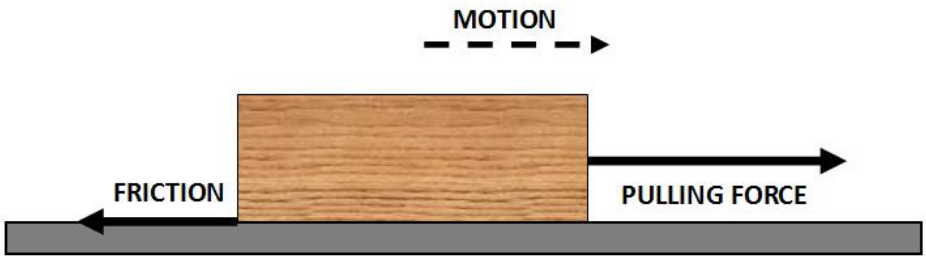
Name _____ Date _____ Period _____

Lab: Forces and Friction

CONCEPTUAL PHYSICS: UNIT 1

Background: Friction is a force that holds back the movement of a sliding object. That's it. Friction is just that simple. You will find friction everywhere that objects come into contact with each other. The force acts in the opposite direction to the way an object wants to slide. If a car needs to stop at a stop sign, it slows because of the friction between the brakes and the wheels. If you run down the sidewalk and stop quickly, you can stop because of the friction between your shoes and the cement.



What happens if you run down the sidewalk and you try to stop on a puddle? Friction is still there, but the liquid makes the surfaces smoother and the friction a lot less. Less friction means it is harder to stop. The low friction thing happens to cars when it rains. That's why there are often so many accidents. Even though the friction of the brakes is still there, the brakes may be wet, and the wheels are not in as much contact with the ground. Cars hydroplane when they go too fast on puddles of water.

Friction is the resistive force acting between bodies that tends to oppose and damp out motion. Friction is usually distinguished as being either **static friction** (the frictional force opposing placing a body at rest into motion) or **kinetic friction** (the frictional force tending to slow a body in motion). In general, static friction is greater than kinetic friction.

Introduction: In this lab you will investigate the factors that affect friction. You will measure **frictional forces** using a spring scale to measure the force. The factors being tested will include the effect of **surface texture**, **weight** and **surface area** contact on friction. In addition you will investigate the difference between "**Static**" and "**Kinetic**" friction.

Materials*:*

- 3 wood blocks (4"x6"x10")
  - wood block with foam rubber side
  - wood block with carpeted side
  - one bare wood block
- 2 20-N spring scale
- 3 equal size books
- Table top

Procedure: Part A-Surface Texture and Friction: Before you begin this section of the lab create a hypothesis describing the effect of different textures on the amount of friction produced. Remember that this should be an "if-then" statement.

Hypothesis:

1.) Attach a 20N spring scale to the hook. All measurements are to be done in NEWTONS.

2.) Lay the wood block **carpet** side down on the table. **Place one book on top of the block**.

3.) VERY VERY slowly and evenly pull on the spring scale horizontal to the table while watching the measurement. Record the **maximum** force applied in Newton's to the block BEFORE it begins to move.

4.) When the block starts to move pull it across the table AT A CONSTANT RATE.

5.) Record the force needed to keep the setup moving AT A CONSTANT RATE. Repeat 3 times.

6.) Repeat steps 1 through 6 using the **bare wood** side and **foam rubber** side

7). Calculate average for each of the surface textures.

TABLE #1: EFFECT OF SURFACE TEXTURE ON FRICTION					
Surface Texture	**TYPE OF FRICTION**	**Trial #1**	**Trial #2**	**Trial #3**	**Average**
Carpet	**Static Friction (N)**				
	Kinetic Friction (N)				
Foam Rubber	**Static Friction (N)**				
	Kinetic Friction (N)				
Bare Wood	**Static Friction (N)**				
	Kinetic Friction (N)				

Procedure: Part B-Weight and Friction: Before you begin this section of the lab create a hypothesis describing the effect of increasing weight on the amount of friction produced. Remember that this should be an "if-then" statement.

Hypothesis:

1.) Attach a 20N spring scale to the wood block.

2.) Lay the wood block flat side down on the bare table. Place **one book** on the top of the wood block.

3.) Pull on the spring scale slowly and gently increasing the force used until the block just starts to move. Record the maximum amount of force needed to get the block moving. Repeat 3 times.

4.) Put **two books** on top of the wood block. Pull on the scale and record the maximum force needed to just get the block moving. Repeat 3 times.

5.) Put **three books** on top of the wood block. Pull on the scale and record the maximum force needed to get the block moving. Repeat 3 times. *Note: You may need 2 spring scales for 3 books.*

6.) Calculate average force for each.

TABLE #2: EFFECT OF WEIGHT ON FRICTION					
Surface Texture	**WEIGHT (# OF BOOKS)**	**Trial #1**	**Trial #2**	**Trial #3**	**Average**
Bare Wood	**1 Book**				
	2 Books				
	3 Books				

Part C: Effects of Surface Area Contact on Friction: Before you begin this section of the lab create a hypothesis describing the effect of surface area and the amount of friction produced. Remember that this should be an "if-then" statement.

Hypothesis:

1.) Place the **bare wood** block with the attached spring scale flat on the wood strip.

2.) Place **two books** on the top of the block.

3.) Slowly pull on the 20N spring scale until the block just starts to move.

4.) Record the maximum force needed to just get the block moving. Repeat the trial 3 times.

5.) Turn the block onto its edge and place two books on top of the block. Balance the books with your hands.

6.) Slowly pull on the spring scale until the block just starts to move.

7.) Record the maximum force needed to just get the block moving. Repeat the trial 3 times.

8.) Calculate average for each test.

TABLE #3: EFFECT OF SURFACE TEXTURE ON FRICTION					
Surface Texture		**Trial #1**	**Trial #2**	**Trial #3**	**Average**
Bare Wood Flat	**Static Friction (N)**				
Bare Wood On edge	**Static Friction (N)**				

Conclusion Questions: (use complete sentences)

1. From Part A, describe how the force of friction changes between smooth and rough surfaces.

2. Define Kinetic and Static Friction.
   Static Friction-

Kinetic Friction-

3. In Part A which force was greater, kinetic or static friction? Why?

4. In Part B, explain how the force of friction changes as the weight pushing the surfaces together changes.

5. Looking at the trend in the data you obtained what would the force of Friction between two objects be if the force pushing the objects together was reduced to zero?

6. In Part C, how does the amount of surface area affect the force of Friction between two objects?

7. On the diagrams below, draw and label force vectors for the three blocks used in Part A (Kinetic Friction). Make sure to draw all of the vectors to **scale**. Include weight, normal force, pulling force, and frictional force

8. What is the net force on the block when you are pulling it with a constant force at a constant speed in a straight line?

9. What do we call this type of equilibrium?

10. Draw and label the force vectors describing the forces acting on the block when it is at rest on the table top.

What is the name given to this type of equilibrium?