CHAPTER 9

Forces and Pressure

What is force?

When the door of your cupboard is jammed shut, you have to pull it extra hard to open it. To move heavy furniture, it needs to be pushed. In both cases, to move the objects, you gave it a push or a pull.

Force is the push or pull needed to move something. Whenever something moves, force must be involved. Look at the pictures shown below.

▲ a push

▲ a pull

Effects of Force

Study the pictures given here to find out what force can do.

▲ Force can make a stationary object move.

▲ Force can stop a moving object.

▲ Force can change the direction of a moving object.

▲ Force can make a moving object slow down.

▲ Force can make a moving object move faster.

▲ Force can change the shape of an object.

Exercise 1

Match the items in column I with those in column II.

Column I	Column II
i. a child running to catch the school bus	**a.** Force can make a stationary object move.
ii. a man blowing a balloon	**b.** Force can stop a moving object.
iii. a woman pushing a table	**c.** Force can change the shape of an object.
iv. a cricketer catching a ball	**d.** Force can make an object move faster.
v. a girl pulling on the leash of a running dog	**e.** Force can change the direction of a moving object.
vi. a driver turning the steering wheel of a car	**f.** Force can make an object go slower.

▲ muscular force

Exercise 2

Column II in the last exercise lists six possible effects of a force. Now look at the examples given below. In each case, identify what effect is produced in each case.

i. A boy kicks a stationary football lying on the ground.

ii. A child pushes a moving swing in the park, on which her friend is seated.

iii. A rubber band is stretched.

iv. A cricketer hits a ball which has been bowled to him.

v. A moving ball hits a window pane and smashes the glass.

▲ impact force

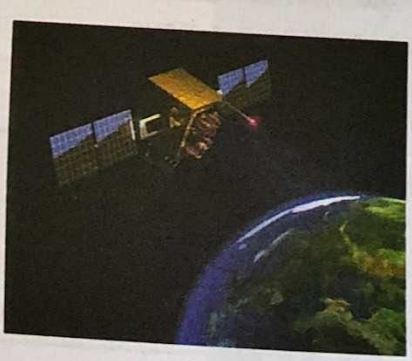
Types of Forces

When you kick a football or pick up your school bag, you use your muscles to apply force. **This force is called muscular force.**

When you hit a nail with a hammer, it is driven into the wall by an impact force. **Impact forces are applied when a moving object hits a stationary object or another moving object.** While playing carom, the impact force on the coins makes them move. It is important to wear seat belts while sitting in a moving vehicle to reduce the impact forces on your body, in case of an accident.

▲ magnetic force

In everyday life, we come across many different kinds of forces. Not all of them can be felt as a push or a pull. You already know what happens when a magnet is taken near paper pins, nails or other iron objects. Magnets attract such objects. **This type of force exerted by a magnet is known as magnetic force.**



▲ gravitational force—satellite orbiting the earth

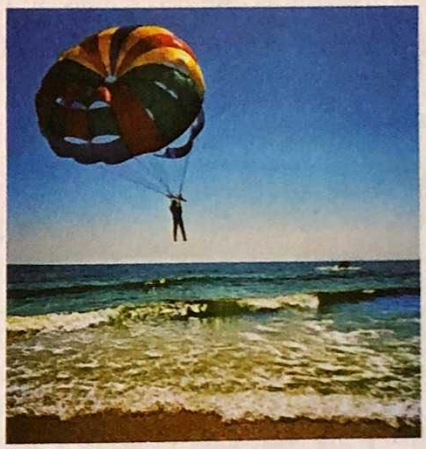
Exercise 3

Give two examples from daily life where magnetic forces are used.

A ball thrown upwards always comes down; when you jump up, you come down; a ripe fruit from a tree falls down. All this happens due to gravitational force. **Gravitational force or gravity is the force with which the earth attracts objects towards itself.**

Exercise 4

The pictures show a parachutist jumping from a plane, floating in air and then returning to the ground. In which of the three positions does gravity act on the parachutist?



It is because of the force of gravity that objects feel heavy when you try to lift them. Gravity acts upon an object and gives it weight. **Weight is a measure of the gravitational force acting on an object. It is measured in Newtons (N).** For convenience, a mass of 1 kg is said to have a mass of 1 kg-wt.

$$1 \text{ kg-wt} = 9.8 \text{ N}$$

Weight can be measured using a spring balance. When you hang an object from a spring balance, it measures the force of gravity pulling the object down towards the earth. In outer space, where the force of gravity is very weak, objects are almost weightless.

