

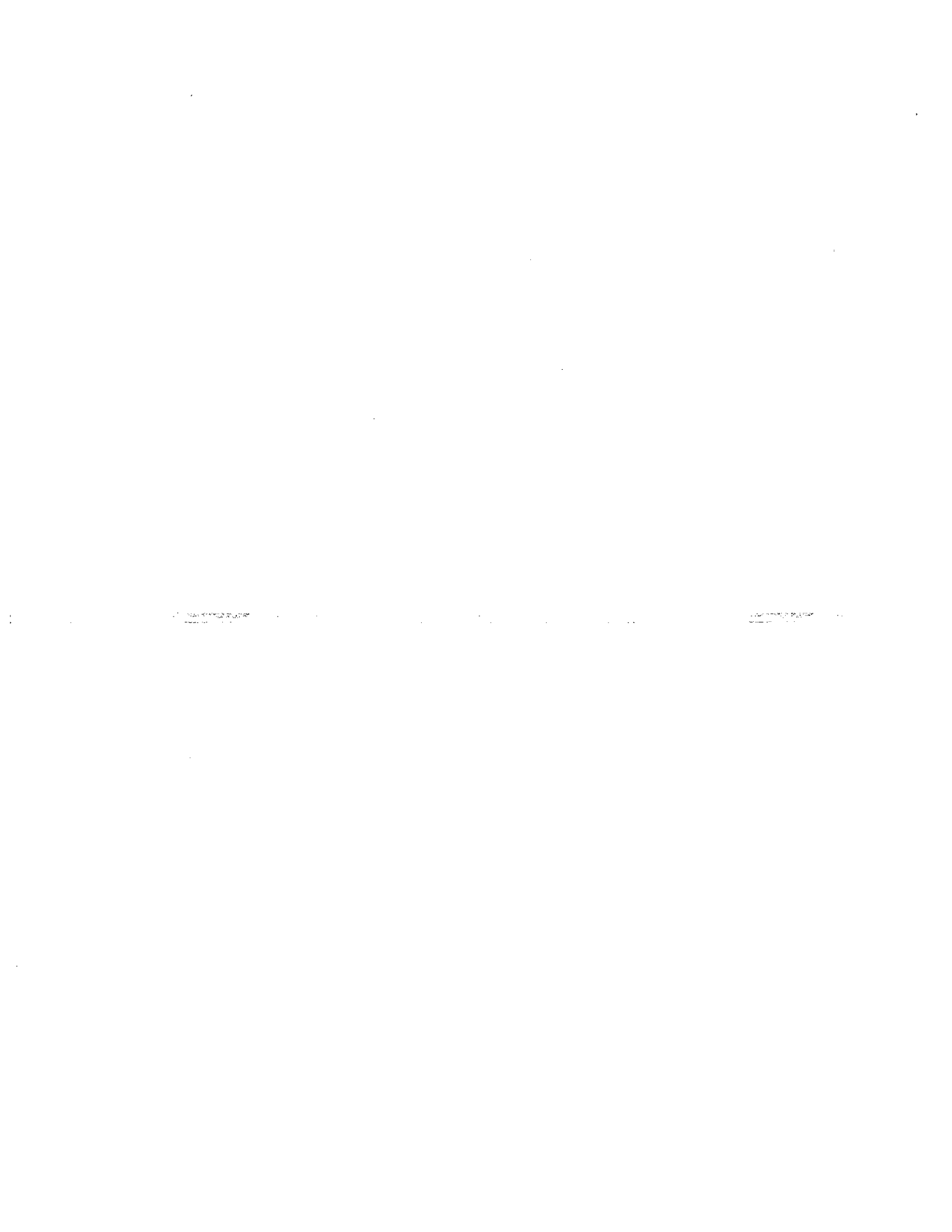
Force and Motion Review

Test Format

Modified True/False; Multiple Choice; Fill in the Blank; Problems; Free-Body Diagrams

Key Vocabulary Words

- Force
- Applied force
- Net force
- Balanced forces
- Unbalanced forces
- Friction
- Static friction
- Sliding/kinetic friction
- Rolling friction
- Fluid friction
- Air resistance
- Gravity
- Normal/support force
- Acceleration due to gravity
- Newton's 1st Law of Motion (aka Law of Inertia)
- Newton's 2nd Law of Motion
- Newton's 3rd Law of Motion



CHAPTER 2: NEWTON'S LAWS STUDY GUIDE

I. Newton's First Law

A. Objects in motion stay in motion, objects at rest stay at rest unless a force acts on it.

B. Also called the Law of Inertia.

1. Inertia is the tendency of an object to resist changes in motion.
2. The more mass an object has, the more inertia it has.
3. Inertia is the reason why you can pull a tablecloth out from beneath objects and the objects still stay on the table.

