Lab – Investigation Friction – WITH DATA

One of the forces you have studied is friction. Friction is a retarding force. This means it lessens the effect of other forces. Friction, therefore, causes a “loss” of useful energy in many mechanical devices. This energy, of course, is not really lost but is transferred to heat energy at the point of contact. In this lab you will explain why the movement of one object over another produces heat and how changes in design can reduce friction. You will also learn how surface area, texture, and weight influence friction.

Purpose – To investigate some factors that affect friction.

Materials – spring scale, block of wood with a metal screw eye in it, wood sliding surface, and a sandpaper sliding surface.

Hypothesis 1 – If the area of the wood block that is in contact with the sliding surface is increased, then the amount of force needed to slide the block will (increase, decrease, stay the same). Circle one. 1 pt.

Procedure – Record all data on the data sheet.
1. Suspend the wood block from the spring scale and record its weight in Newtons.
2. Measure the surface area of sides A and B of the wood block in cm$^2$ and record.
3. Place the block on the wood sliding surface with the larger surface (side A) downward. See diagram below.
4. Keep the spring scale level with the table and pull the block along the wood surface. Record the force needed to start the block moving and the force needed once the block is already sliding along the wood surface in Newtons.
5. Repeat steps 3 and 4 so that you have 3 trials. Calculate the average force for starting and sliding friction.
6. Repeat steps 3 – 5 with the smaller surface (side B) downward.

Hypothesis 2 – If I increase the weight of the object without changing the surface area, then the amount of force needed to slide the block will (increase, decrease, stay the same) Circle one. 1 pt.

7. Now borrow blocks from a lab group near you and repeat steps 3 – 5 using 2 and then 3 blocks stacked on top of each other. Side A must be down for this.

Hypothesis 3 – If I make the sliding surface rougher, then the amount of force needed to slide the block will (increase, decrease, stay the same). Circle one. 1 pt.

8. Repeat steps 3 – 6 except slide the block over the sand paper instead of the bare wood surface.
DATA 1 pt.
Weight of 1 wood block _____ Newtons   Area of Side A _BIG SIDE
Weight of 2 wood blocks ___~x2___ Newtons
Weight of 3 wood blocks _____~x3__ Newtons   Area of Side B __NARROW SIDE

BARE WOOD SLIDING SURFACE

<table>
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<tr>
<th>Trial</th>
<th>Side A down</th>
<th>Starting Friction (N)</th>
<th>Sliding Friction (N)</th>
<th>Side B down</th>
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SANDPAPER SLIDING SURFACE

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CONCLUSION QUESTIONS

1. How is the starting friction different from the sliding friction?  1 pt.

2. Look at Hypothesis 1 and your results and then write a statement which tells how surface area affects the sliding force of friction.  2 pts.

3. Look at Hypothesis 2 and your results and then write a statement which tells how weight affects the sliding force of friction.  2 pts.

4. Look at Hypothesis 3 and your results and then write a statement which tells how the texture of the sliding surface affects the sliding force of friction.  2 pts.

5. Why is the starting friction always greater than the sliding friction?  1 pt.

6. List two situations in which friction can be helpful?  2 pts.

7. List 2 ways you could have reduced the friction between the wood block and the sliding surface in this lab.  2 pts.


9. Which would require more effort, pushing a 1 kg box across an ordinary floor or pushing a 2000 kg box across a frictionless floor? EXPLAIN YOUR ANSWER.  2 pts.
Read pages 331 – 343 and answer the following questions. **SHOW YOUR WORK** if a calculation is required.

1. How are acceleration and force related?
   The greater the force, the more acceleration.

2. State Newton’s 2nd Law of Motion.
   Force = mass x acceleration

3. Do the 2 practice problems on the bottom of page 332.
   1. 66 kg x 1 m/s^2 = 66N
   2. 1000 kg x 9.8 m/s^2 = 9800 N

   For every action there is an equal and opposite reaction.

5. Complete the following statement. ALL FORCES COME IN PAIRS.

6. Explain how the floor of this room can exert a force.
   All materials “bounce,” so the floor “gives” when you step on it and then pushes back on you.

7. Answer the question by Figure 13-14.
   Newton’s 3rd Law

8. How does Newton’s 3rd Law allow a bird to fly?
   Bird exerts force on air – Air pushes back on bird’s wings propelling bird forward.

9. Explain why a bowling ball and a marble that are dropped from the same height will hit the ground at the same time.
   Both will hit at the same time. Gravity pulls on all objects with the same force.

10. How fast will an object be going after falling for 10 seconds?
   \[ 9.8 \text{ m/s}^2 \times 10\text{s} = 98 \text{ m/s} \]

11. Answer the question in Figure 13 –19.
   The leaf has more air resistance than the rock.
12. Give an example of how air resistance (fluid friction) is helpful.  
   Parachutes, sail boat, planes fly.

13. What keeps the planets in their orbits around the sun?  
   gravity

14. What does Newton’s Law of Universal Gravitation say?  
   All objects in the universe attract each other by force of gravity.

15. Upon what 2 things does the force of gravity depend?  
   Mass of object – more mass = more gravity  
   Distance between objects – less distance = more gravity

16. Define weight and tell what units are used to measure weight.  
   Weight = force of gravity on an object measured in Newtons.

17. How are mass and weight different?  
   Weight of an object can change depending on gravity while mass is the amount of matter and doesn’t change.

18. How are mass and weight related?  
   Weight = mass x acceleration of gravity.

19. Suppose the acceleration due to gravity on the planet, Zorb, is 20 m/s/s.  What is the weight of a 100 kg Zorbian?  
   Wt = 100 kg x 20 m/s² = 2000 Newtons