Activity 1

Borrow a spring balance from the school laboratory. Measure the weight of different objects with a spring balance. You can use some five rupee coins, a cup full of gravel, your science textbook, and some other such things.

Exercise 5

In 1969, Buzz Aldrin was one of the first men to walk on the moon. On the moon, Aldrin weighed six times less than on earth. What does this tell you about the force of gravity on the moon?

Activity 2

Take a plastic comb. Rub it well on your dry hair. Now take it near small bits of paper. What do you see?

Do the bits of paper fly up and stick to the plastic comb?

Try something else. Rub the plastic comb on your dry hair and take it very close to a thin stream of water running out of the tap. What happens?

When the comb is rubbed on dry hair, it acquires an electric charge because of which it can exert a force. This force is called **electrostatic force**.

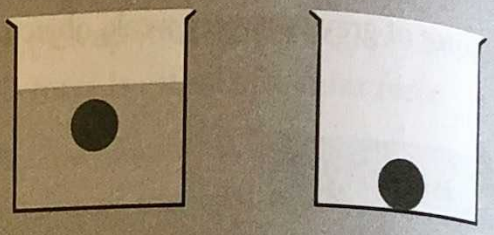
An electrically charged body can attract or repel other objects due to electrostatic force. You will learn more about this in Chapter 12.

Take a ball and roll it on the floor. You will notice that the ball stops moving after some time. This means that some force acts on the ball and makes it stop. This force is known as friction. **Friction is a force that resists the motion of an object.**

Activity 3

You will need: plasticine, two jars, water

First make two small balls of plasticine of the same size. Fill one jar with water. Drop one plasticine ball into each jar at the same time. In which jar does the ball reach the bottom first? What is there in the other jar? Why do you think this happens?



Rub your palms together for a few seconds and notice how warm they become. **Friction** between your moving palms **produces heat**. Early man discovered fire by rubbing together two pieces of stone called flints. The heat produced by friction between the stones gave rise to a spark that led to the discovery of fire. When you strike a matchstick against a rough surface, it catches fire. Can you now say why the jar of a mixer becomes hot after if is used for some time?

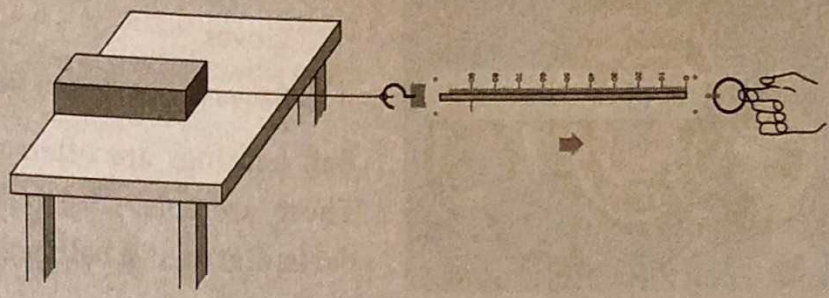
What happens to your eraser on repeated use? Friction between the eraser and paper causes it to wear out. Thus **friction causes wear and tear**. Friction between moving machine parts causes them to wear out. Think of more examples where friction causes wear and tear.

Activity 4 Teacher Demonstration

You will need: a block of wood with a hook, a spring balance, a sheet of glass, a large sheet of coarse sandpaper, two round pencils, a large table

Pull the block of wood gently across the tabletop with the spring balance. Note down the reading on the spring balance. This tells you the force needed to pull the block.

Place the sheet of glass on the table. Pull the block of wood over it. How much force is required now?



Next place the sandpaper on the table, with the rough side up. Repeat the activity. How much force is required now?

Finally place the wooden block over the two pencils and pull it with the spring balance. What is the reading in the spring balance this time? Compare the results obtained for each kind of surface.

Type of surface	Force required to move the wooden block
tabletop	
glass	
sandpaper	
pencils	

What do you find? When was the force needed to pull the wooden block the minimum?

You would have found that it was much easier to move the wooden block when it was on the pencils. The pencils act as rollers. It is easier to roll a cylindrical object along a surface than to push it. In other words, **rolling friction is much less than sliding friction**. Now you can realise why the invention of the wheel was so important.

When we put rollers under a heavy box or under heavy furniture, we are reducing the friction that makes it difficult to move these heavy objects.

