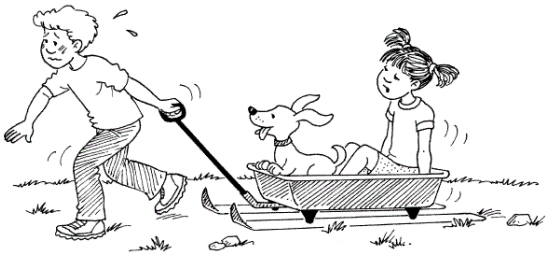
Name _____ per_____ due date_____ mail box_____

FRICTION LAB

VECTOR DIAGRAM



Procedure

- Move your wooden block from start to finish with the least amount of force.
- You will drag a wooden block by hooking the spring scale to it at one end and pulling it across various surfaces a distance of 40cm. You must keep the largest area surface of the block in contact with the friction surface at all times.
- The block must be dragged at an even pace over each surface. You can tell if you are dragging it evenly over the surface by looking at the spring scale. As you drag, the force should measure about the same for the entire 40cm. This may take some practice, but try and get it right.

Materials:	wooden blocks	wooden dowels	tape	meter sticks	spring scales
wax paper	sand paper	paper towels	linen	other surface?	

a. Measure 40cm of length on the lab table surface with the meter stick and mark the start and finish with masking tape.
b. Start with the surface that was assigned to your group. Make sure you record your data in the correct place on the data table throughout the lab.
c. Make sure your spring scale pointer is zeroed - if not see your teacher.
d. Place the block at the beginning of the 40cm, attach the spring scale and begin dragging
e. If you complete a station before Burns says switch, go onto the multiple choice and short answer section.
f. Pay extra attention to the force required to get the block moving. This is the **initial** force required to move the block (momentum of inertia). Disregard this number. Option, can be recorded below.
g. Instead, record the **constant** frictional force – this is the force that remains constant while dragging for 40cm. You will then find the average of the constant force.
h. Complete trials and record data at least 3 times for each station.

1. Question – How much of an effect will the different surfaces have on the applied force (F_{app}) requirements to pull the block across them?

Hypothesis - _____

_____

What is the **independent** variable in this experiment? _____

What is the **dependent** variable in this experiment? _____

Surface Type	**Trial 1** **Friction Force (N)**		**Trial 2** **Friction Force (N)**		**Trial 3** **Friction Force (N)**		**Average Constant Frictional Force**
	Initial	Constant	Initial	Constant	Initial	Constant	
Lab Table							
Sand Paper							
Linen							
Dowels							
Wax paper							
Paper towels							

Analysis and conclusion questions, COMPLETE sentences and legible –

2. What surface requires the least amount of force to move the block? Explain quantifiably using the data you collected. _____

3. What was the difference in applied frictional force for the highest verses the lowest frictional surface. Give a number. _____

4. With water say added to the paper towel surface, elaborate on the other types of frictional forces taking place. How can water increase friction in this instance.

_____

_____

5. Find the gravitational force on your block. Utilize triple beam balance to find mass?

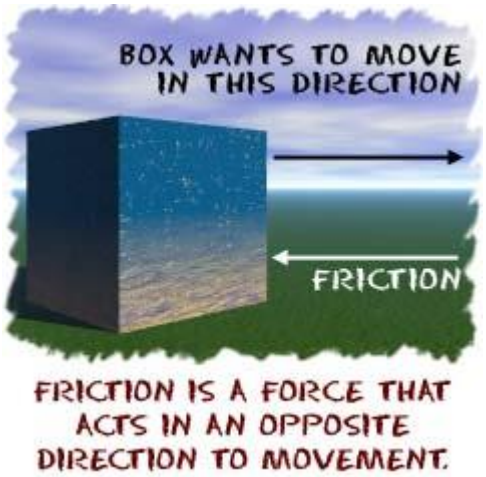
WRITE THE FORMULA / SHOW WORK / INCLUDE UNITS / BOX ANSWER

6. Explain another way you could find the force required to pull the block across a surface using Newton's Second Law.

_____

_____

Friction Basics



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. Note vector diagram at right. 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 or along a wet patch of recently mopped floor? 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. Reduced friction occurs with cars when it rains for example too. That's why there are increased accidents just after rains. Even though friction is still present, it is reduced. Brakes can be wet, and wheels not in direct contact with the ground, due to a thin film of water. Cars can **hydroplane**, meaning slide along atop this film or puddle of water for great distance unable to turn due to reduced friction.

