PHYSICS
EXPERIMENT 2:

# The Frictional Force

/30 = %

Name:_____ Date:_____

Partners: _____

1. **PURPOSE:** To study the force of friction.

2. **HYPOTHESIS: (SKIP)**

3. **PROCEDURE:**

| APPARATUS: | MATERIALS: |
|---|---|
| 5 wooden blocks<br>Fisher Scientific<br># S40916 or equivalent<br>1 spring balance | aluminum foil<br>brown bag paper<br>¼ or ½ inch foam |

**NOTE**
Before using the spring balance make sure it is reset to zero.

Make sure the blocks are numbered 1, 2, 3, 4 and 5 so they may be identified.

➲ **PART-A**: Coefficient of friction.

Does the coefficient of friction depend upon the weight? Let's find out!


Step-1: Weigh block-1 and record the weight in the table below.
Step-2: Place the block with its largest face down and attach a spring balance to it.
Step-3: Pull gently on the spring balance so as to slide the block at ***constant velocity*** across the horizontal surface. Make sure the balance remains horizontal and does not touch the horizontal plane while you pull on the balance.
- ***Hint***: Practice a few times pulling the block so that it moves evenly and very slowly.

Step-4: While the block is moving smoothly, have your partner read the balance and record the value in the table below.
- ***Note***: When the block moves at constant velocity, the applied force on the balance equals the frictional force.

Step-5: Using the formula f = kN, calculate and fill-in the coefficient of friction.
Step-6: Weigh block-2 and record the sum of block-1 ***plus*** block-2 in the table below.
Step-7: Place block-2 on top of block-1 then repeat steps 3 to 5 above.
Step-8: Using the formula for friction, calculate and fill-in the coefficient of friction. (2)

| **Blocks** | **Weight** (newtons) | $\mathbf{F_A}$ (newtons) | **k** ($F_A$/weight) |
|---|---|---|---|
| 1 | | | |
| 1 + 2 | | | |

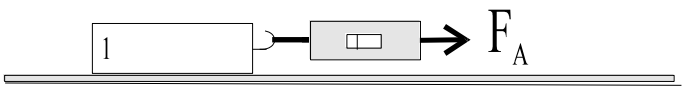
✍ 1) Does the coefficient of friction depend upon the weight? Explain using your results. (2)

_____

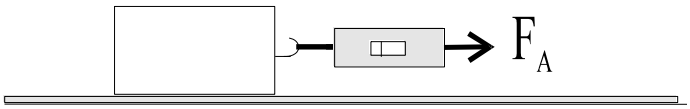
_____

➲ **PART-B**: Surface area

Does the frictional force depend upon the surface area? Let's find out!



Step-1



Step-4

Step-1: Place block-1 with its largest face down and attach a spring balance to it.
Step-2: Pull gently on the spring balance so as to slide the block at ***constant velocity.*** across the horizontal surface. Make sure the balance remains horizontal and does not touch the horizontal plane while you pull the balance.
Step-3: While the block is moving smoothly, have your partner read the balance and record the value on the line labeled "Large surface" in the table below.
Step-4: Place the block on its side (as shown above) and again gently pull on the spring balance so as to slide the block at ***constant velocity***
Step-5: While the block is moving smoothly, have your partner read the balance and record the value on the line labeled "Small surface" in the table below. (2)

| **Area facing horizontal plane** | **Frictional force** (newtons) |
|---|---|
| Large surface | |
| Small surface | |

✍ 2) Does the force of friction depend upon the surface area? Explain using your results. (2)

_____

_____

➲ **PART-C**: Velocity

Does the frictional force depend upon the velocity? Let's find out!


Step-1: Place block-2 on top of block-1 as shown above.
(We will use two blocks so as to obtain a slightly greater frictional force)
Step-2: Attach a balance to block-1.
Step-3: Pull gently on the spring balance so as to slide the block at ***constant velocity***.
Step-4: While the block is moving smoothly, have your partner read the balance and record the value on the "Slow" velocity line in the table below.
Step-5: Again pull gently on the spring balance so as to slide the block at ***constant velocity*** a little faster than in the previous step.
Step-6: While the block is moving smoothly, have your partner read the balance and record the value on the "Medium" velocity line in the table below.
Step-7: Yet again pull on the spring balance so as to slide the block at ***constant velocity*** but with a faster velocity.
Step-8: While the block is moving smoothly, have your partner read the balance and record the value in the "Fast" velocity line in the table below. (3)

| **VELOCITY** | **FRICTIONAL FORCE** (newtons) |
|---|---|
| Slow | |
| Medium | |
| Fast | |

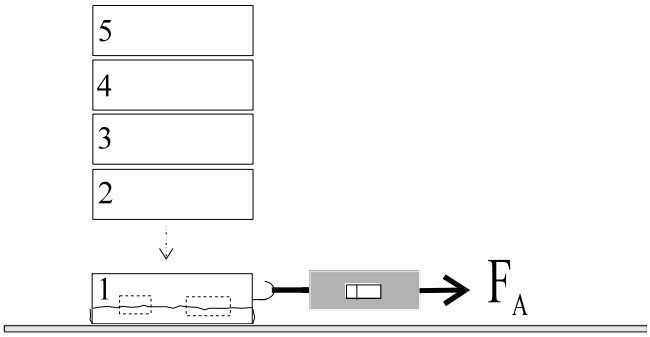
✍ 3) Does the force of friction depend upon the velocity? Explain using your results. (2)

_____

_____

➲ **PART-D**: Nature of surfaces in contact

Does the force of friction depend upon the nature (type) of surfaces in contact? Let's find out!