There are other ways of reducing friction too. What do you do when the hinges of a door start creaking? Oil is commonly used as a lubricant. **A lubricant is a substance that reduces friction between two moving surfaces**. Polishing makes surfaces smoother and also helps to reduce friction.

Exercise 6

Underline the lubricant used in the following examples.

i. Nidhi removes her bangles easily by applying soap to her hands.

ii. Rashmi puts some talcum powder on the carom board.

iii. Piyush applies grease on the chains of his bicycle to prevent wear and tear.

▲ ball bearings in machines

iv. A surgeon powders his hands before pulling on his plastic gloves.

v. Saliva in our mouth helps us to swallow food.

Ball bearings are often used to reduce friction in machines. These are tiny steel balls placed between moving machine parts. Get an old ball bearing from any bicycle repair shop and study it.

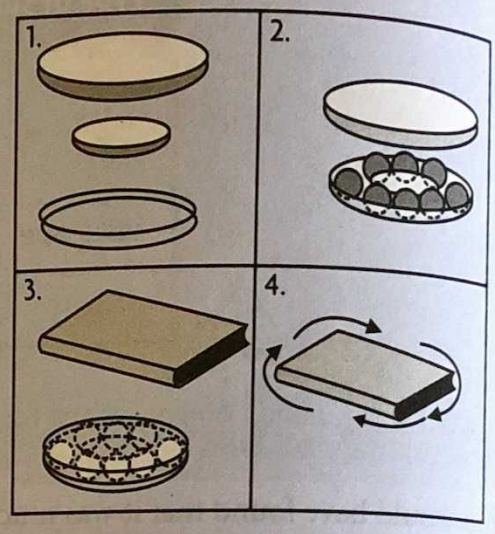
Activity 5 Make a Ball Bearing Model

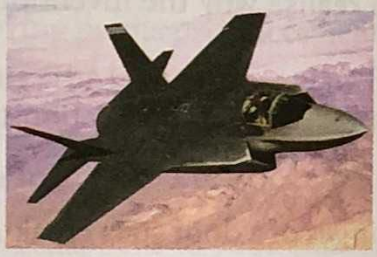
You will need: three bottle caps of different sizes, glass marbles, some books

Keep the smallest bottle cap inside the middle-sized cap. Take the glass marbles and put them between the edges of the two caps to form a ring of marbles.

Place the largest cap such that it rests on the marbles only and does not touch any of the other caps. Keep a book on the largest cap and spin it. Does it spin easily?

Now take out the marbles. Place the top cap back and place the book on it. Try to spin the book again. What difference do you find now?





An object moving through air or water also has to overcome friction. For this reason, ships and aeroplanes have streamlined shapes. In a streamlined body, the front portion of the object is narrower than the back. Birds too have streamlined bodies to reduce friction as they fly through the air. List some animals and other objects that have streamlined bodies.

Using Friction

Friction is not always a nuisance. We would not be able to walk without friction between our shoes and the ground. Without friction, pencils would not write on paper and your teacher would not be able to write on the blackboard with chalk.

Exercise 7

Say whether friction is helpful or troublesome in the following cases.

i. Applying the brakes on a cycle.

ii. lighting a matchstick

iii. Rohan uses a towel to open a tightly-closed lid of a bottle.

iv. The engine of a car becomes hot after running for some time.

v. Soles of shoes wear out after some time.

vi. tying shoe laces

vii. pulling a drawer out of a desk

Exercise 8

Why does a piece of chalk get smaller on repeated use?

Exercise 9

◀ Why do tyres of vehicles have treads?

Exercise 10

i. In a tug of war, there is friction between the rope and the _____ (hands/feet), and also between the ground and the _____ (hands/feet).

ii. A car must stop when the traffic lights are _____.
The driver uses the brakes and _____ stops the car.

iii. _____ between the rope and hands helps climbers to climb up with a rope.

Contact and Non-Contact Forces

You have learnt about different types of forces and what forces can do. Forces that can act from a distance are called **non-contact forces**. For example, a magnet can exert a pull or push on another magnet, even when they are not in contact. A comb vigorously rubbed on your hair can also pull bits of paper from a distance.

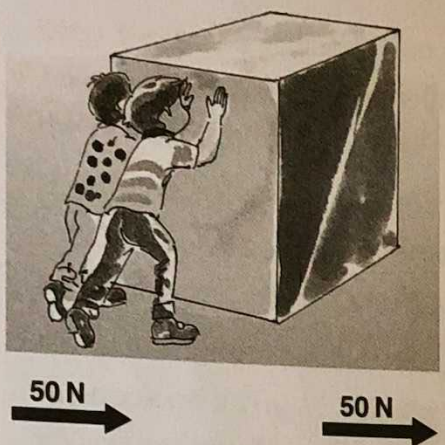
Mostly we exert a force on an object by touching it, that is, by contact. Forces that must touch an object before they can act on it are called **contact forces**.

