Lab – Friction and Forces on an Incline

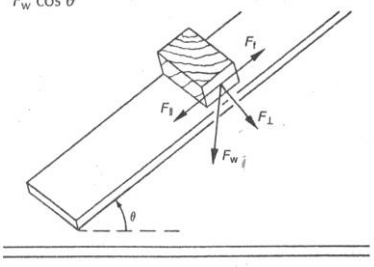
Purpose: To investigate friction and measure the coefficients of friction.

Materials: spring scale, object: block of wood or similar object, flat board, string, masking tape, protractor.

Procedure:

1. Select an object and a flat board for this experiment. Describe the object and the surface of the board.
2. Tape the string to the end of the object. Hang the object by the string from the spring scale. Measure the weight of the object.
3. Place the flat board on a horizontal surface. Hold the spring scale, and with the string (or hook) held parallel to the level board, pull the object along the board at a constant speed. With the spring scale, measure the amount of force required to keep the object moving at a uniform rate. Repeat this procedure several times (min. 3), average your results – this is the value for the force of sliding friction between the surface of the board and the surface of the object.
4. Detach the spring scale from the object and place the object on the flat board. Slowly lift one end of the board. Continue increasing the angel of the board with the horizontal until the object starts to slide. Use the protractor to measure this angle. Record the value of this angle as the angle of static friction. The tangent of this angle is the coefficient of static friction.
5. Move the object to one end of the board. Again, slowly lift this end of the board while your lab partner lightly taps the object. Adjust the angle of the board until the object slides at a constant speed after it has received an initial light tap. Use the protractor to measure this angle and record it as the angle for sliding (kinetic) friction. The tangent of this angle is the coefficient of sliding (kinetic) friction.
6. Calculate the coefficients of static and sliding friction for the object used.

$$\mu = \frac{F_f}{F_\perp} = \frac{F_\parallel}{F_\perp} = \frac{F_w \sin\theta}{F_w \cos\theta} = \tan\theta.$$



7. Repeat the experiment with another side of the object. Your first experiment should use the vinyl side of the block, and the second experiment should use the wood side.

	Description			
Object				
Surface				
Weight of object (N)				
Force of sliding friction (N)	1	2	3	Average
Motion	Angle (°)		$\mu = \tan \theta$	
Static				
Sliding				

Questions:

1. Explain any differences between the values for the coefficients of static and sliding friction.
2. Using the average force of sliding friction from the data, calculate the coefficient of sliding friction. Show work and compare it to the coefficient that was calculated using the angle – finding a percent difference. Explain the difference.
3. A brick is positioned first with its largest surface in contact with an inclined plane. The plane is tilted at an angle to the horizontal until the brick just begins to slide, and the angle, θ, of the plane with the horizontal is measured. Then the brick is turned on one of its narrow edges, the plane is tilted, and θ is again measured. Predict whether there will be a difference in these measured angles. Explain your answer in terms of the equation for the force of friction. Is the coefficient of static friction affected by the area of contact between the surfaces?
4. A brick is placed on an inclined plane which is tilted at an angle to the horizontal until the brick just begins to slide. The angle, θ, of the plane with the horizontal is measured. Then the brick is wrapped in waxed paper and placed on a plane. The plane is tilted, and θ is again measured. Predict whether there will be a difference in these measured angles. Explain.
5. From the previous two answers, determine the factors that influence the force of friction.
6. While looking for a set of new tires for a car, you find an advertisement that offers two brands of tires, brand X and brand Y, at eh same price. Brand X has a coefficient of friction on dry pavement of 0.90 and on wet pavement of 0.15. Brand Y has a coefficient of friction on dry pavement of 0.88 and on wet pavement of 0.45. If you live in an area with high levels of precipitation, which tire would give you better service? Explain.