Friction and Gases

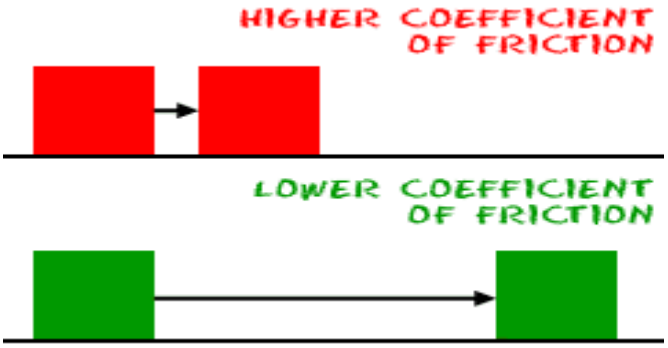
Friction *technically* only happens with solid objects. When it involves liquids or gases, we refer to it as resistance to motion, or sometimes it may be referred to as fluid friction. This doesn't involve sliding surfaces like typical friction does, but is instead the kind of resistance you get if you try to push your way through a crowd. It's a colliding situation, not a sliding one. If the gas is air, this is referred to as air resistance.

If you were in the space shuttle and re-entering the atmosphere, the bottom of the shuttle would be getting very hot. The collisions that occur between the molecules of the air being compressed by the shuttle, heat up the air AND the shuttle itself. The temperature on the top of the shuttle is also warm, but nowhere near the temperatures found on the bottom. This is due to friction arguably yes, but to be more correctly classified as air resistance not contact friction like we are studying in this lab.

Friction and Liquids

Although liquids offer resistance to objects moving through them, they also smooth surfaces and can even reduce friction, think WD-40. Liquids tend to get thinner (less viscous) as they are heated. This is like the *viscosity* of the oil you put in your car. Car engines have a lot of moving parts, and they rub on each other. The rubbing produces friction and the result is heat. When oil is added to a car engine, the oil sticks to surfaces, and helps to decrease the amount of friction and wear on the parts of the engine. An engine that runs hotter requires a more viscous oil in order for it to stick to the surfaces properly.

Measuring Friction



Measures of friction are based on the type of materials that are in contact. Concrete on concrete has a very high **coefficient of friction**. That coefficient is a measure of how easily one object moves in relationship to another. When you have a high coefficient of friction, you have a lot of friction between the materials. Teflon on most things has a very low coefficient. Teflon is used on surfaces where we don't want things to stick; such as pots and pans. Scientists have discovered that there is even less friction in your joints than in Teflon! Thus the coefficient of friction in say a knee or elbow joint is an extremely low number in deed.

_____ 1. Friction is a force that resists the movement of objects in contact with one another. This force acts in a specific vector to the direction of motion. Which way is it?

A. Opposite
B. The same
C. The direction of push
D. The direction of pull

_____ 2. This is what can happen when a car or something similar moves at a high rate of speed over a wet surface.

A. hydraulics
B. hydrofracking
C. friction increases
D. hydroplaning

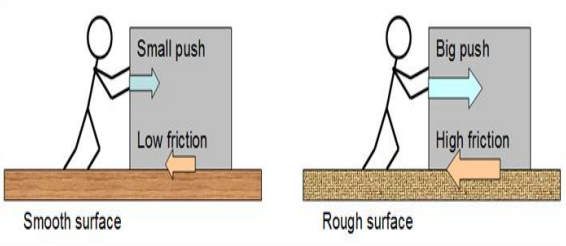
_____ 3. When friction involves fluids it is referred to technically as _____ rather than friction.