Exercise 11

Study the classification of forces given here. One of them has been put into a wrong group. Which one is it?

Contact forces	Non-contact forces
friction	magnetic force
impact force	electrostatic force
gravitational force	

Resultant Forces



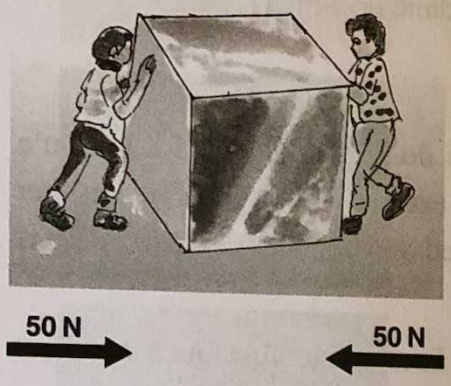
Arun pushes a box with a force of 50 N. The box moves slightly. He requests Varun to help him. Varun also pushes with a force of 50 N. The box now moves easily. Thus the total force is equal to the force applied by Arun + the force applied by Varun = 50 + 50 = 100 N. This total force is called the **resultant force**.

In order to define a force, we must know its **magnitude** as well as the **direction in which it is acting**.

When more than one force acts on an object, the total effect is due to the resultant force acting on it. The direction is which the object moves will depend on the direction of the resultant force.

Exercise 12

If Arun and Varun push the box from opposite ends with the same force, what do you think will happen? What would be the resultant force?



Exercise 13

Suppose Arun pushed extra hard with a force of 60 N. What do you think will happen? What will be the resultant force?

Exercise 14

In a tug of war, the three members of team A pull with a force of 100 N, 120 N and 135 N. The three members of team B pull with a force of 130 N, 105 N and 120 N. Which team will win?

To sum up:

i. When two forces act on a body in the same direction, the resultant force is found by adding the two forces. This resultant force makes the body move in the same direction as the two forces.

ii. When two forces act on a body in opposite directions, the resultant force is the difference of the two forces and it makes the body move in the direction of the larger force.

iii. If two equal forces act on the body in opposite directions, then the resultant force on the body will be zero and the body will not move.

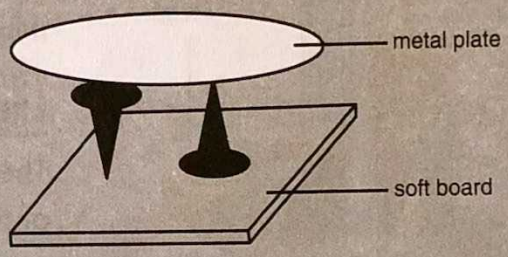
Pressure

The effect that a force has when it acts on a surface depends on two things: the amount of force and the area that it is pressing on. We measure this as **pressure**.

Activity 6

You will need: two drawing pins, a piece of soft board, a metal plate

Hold a pin erect on the soft board. Hold another pin next to it but upside down so that its flat head rests on the soft board. Press both the pins down with a flat object like a metal plate. Which pin pierces through the soft board?



The force exerted on both the pins was the same. However, the area of contact between the pin and the board was different in the two cases. With the pointed end in contact with the soft board, the force applied was concentrated over a tiny area of the pin point. Thus the effect of the force was larger and the pin was pushed into the soft board.

In the second case the area in contact with the soft board was larger. The force applied was spread over this larger area. The effect of the force was less.

Thus when a force is spread over a large area, it produces a small pressure and when a force is spread over a small area, it produces a large pressure. Thus, we can see that pressure depends on the force applied, and the area over which this force is spread.

Pressure is defined as the force acting per unit area.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Pressure is measured in Pascals (Pa). If a force of 1 N is applied to an area of 1 m^2, then the pressure is 1 Pascal (or 1 N/m^2).

Exercise 15

A force of 20 N acts over an area of 4 m^2. What is the pressure?