C. In space, objects will not need any force to keep moving as there is no friction. So the net force on the object would be zero.

D. All the forces that are on an object can be added together to get the net force.

1. If the two forces are equal and opposite, the object won't move and the net force is zero.
2. If the two opposite forces aren't equal, you subtract them and that will tell in what direction and with how much force an object moves.
3. *Write in the following examples.*

Ex. 1 7.5 N ← → 7.5 N net force = _____

Ex. 2 100 N ← → 25 N net force = _____

E. There are different kinds of forces.

1. Friction—the force that opposes motion.
 - a. There are two types of friction... starting and sliding.
 - i. Starting friction is always more than sliding friction.
 - b. Friction is caused by small bumps on the surfaces of two objects touching which causes the objects to get "hung up" on each other.
2. Weight—the force of gravity on mass.
 - a. Mass—how much "stuff" is in an object and doesn't change no matter where the object is.
 - b. Weight can change depending on gravity.
 - c. On Earth, the acceleration due to gravity is 10 m/s^2 . Therefore, use this number in your equation of $F = ma$ for the acceleration whenever you are finding or using weight in the problem.

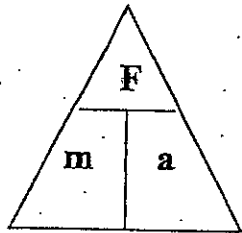
3. Air resistance is another force. It is actually a form of friction as it is going against your motion (down...duh...as you're falling). When air resistance pulling up equals the force of gravity pulling you down, you stop accelerating but you still fall...just at the same speed. This speed is called terminal velocity.
4. Normal force—the force that an object exerts upwards and cancels out the force of gravity (the weight).
 - a. So, if a book weighs 3 N and is put on a table, the table has a normal force of 3 N.
 - b. This is an example of Newton's third law, by the way.

II. Newton's Second Law

A. $F = ma$

1. **F**—force and measured in *newtons (N)*
2. **m**—mass and is measured in *kilograms (kg)*
3. **a**—acceleration and is measured in *meters per second squared (m/s^2)*
4. Therefore, accelerations are caused by unbalanced forces and a constant force would produce a constant acceleration. If the force doubles, the acceleration doubles!!

- B. Use the triangle to solve for whatever missing letter you are looking for. Don't forget your units!! Here's the triangle and here is a special (difficult) problem for you to solve. Good luck!!



You pull on an object with a force of 40 N. There is 20 N of friction in the opposite direction. If the mass of the object is 5 kg, what is the acceleration?

III. Newton's Third Law

- A. For every action, there is an equal and opposite reaction.
 - B. In other words, forces always occur in pairs. So when you catch a ball in a glove, the ball exerts a force on the glove but the glove also exerts a force on the ball.
- IV. Finally, in regards to motion in two directions (tossing a ball in the air while you are riding in a car), *your forward motion does not affect the up and down motion of the ball*. Therefore, if the car is going 45 miles per hour, that means the ball is also going the same speed. Just because you throw it up in the air does NOT mean it stops going 45 miles per hour forward. This is the reason that it lands back in your hand and not in the seat behind you.

REVIEW OF NEWTONS THREE LAWS

1. Define Newton's First Law:
2. The reason why objects slow down is because of _____. If there is no _____, then the object would never stop. So when something is fired into space, it will keep going forever because there is no _____.
3. Define Inertia. If you pull a tablecloth off a table quickly, the objects on the table will stay. Why?
4. Inertia depends on the _____ of an object.
5. What is the difference between mass and weight?
6. In order to determine weight on Earth, you have to multiply the mass by 10 (because of gravity). So, if an object has a mass of 20 kg, what would be its weight? If an object has a weight of 30 N, what would be its mass?
7. Define friction. What is static friction? Kinetic friction? What is stronger, static or kinetic friction?

(13 a)

8. What is a net force? What are balanced forces? If you pull with a force of 20 N to the east and your friend pulls with a force of 30 N also to the east, what is the net force? Suppose your friend pulls with a force of 30 N to the west?

9. Define Newton's Second Law.

10. According to Newton's Second Law, all accelerations are caused by:

11. When something reaches its terminal velocity, what is its acceleration?

12. If the force on an object cuts in half, what happens to the acceleration?

13. Air resistance is a type of _____. So if an object has a weight of 10 N and it encounters an air resistance of 5 N, its net force is: _____ If an object is traveling through space, it will keep going forever because of no _____.