A. inert force
B. opposition force
C. resistance
D. water cohesion

_____ 4. Car engines that run hotter tend to have higher coefficients of friction between their moving parts. To reduce friction they need _____

A. less viscous oil to lower the coefficient of friction between moving parts.
B. less viscous oil to increase the coefficient of friction between moving parts.
C. more viscous oil to lower the coefficient of friction between moving parts.
D. more viscous oil to increase the coefficient of friction between moving parts.

_____**5.** Consider the image at right. Strictly speaking, if we compare the magnitudes of both vector force arrows in both diagrams do these boxes appear *balanced* or *unbalanced*?



A. balanced **C.** both
B. unbalanced **D.** neither

_____**6.** Assuming the mass is the same for each box which will require greater force to move?

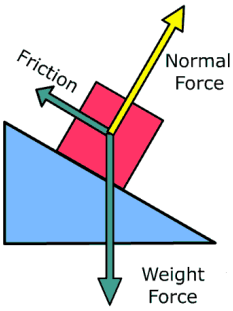
A. Box on smooth **C.** Same force
B. Box on rough **D.** Need more information

Reference

For the following, circle number(1. or 2.) that best fits images above and is correct.

1. In image **A** (skier), weight force (gravity) is greater than the force of friction resulting in motion.

2. In image **A**, the weight force is less than the force of friction resulting in motion.



Which is correct circle number(3. or 4.)?

3. In image **B** the friction, normal and weight force have a resultant net force which is unbalanced.
4. In image **B** the friction, normal and weight force have a resultant net force of zero.

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Which is correct circle number(5. or 6.)?

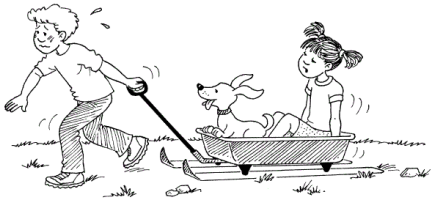
5. There is no frictional force in image **A**, resulting in motion from the force of gravity.
6. There is frictional force in image **B** balancing out with weight and normal force.

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _

7. Sketch a complete vector diagram (F_{app} / F_k / F_g / F_n) with the proper lab data here:

Utilize notes from front cover.

Bonus provide a witty caption for the young girl being pulled by the boy. Relate it to friction of course. Appropriate and funny get a pt! ☺



If absent and unable to schedule a lab make up time, fill in your data table from the one below. Then complete assignment. See me if you have questions you are unable to complete.

Data Table -

Surface Type	Trial 1 Friction Force (N)		Trial 2 Friction Force (N)		Trial 3 Friction Force (N)		Average Constant Frictional Force
	Initial	Constant	Initial	Constant	Initial	Constant	
Lab Table	0.5	0.6	0.7	0.6	0.7	0.7	$0.6\overline{3}$ N
Sand Paper	1.1	1	1.2	1	1.1	1	1 N
Linen	1.5	1.4	1.5	1.3	1.5	1.3	$1.\overline{3}$ N
Dowels	0.2	0.1	0.2	0.1	0.1	0.1	0.1N
Wax paper	0.5	0.4	0.6	0.5	0.5	0.4	0.43N
Paper towels	0.5	0.4	0.5	0.4	0.4	0.4	0.4N

Surface Type	Trial #1	Trial #2	Trial #3	Averages
	Friction Force (N)	Friction Force (N)	Friction Force (N)	Friction Force (N)
Lab Surface	0.5	0.6	0.7	0.6
Sand Paper	1	1	1	1
Shelf Liner	1.4	1.3	1.3	1.3
Pencils	0.1	0.3	0.2	0.2
Wax Paper	0.5	0.5	0.6	0.53
Paper Towels	0.5	0.4	0.5	0.46