Force = _____; Area = _____

Pressure = $\frac{\text{Force}}{\text{Area}}$ = _____ N/m^2

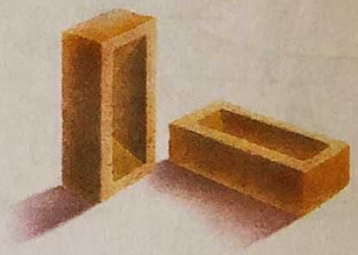
Exercise 16

A pressure of 50 N/m^2 acts on an area of 5 m^2. Calculate the total force.

The pressure is 50 N/m^2. Thus on every 1 m^2, the force acting is 50 N. Therefore, on 5 m^2, the force acting is _____

Exercise 17

A force of 800 N exerts a pressure of 40 N/m^2. What area is it acting on?

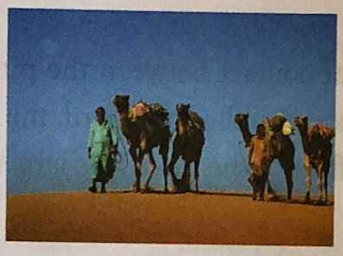


Exercise 18

A person weighs 600 N. He is wearing shoes with a total area of 0.02 m^2. What pressure do they exert on the floor?

Exercise 19

The surface area of the end of a brick is 50 cm^2. The surface area of the base of the brick is 200 cm^2. Each brick weighs 50 N. What pressure is exerted on the ground by the brick in the two cases shown here?



▲ camels in desert

There are lots of examples in nature where the right kind of pressure is used to perform an activity. When we walk on sand, our feet sink into it and it is difficult for us to walk. A camel which is much heavier can easily walk on sand. This is because a camel has broad feet. The weight of the camel is spread over the large area covered by its feet. Thus the pressure exerted by its body on the sand is less.

▲ woodpecker

Another example is that of a woodpecker. It has a long, sharp and pointed beak. It hammers at tree trunks with its beak. The force it exerts is concentrated on the small area at the tip of its pointed beak. Hence its effect is large and the bird can quickly make a hole in the wood.

Exercise 20

Why do knives, axes and cutting tools have sharp edges?

Air Exerts Pressure

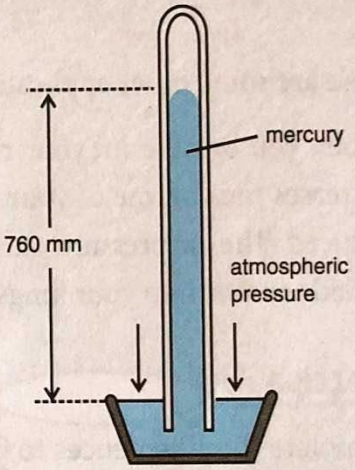
The earth is surrounded by a layer of air, about 120 km deep, which we call the atmosphere. The atmosphere exerts an enormous pressure of around 100,000 N/m² on all objects on the earth. **The pressure exerted by the atmosphere is called atmospheric pressure.** We do not even feel this pressure of the atmosphere! This is because the cells in our bodies contain fluids which exert an equal but opposite pressure from within.

Exercise 21

Do you know why astronauts wear specially-made suits when they travel in space?

Measuring Atmospheric Pressure

A **barometer** is used to measure atmospheric pressure. The first mercury barometer was made by an Italian scientist, Torricelli, in 1643. He took a glass tube, one metre long and closed at one end, and filled it with mercury. He then held his finger over the open end and turned the tube upside down into a trough of mercury. When he took his finger away from the open end, some of the mercury flowed out into the trough. However a column of mercury about 76 cm high stayed in the tube. What kept the mercury in the tube? Why didn't all the mercury flow out?



▲ Toricelli barometer

Torricelli found that at sea level, the atmospheric pressure acting on the mercury in the dish was able to balance the weight of 76 cm of mercury acting downwards.

Exercise 22

What is most likely to be the level of mercury in the barometer if it is taken to a higher altitude? Would it be 76 mm, 76 cm, 78 cm or 74 cm. Explain your answer.


▲ aneroid barometer

An aneroid barometer does not contain any liquid, is light and can be moved from place to place. In aircrafts, a special kind of aneroid barometer called an **altimeter** is used. This is used to measure the altitude or height at which the aircraft flies.

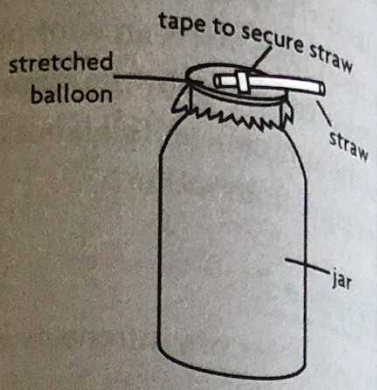
Scientists need to measure the atmospheric pressure to make predictions about the weather. Differences in the atmospheric pressure set up winds. High pressure means that the weather is clear whereas low pressure is an indication of clouds or a storm.