Step-1: Attach a spring balance to block-1 and pull gently on the spring balance so as to slide the block at ***constant velocity***.
Step-2: While the block is moving smoothly, have your partner read the balance and record the value in the table below.
Step-3: Repeat steps 1 and 2 above, each time adding another block (2, 3, 4, and then 5) on top of block-1.
Step-4: Tape a piece of brown bag paper underneath block-1.
Step-5: Repeat steps 1, 2 and 3 above with the paper as the contacting surface.
Step-6: Remove the paper and tape a piece of aluminum foil underneath block-1.
Step-7: Repeat steps 1, 2 and 3 with the aluminum foil as the contacting surface.
Step-8: Remove the aluminum foil and place a piece of foam underneath block-1.
↳ ***Note***: You need not tape the foam (it will stay underneath block-1).
Step-9: Repeat steps 1, 2 and 3 with the foam as the contacting surface.

Force of friction in newtons (5)

| **BLOCKS** | **WOOD** | **PAPER** | **ALUMINUM** | **FOAM** |
|---|---|---|---|---|
| 1 | | | | |
| 1+2 | | | | |
| 1+2+3 | | | | |
| 1+2+3+4 | | | | |
| 1+2+3+4+5 | | | | |

✍ 4) Does the force of friction depend upon the nature of the contacting surfaces? (Explain using your results. (2)

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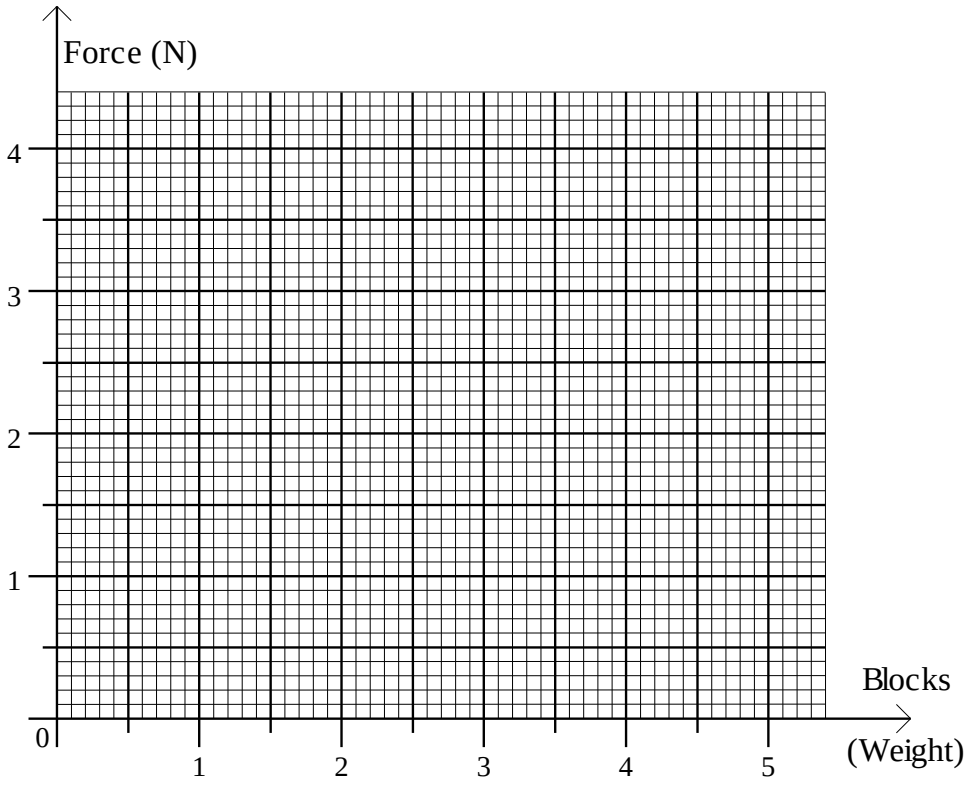
✍ 5) Using the data from the table in **PART-D** above, plot the force of friction versus the number of blocks ***both*** for the ***WOOD*** surface and for the **FOAM** surface. (5)




✍ 6) What does the slope of your graph represent? (1) _____

✍ 7) State two factors which influence the force of friction: (2)

_____

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✍ 8) State two factors which ***do not*** influence the force of friction: (2)

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◆ ◆ ◆ ◆ **End of experiment-2** ◆ ◆ ◆ ◆