14. Define Newton's Third Law:

15. According to Newton's Third Law, if your foot pushes on the Earth, then:

16. Solve the following problems:
 - a. A 10 kilogram object is moving at 1.5 m/s^2 . What is the force of the object?

 - b. A 30 kg object strikes with a force of 150 N. What was its acceleration?


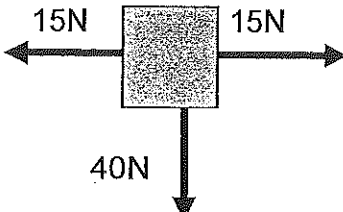
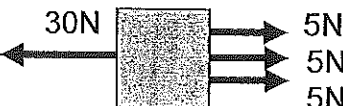
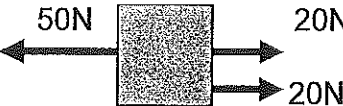
Name _____

Test Review
Newton's Laws

Units: Complete the table below. The first one is done for you.

	<u>Measurement</u>	<u>...is measured in the unit...</u>
a.	Distance	Meters (m)
b.		Newtons (N)
c.		kg
d.		m/s ²
e.	Momentum	
f.	Speed/velocity	
g.	Weight	

Free Body Diagrams: For each diagram or description below, determine the magnitude and direction of the net force.

		
<p>Net Force: _____</p>	<p>Net Force: _____</p>	<p>Net Force: _____</p>
	<p>Fanny Friction is pushing with a force of 100 N to the right. The friction of the surface is 90 N.</p>	<p>Skydiving Sally is falling to the Earth with a force of 300 N. The air resistance she feels is 300 N.</p>
<p>Net Force: _____</p>	<p>Net Force: _____</p>	<p>Net Force: _____</p>

Name _____

Test Review
Newton's Laws

Forces: Use the word bank to complete the following statements.

acceleration	subtract	balanced
air	gravity	sliding
normal	net	friction
Inertia	equal	fluid
reaction	applied	pairs
unbalanced	static	

- Newton's 3rd Law of Motion (action-reaction) tells us that forces always act in _____.
- When two forces are acting in the same direction, we add the forces together. When two forces act in opposite directions, we _____ the forces.
- Combining all the forces together gives us the _____ force.
- If the net force is 0 (zero), then the forces are _____.
- If the net force is greater than 0, the forces are considered _____. This causes changes in the velocity of the object.
- Newton's 1st Law of Motion says that an object at rest wants to stay at rest, and an object in motion wants to stay in motion. This is known as _____.
- _____ is the force that always exists when objects slide against one another.
- It is harder to get a still object to start moving. During this time, you are pushing against _____ friction. Once the object is moving, it is easier to push. During this time you are pushing against _____ friction.
- Newton's 2nd Law of Motion says that force equals mass multiplied by _____.

Name _____

Test Review

Newton's Laws

j. Newton's 3rd Law of Motion states that for every action, there is an _____ and opposite _____.

k. Any push or pull by a person or machine is known as an _____ force.

l. The downward force all objects feel from the Earth is _____.

m. The upward force from the ground, floor, or table that holds up the weight of an object is the _____ force.

n. Any time an object moves through a liquid or gas, the friction is known as _____ friction. _____ resistance is one specific type of fluid friction.

Problems:

1. What force is needed to accelerate a car at a rate of 30 m/s^2 if the car has a mass of 4500 kg?

Unknown:

Formula:

Plug & Chug:

2. What is the acceleration of a 10 kg book being pushed with 50 N of force?

Unknown:

Formula:

Plug & Chug:

Name _____

Test Review
Newton's Laws

3. What is the mass of a falling rock if it produces a force of 147 N?

Unknown:

Formula:

Plug & Chug:

4. If a plane is moving at 3,000 m/s and has a momentum of 85,000 kg m/s, what is the mass?

Unknown:

Formula:

Plug & Chug:

Identify the Law: Identify which of Newton's Laws is being described.

- _____ a. I can throw a ping pong twice as fast as a bowling ball.
- _____ b. When I start pulling on a sled, my dogs fall off the back.
- _____ c. I have to use twice the force to pick up an object with twice the mass.
- _____ d. A bird pushes his wings backwards in order to fly forwards.
- _____ e. If my car quickly comes to a stop, I feel pushed towards the windshield.
- _____ f. A rocket pushes gases out the back to move upward.