Activity 7 Make a Simple Barometer

You will need: a large glass jar, a balloon, a rubber band, two drinking straws, tape, white paper

Stretch the balloon over the top of your glass jar as shown. Secure it tightly with the rubber band. Make sure that the jar is airtight.

Place a straw horizontally across the top of the jar with about two-thirds of it on the balloon. Tape the straw in place on the stretched balloon. Place your barometer near a sheet of paper fixed on the wall and record the movement of the straw. Observe it for a few days. Can you explain how it works?



Here are some other applications of atmospheric pressure.

When you breathe in, your ribs move upward and outward, while the diaphragm moves down. This increases the volume of your chest cavity. The air inside is spread over a large space and its pressure is reduced. The air pressure outside is now greater than the air pressure inside your chest. Hence, the air outside rushes into your lungs.

Exercise 23

Complete these sentences to find out how a vacuum cleaner works.

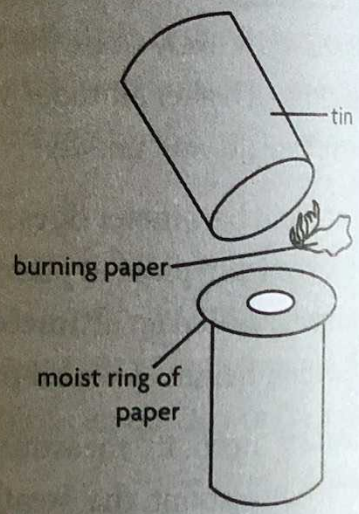
A vacuum cleaner works by removing some of the air inside itself. This reduces the _____ inside it. So the air pressure outside is _____ than the air pressure inside. The air pressure _____ the vacuum cleaner pushes air into it, taking in bits of dirt with it.

Activity 8

You will need: two identical tins, paper, a matchbox.

Cut a ring of paper as shown in the figure. Moisten it and place it on the mouth of the first tin. Light a piece of paper, drop it into the lower tin and quickly cover it with the second tin. After some time, pick up the top tin. What do you find?

What happened to the air in the lower tin when the burning paper was put into it? Would the air pressure inside the two tins have increased or decreased? Would the outside atmospheric pressure be more or less than the air pressure inside the tins? Talk about this in class and then check the answer.



Pressure in Liquids

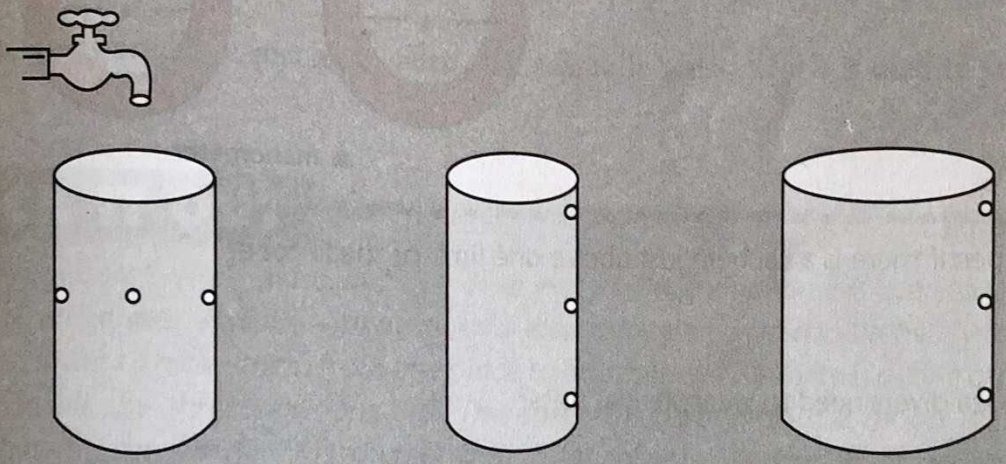
Like air, water and other liquids can also exert pressure. What happens when you fill a balloon with water? The walls of the balloon bulge outwards due to the pressure of the water inside. If you keep on filling water in the balloon, what do you think will happen? The balloon will burst because the pressure on the walls of the balloon will increase beyond what its walls can withstand.

