Mu Shoe Physics – Guided

PSI Physics – Dynamics

Name_____ Date_____ Period_____

Objectives:

You will determine the coefficient of friction (μ) of an athletic shoe (sneaker).

Background:

Athletic shoes are designed to give the athlete better traction on the field or floor of a gym. Essentially, that means the shoe adds friction so the athlete can turn, shoot, block or what ever is necessary for the sport.

Materials:

- Sneaker
- Various masses
- Spring scales
- Surface such as lab table or floor

Procedure: You will perform 3 sets of measurements for 2 different surfaces.
For each measurement:

You will pull a shoe with a constant velocity with a spring scale parallel to the direction of motion. The reading that you record on the spring scale will give be the applied force, and is equivalent to the friction force that the shoe experiences.

Step by step:
For each surface (you will do 2):

1. Above the data table, write the surface you will be pulling the shoe on.
2. Using a scale, measure the **weight** of the shoe. Record this value in column (1).
3. You will add weight to the shoe. Masses such as 0.5 kg, 1.0 kg, 1.5 kg, etc. work well. Select three (3) different masses. Find the weight of each mass (mg) and record this value in column (2).
4. Add the weight of the block and the added weight. Record this value in column (3)
5. The Normal Force is equal to the *Total Weight* . Copy the *Total Weight* values to column (4).

For each of the added weights:

6. Attach the spring scale to the front lace of the shoe. Pull the shoe at a constant velocity with the spring scale parallel to the direction of motion. The reading that you record on the spring scale will give be the applied force, and is equivalent to the friction force that the block experiences. Record this value in column (5).

Data Collection:

Table 1: Surface: _____

(1) Weight of Shoe (N)	(2) Added Weight (N)	(3) Total Weight (N)	(4) F_{normal} (N)	(5) $F_{app} = F_{friction}$ (N)

Table 2: Surface: _____

(1) Weight of Shoe (N)	(2) Added Weight (N)	(3) Total Weight (N)	(4) F_{normal} (N)	(5) $F_{app} = F_{friction}$ (N)

Analysis:

1. Sketch and label the free body diagram for shoe with added weight.

Graphical Approach:

2. Graph $F_{friction}$ (vertical axis) vs. F_{Normal} (horizontal axis) for the 2 different surfaces. Connect the points with a straight line that goes through the origin..

3. Find the slope of your graph for the 2 surfaces and the shoe, and then write an equation relating $\mathrm{F}_{\mathrm{friction}}$ to $\mathrm{F}_{\mathrm{normal}}$, using μ_k as your slope.

    a. Surface 1:

    b. Surface 2:

Conclusions:

1. Summarize your results:

Surface	μ_k

2. Which surfaces had the smallest and largest coefficient of friction?

3. How did the coefficient of friction relate to the types of surface you used?

4. What happened to the **force of friction** when you increased the weight on the shoe?

5. Give at least two ways to reduce the amount of friction.

For Discussion of the Class's Results:

6. Is there a type of shoe that has the highest coefficient of friction?