Static Friction μ_k

Determine the coefficient of friction for a block as it slides down an incline

Equipment

board/ramp
meter stick
protractor
mass / slider block

To calculate the coefficient of static friction μ_s

1. Attach the **spring scale** to the block.

2. Place the block on a flat surface and **gently pull horizontally** on the spring scale.

3. **Increase the pulling force slowly** until the block *just begins to move*.

4. Record the **maximum force reading** right before motion begins — this is the **force of static friction (F_s,max)**.

5. Repeat five times and record all measurements in the table below.

Table 1: Measurements used to determine the coefficient of static friction

Maximum Force before Motion (N)					

Find the average force.

Find the mass of the block.

Analysis

1. Draw and label a **free-body diagram** of the block showing all forces acting on it just before motion begins.

2. Use the mass of the block to calculate the **normal force**:

3. Calculate the **coefficient of static friction**, **μ_s**.

Kinetic Friction μ_k

To calculate the coefficient of kinetic friction μ_s

1. Keep the block attached to the spring scale.
2. Pull the block **horizontally at constant speed**. (Adjust your pull until the scale reading stays steady.)
3. Record the **steady reading** of the spring scale — this is the **kinetic friction force (F_k)**.
4. Repeat this five times and record the times in the table.

Table 1: Measurements used to determine the coefficient of kinetic friction

Force at Constant Speed (N)					

Find the average force.

Find the mass of the block.

Analysis

1. Draw and label a **free-body diagram** of the block moving at constant velocity.

4. Use the mass of the block to calculate the **normal force**:

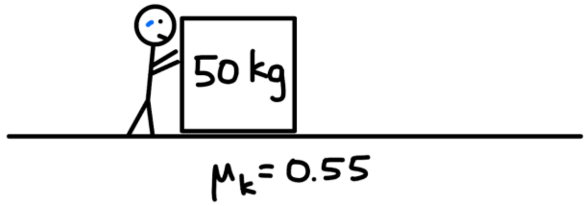
2. Find the **coefficient of kinetic friction, μ_k**.

Reflection

1. Why is μ_s generally larger than μ_k for the same surfaces?
2. How could you reduce the friction between the surfaces?
3. Would adding mass to the block change μ_s or μ_k? Explain.
4. How does surface roughness influence your results?
5. Suppose the scale reads 2.4 N for a 0.50 kg block. What are μ_s and μ_k?
6. Compare your experimental values to published ones (e.g., wood-on-wood, metal-on-wood).
7. What sources of error could affect your results?
8. Sketch graphs of frictional force vs. applied force — label the transition between static and kinetic friction.

Friction Problems

1) An 50 kg object is pushed with a force of 300 N. The coefficient of kinetic friction between the object and the ground is 0.55. Determine the acceleration of the object.



2) Snorlax has a mass of 460 kg. The coefficient of static friction is 0.70 and the coefficient of kinetic friction is 0.60.
   a) If Ash and his friends can exert a force of 2600 N, will they be able to move Snorlax out of the way?
   b) If so, what will be its acceleration? If not, how much additional force will it require?

3) An object is sliding with an initial velocity of 10 m/s across a rough surface (μ_k = 0.70). How much time will it take for the object to come to rest?