Activity 9 Studying Water Pressure

You will need: three tins of different sizes as shown in the picture, a hammer and a nail

Punch holes of the same size in the tins as shown in the figure. Put a strip of tape over the holes. Work over a sink to avoid making a mess. Hold the tins, one by one, under an open tap. When a tin is almost filled with water remove the tape from the holes. Repeat with each tin. You will see spouts of water come out of the holes in the tins. This is because **water exerts pressure on the sides and the base of the tin**.

In your notebook, draw what you observe. Then check the answer.

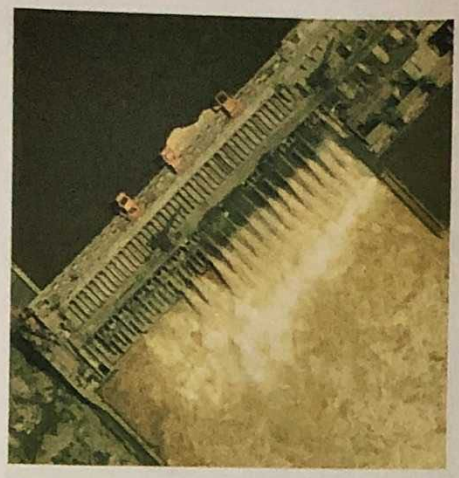


The water in the tins exerts pressure on the sides and the base of the tins. In the first case, the water came out equally far from all the holes, which were at the same depth. This means that **the pressure exerted by water in all directions is the same at the same depth**.

In the second tin, the three spouts of water are not identical. Through which hole does the stream of water fall out the farthest? And the nearest? **The pressure of the water increases with depth**. Hence the stream of water that reaches farthest is from the lowest hole.

In the third tin, the holes are at the same height as in the second tin, though the tin is wider. Does this make a difference to the streams of water coming out? **The pressure exerted by the water does not depend on the size or shape of the container**.

Your experiment has shown you three important facts about the pressure exerted by liquids. Write these three facts in your notebook and remember them.

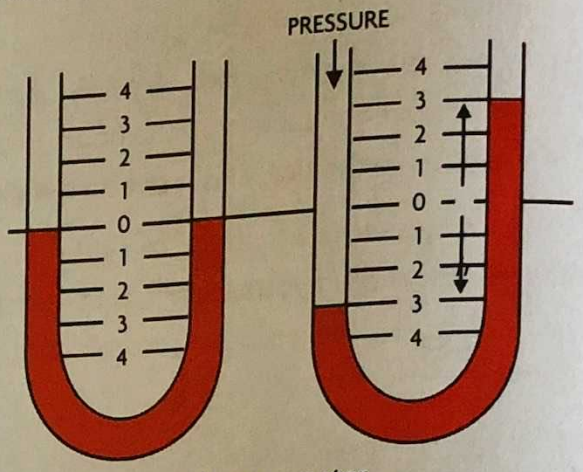


▲ dam

Exercise 24

Look at this picture of a dam. Dams are much wider at the base and narrow at the top. Can you explain why dams are built like this?

A **manometer** is a simple device used to measure pressure. It is made of a U-tube, half-filled with liquid. When both ends of the tube are open, the liquid is at the same height in the two limbs. When extra pressure is applied to any one limb, the liquid in it is forced down. The level in the other tube rises. The difference in height, "h", between the two levels indicates the pressure.



▲ manometer

Exercise 25

What will happen if there is a vacuum just above one limb of the U-tube?

Exercise 26

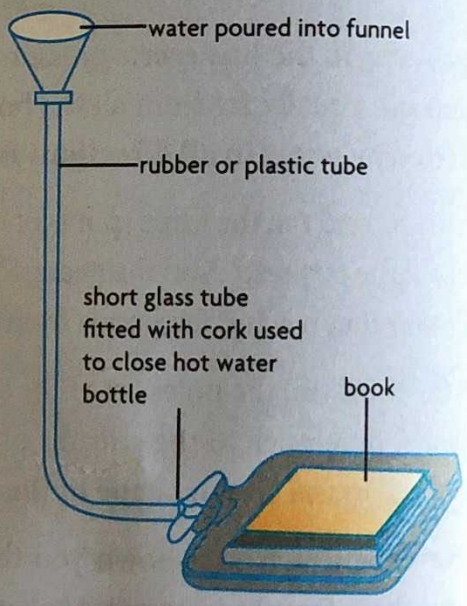
Why do deep-sea divers need to wear special suits?

