ACTIVITIES

CLASS 9

CHAPTER 9 FORCE AND LAWS OF MOTION

NCERT Class 9 Science Lab Manual – Relationship Between Weight of a Body and Force Required to Just Move it

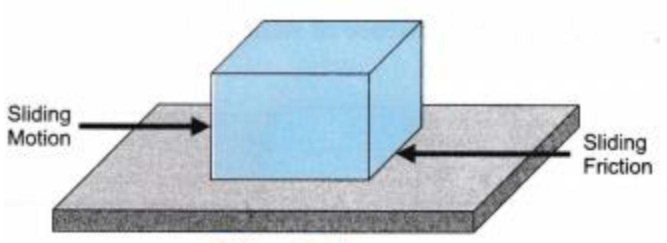
Introduction

1. **Friction** is a force that is created whenever two surfaces move or try to move across each other.
2. Friction always opposes the motion. Friction is dependent on the texture of both surfaces and on the contact area of two bodies.
3. On a leveled surface, the normal force is always equal and opposite to the weight of the object.
4. The force of friction depends upon both surfaces in contact and the normal force.
5. When the force is applied on an object to overcome its static friction, this force is called force of static friction.
6. To stop a moving object, a force must act in the opposite direction to the direction of motion. The force that opposes the motion of an object is called friction.
7. The maximum value of force of friction, acting between the two solid surfaces just before the object sets into motion is called limiting force of friction.
8. Limiting friction acts tangential to the surfaces in contact in opposite direction of motion.

Types of Friction

1. **Sliding friction:** When the object is kept on a surface and pushed with a force to slide on the surface, is called sliding friction. The weight of the object and the type of surface on which it has to move will determine the amount of

force required to slide it. The weight of the object also decides the force it will take to slide. As heavy object will exert more pressure on the surface hence the sliding friction will be greater.



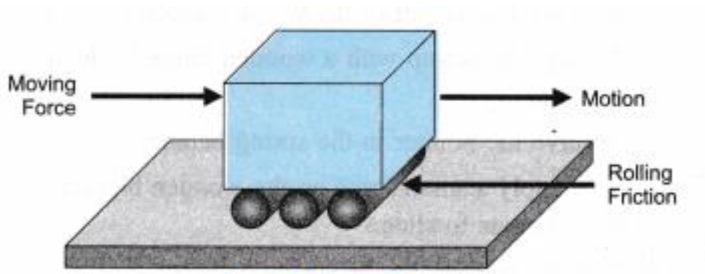
Sliding Friction

2. **Fluid friction:** All substances that flow are called the fluids. Air, water and oil are all fluids. When fluids offer resistance to the flow or motion of the bodies it is called fluid friction. As an object falls, air resistance pushes the object

Fluid Friction

upward.

3. **Rolling friction:** When an object rolls on a surface, the contact between the rolling body and the surface is called rolling friction. E.g., when riding a cycle the contact between the tires rolling on the road provides the rolling friction. The force needed to overcome this rolling friction is always less than the sliding friction. Hence, by reducing the surface of contact between two bodies its friction can be reduced.



Rolling Friction

EXPERIMENT

Aim

To establish a relationship between the weight of a rectangular wooden block lying on a horizontal table and the minimum force required to just move it using a spring balance.

Materials Required

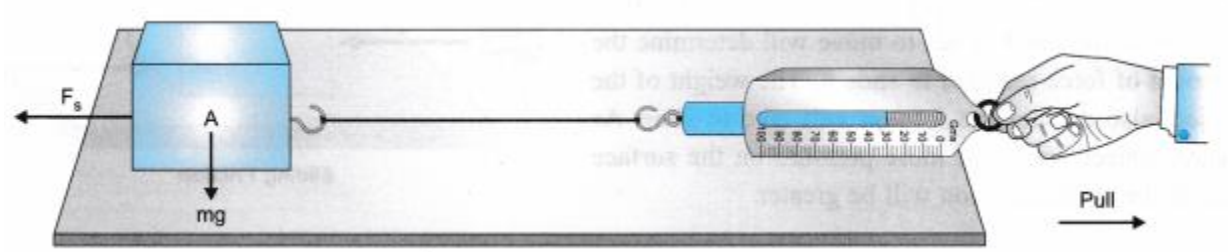
1. A bench, a wooden slab, a string, slotted weights, weight box, a spring balance etc.

Specific Objectives

1. Learn about the force in taut strings called as Tension.
2. Learn about the presence of friction in an object even at rest – Static Friction.
3. Learn about the way the tension changes as more and more weight is added to the pan.
4. Learn about how the static friction varies as more and more weight is added to the pan.
5. Learn to handle a set-up with vertical and horizontal movement.

