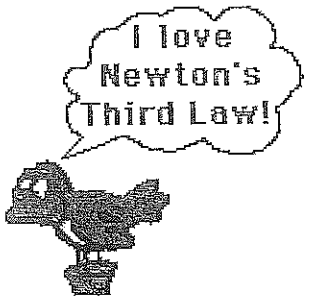
Reaction: The ball flies away in the opposite direction *or* the ball pushes back on the club

3 A frog sits on a lily pad in the middle of a pond. Suddenly it makes a leap pushing off the lily pad.



Action: Frog pushes down on the lily pad

Reaction: The pad pushes back on the frog and the frog goes up



A Worksheet ABOUT NEWTON'S LAWS

1. What law relates force to acceleration? 2

2. Which is the law of inertia? 1

3. Which is the law of acceleration? 2

4. Which law is in control of a spacecraft which cruises through space at a constant speed without using any fuel? 1

5. Which law governs when a tablecloth is pulled out from under a setting of china without damaging it? 1

6. Which law governs why a car is set in motion and not the asphalt highway on which it travels? 3

7. Which law allows a spaceship to accelerate by burning rocket fuel? 3

8. Which law relates acceleration to mass? 2

9. Which law governs when two skaters push apart in a rink? 3

10. Which law governs why a golf ball will go farther than a baseball if each are hit with the same amount of force? 2

Which Law? 1st, 2nd, or 3rd?

3 1. As the fuel in a rocket ignites, the force of the gas expansion pushes out the back of the rocket and pushes the rocket forward.

1 2. When you are standing up in a bus, the bus suddenly stops, and your body continues to go forward. (inertia)

2 3. You start up your motorcycle and drive down the street. As you give it more gas, it goes faster. force = mass * accel.

2 4. A pitched baseball goes faster than one that is gently thrown.
more force = more acceleration

3 5. A swimmer pushes water back with her arms, but her body moves forward. action / reaction

2 or 3 6. As an ice skater pushes harder with his leg muscles, he begins to move faster. → more force

2 7. When Bobby, age 5, and his dad are skipping pebbles on the pond, the pebbles that Bobby's dad throws go farther and faster than Bobby's.
more force...

1 8. A little girl who has been pulling a sled behind her in the snow is crying because when she stopped to tie her hat on, the sled kept moving and hit her in the back of the legs. objects in motion...

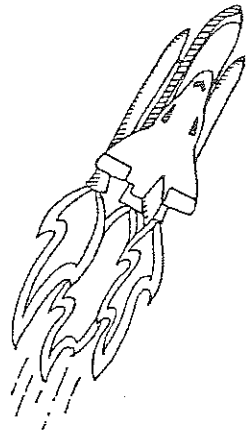
9. The snowboard sits at the bottom of the hill, unmoving, until Andrea gets on it and pushes it along. friction kept it from moving.

10. A skier waxes his skis so he can go faster. He is reducing the force of friction.

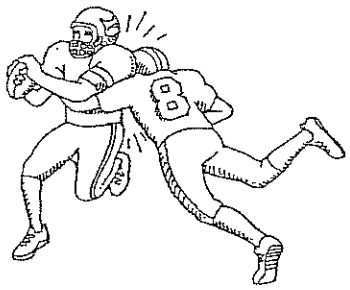
Name _____ Date _____

Identifying Newton's Laws

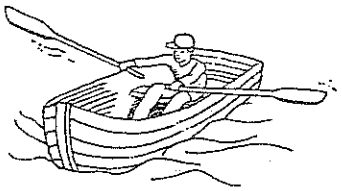
For each illustration, describe how the given laws affect the object's motion.



1. First Law of Motion: The rocket will stay in motion in space because there is no force acting on it.
2. Third Law of Motion: Action: fuel/fire out the back Reaction: Rocket goes up.

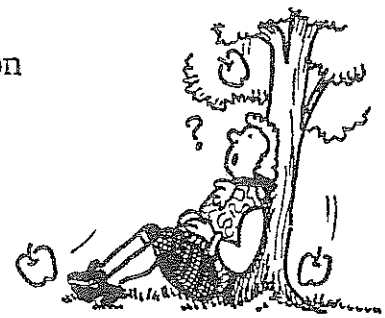


3. Second Law of Motion: If he runs faster (more acceleration) he will hit harder
4. Third Law of Motion: Number 8 will hit the other guy, but will also be hit back



5. First Law of Motion: The boat will not move without a force
6. Second Law of Motion: The harder you paddle, the faster you go

WHICH LAW?



We're told that Sir Isaac Newton discovered some things about motion when an apple dropped on his head. Whatever "force" was behind his discoveries, we have benefited from his discoveries.
Here are his three laws of motion. You should be familiar with them. Fill in the missing words in each of the three laws. Then tell which law fits each example below.

Which law? First, Second, or Third?

1 1. A frog leaping upward off his lily pad is pulled downward by gravity and lands on another lily pad instead of continuing on in a straight line.

3 2. As the fuel in a rocket ignites, the force of the gas expansion and explosion pushes out the back of the rocket and pushes the rocket forward.

1 3. When you are standing up in a subway train, and the train suddenly stops, your body continues to go forward.

2 4. After you start up your motorbike, as you give it more gas, it goes faster.

2 5. A pitched baseball goes faster than one that is gently thrown.

3 6. A swimmer pushes water back with her arms, but her body moves forward.

2 7. As an ice skater pushes harder with his leg muscles, he begins to move faster.

2 8. When Bobby, age 5, and his dad are skipping pebbles on the pond, the pebbles that Bobby's dad throws go farther and faster than his.

3 9. When you paddle a canoe, the canoe goes forward.

1 10. A little girl who has been pulling a sled behind her in the snow is crying because when she stopped to tie her hat on, the sled kept moving and hit her in the back of her legs.

NEWTON'S FIRST LAW OF MOTION:
An object at rest stays at rest or an object that is in motion at a constant speed in a straight line keeps moving at that speed unless another force acts on it.

NEWTON'S SECOND LAW OF MOTION:
The amount of force needed to make an object change its motion depends on the mass of the object and the force required.

NEWTON'S THIRD LAW OF MOTION:
For every action (or force), there is an equal and opposite action (or force).

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Name