Theory

1. The force of friction always acts in a direction opposite to the direction of applied force. As the force applied on the wooden block to be moved increases, the force of friction also increases accordingly to balance it. This indicates the presence of static friction—friction when an object is at rest.



2. But the force of friction can increase upto a certain limit. Once the applied force exceeds this limit, the object moves. The maximum value of force of friction, acting between the two solid surfaces just before the object sets into motion is called limiting force of friction or limiting friction. The force is directly proportional to the weight of the object.

Procedure

1. Find the range and the least count of the spring balance.
2. Measure the weight of the wooden block using a spring balance.
3. Arrange the set-up with a wooden block in the horizontal surface and connect it with a spring balance as shown
4. Observe the pointer in the spring balance.
5. Now apply a small force on the wooden block by pulling the spring balance. Gradually increase the force till the block begins to slide.
6. Note the reading on the spring balance.
7. Repeat the experiment with increasing weight of 50 g on wooden block and record your observations.

Observations

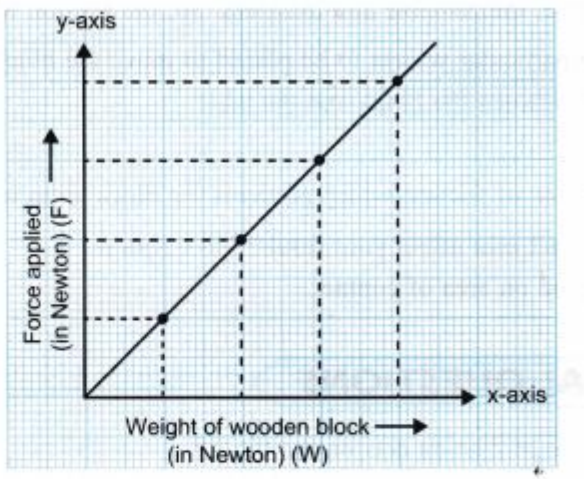
1. Range of the spring balance = 0 – 500 g = 0 – 5 N
2. Least count of the spring balance = 10 g
3. Mass of the wooden block with hook, R = 50 g
4. Value of ‘g’ = 9.8 m/s^2

S.No.	Mass placed on the wooden block (q)	Total weight of wooden block (W = q + R)	Total Force required to pull the block (F) (Reading on Spring balance)	F/W
1.	0	50 g i.e. 0.5 N	0.01 N	0.02
2.	50 g	100 g i.e. 1 N	0.02 N	0.02
3.	100 g	150 g i.e. 1.5 N	0.03 N	0.02

4.	150 g	200 g i.e. 2 N	0.04 N	0.02
5.	200 g	250 g i.e. 2.5 N	0.05 N	0.02

Graph

1. Plot a graph between weight of wooden block, W on V axis and the reading on spring balance, F on 'y' axis.
2. The graph obtained is a straight line as shown in the figure.



Result

1. The force required was found to increase with the increase in the weight of the block.
2. The ratio F/W is constant.
3. The constant ratio of F/W and the straight line graph indicates the maximum force required to just move the block is directly proportional to the weight of the block.

Precautions

1. Reading in spring balance should be noted as soon as the wooden block starts moving.

2. The horizontal surface must be clean and dry.
3. The spring balance should not touch the wall or any surface.
4. The force applied on the wooden block by pulling the string should be gently and gradually increased.
5. The string should be inextensible.
6. The string should be kept horizontal while the force is applied on the block.

VIVA VOCE

Question 1:
Can a mass be moved using a string which is not taut?
Answer:
No, taut string has tension.

Question 2:
What is the SI unit of tension?
Answer:
Newton, as tension is a force.

Question 3:
Why does the block not move if we pull the spring balance with less force?
Answer:
Due to the presence of friction on the block.

Question 4:
Is friction experienced by the block a constant force?
Answer:
No, it increases from zero to a particular value equal to the weight at which the slab slides.

Question 5:
In what way dust affects our reading?
Answer:
Dust increases the friction.

Question 6:
Will your result hold good if the string is heavy?

Answer:
No, as the tension varies from point to point in the string if it is heavy.

PRACTICAL BASED QUESTIONS

Question 1:
Why is the tension on the vertical and horizontal string equal?
Answer:
The string is incompressible, inextensible and massless. So, the tension will be the same at both the sides.

Question 2:
Why is it necessary for a particular weight to be placed to move the block?
Answer:
To overcome the friction between the block and the table.

Question 3:
What is limiting friction?
Answer:
The maximum value of force of friction which prevents the block from moving is called limiting friction.

Question 4:
Does the value of the contact area affect your result? Give reason

Question 5:
How much force is required to move an object with a constant velocity?
(a) No force is required.
(b) Force should be greater than frictional force.
(c) Force should be less than frictional force.
(d) Force just equal to the frictional force.

Question 6:
A spring balance measured the object as 20g. Its weight is
(a) 20g x 10N
(b) 200 x 10N
(c) 0.02 x 10N
(d) 0.02 x 980N

Question 7:
A car weight 9000 N. For this car, the recommended pressure is 18 N/cm2. What is the area of each tyre in contact with the ground?
(a) 500 cm^2
(b) 250 cm^2
(c) 125 cm^2
(d) 1.62 x 105 cm^2

9.9 Force and Laws of Motion

ACTIVITY 9.9.1

How are the directions of action and reaction forces related?

What is required? Syringe, sleeve (thin flexible tube), aluminium wire about 5 cm long and a beaker.

How will you proceed?

(a) 1. Take a syringe and fit a sleeve (thin flexibles tube) of about 15 cm length to its nozzle. 2. Insert the aluminium wire into the sleeve and bend it into a 900 arc of a circle.
(b) 3. Dip the sleeve in water kept in a beaker and pull out the piston of the syringe so that the syringe is filled with water. You inevitably pull in some air bubbles too. Push the bubbles out and once more completely fill the syringe with water.
(c) 4. Take the sleeve out of water. Hold it stable horizontally against the edge of a table, with bent wire pointing to side.
(d) 5. Push the piston inwards.
(e) 6. Observe in which direction the stream of water comes out of the sleeve?

7. Also observe simultaneously, what happens to the sleeve? It moves opposite to water stream. Is there any force acting on the sleeve? What is the direction of this force? Repeat Steps 3 to 7 several times and conclude from your observations. Fig. 9.9.1(a)

(f) Arrangement to show the action and reaction forces
(g) Sleev bends when water is freed out Aluminium wire

(h) **What have you learnt?**
(i) As the stream of water comes out from the sleeve, the sleeve moves in opposite direction. This shows that moving out of water is due to force of the action. Movement of the sleeve is due to force of reaction. The action and reaction forces act in the opposite directions. Extension Repeat this activity by pressing the piston slowly and quickly. Do you find any effect of it on the motion of sleeve in backwards direction? Alternatively, the above relationship between directions of action and reaction forces can be learnt by the following activity also

Activity 9.9.1(b)

Are the direction of action and reaction forces related?

What is required? A balloon, a straw, thread, a pair of scissors and an adhesive tape

How will you proceed?

1. Pass a thread of about 4 m to 5m length through a straw and tie it across the length or breadth of the room.

2. Take a big balloon. Inflate it fully and hold its neck so that air does not come out. Move the straw near one end of the thread, and keep the inflated balloon under the straw in contact with it, the neck of the balloon facing the wall as shown in [Fig. 9.9.1(b)]. Fig. 9.9.1(b) Arrangement to show the direction of reaction forces

3. Let your friend stick the balloon under the straw by atleast two pieces of sticking tape

. 4. Now release the balloon. What happens to the balloon? In what direction does it move? In which direction does air escape from the balloon? Window Straw Adhesive tape Thread Balloon Window

What have you learnt?

The balloon and the air escaping from the balloon move in opposite directions. Thus, action and reaction forces act in the opposite directions. Extension Hold the thread vertically with the balloon at the lower end and its mouth facing the ground. Also repeat the activity using balloons of different sizes

Class: IX
Unit: Laws of Motion
Objective: To study the effect of force on an object
Material: Coins, cups, cards (large enough to cover the mouth of the cup)
Steps:

- Take a tumbler and cover it with a stiff piece of playing card.
- Place a 5 rupee coin at the centre of the card.
- Give the card a sharp horizontal flick with a finger.
- If the student does it fast, then the card shoots away, allowing the coin to fall.

vertically into the glass tumbler due to its inertia.
• The inertia of the coin tries to maintain its state of rest even when the card flies off.

Conclusion:

state of rest. If it is at rest, it tends to remain at rest. This property of an object is called inertia.
Similarly, when the branch of a tree is shaken vigorously, all the leaves fall; only the carom coin at the bottom of the pile is removed when a fast moving striker hits it; when a carpet is beaten, all the dust particles fall due to the inertia.
This examples illustrate that there is a resistance offered by any stationary object to change its
state