Activity 10 Using Fluid Pressure to Lift Things

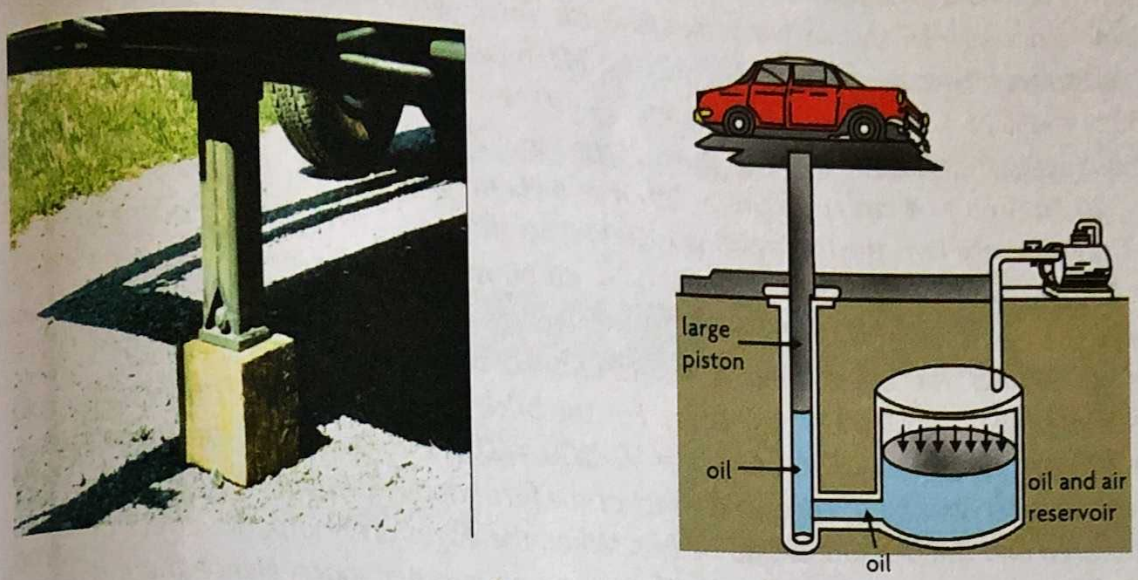
You will need: a rubber hot water bag, a funnel, rubber tubing, a book

Set up the activity as shown in the figure. What happens as you fill water in the hot water bag?

You will find that as water is filled into the hot water bag, the book will be raised. This shows an important fact about pressure in liquids. The increase in pressure is transmitted equally in all directions. It is this pressure which lifts the book.



Cars in service stations are raised up using a hydraulic jack. As you can see in the figure below, pressure pushes down on the oil in the reservoir. This is passed on to the oil below the piston. This increased pressure forces the piston upwards and raises the car.



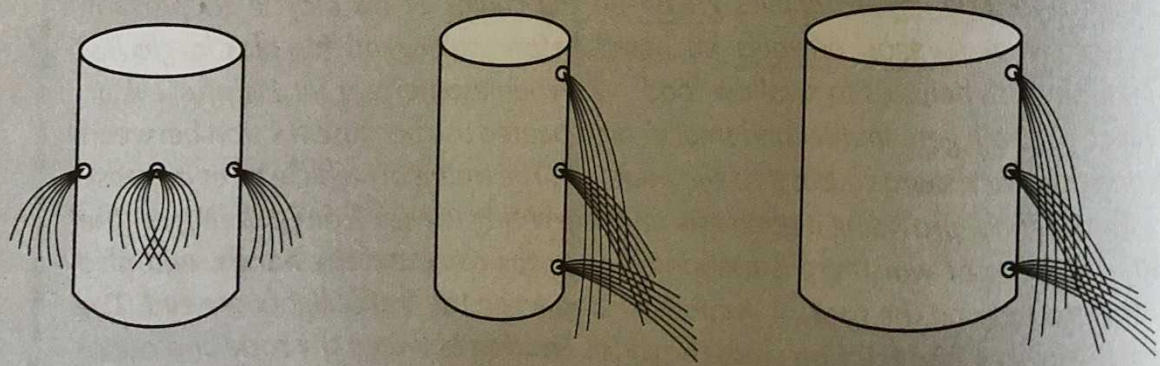
▲ hydraulic jack

The same principle is used in a machine called the hydraulic press, which is used to compress bales of cotton.

CHECK IT OUT

1. i-d; ii-c; iii-a; iv-b; v-f; vi-e **2.** *i-a; ii-d; iii-c; iv-e; v-c* **3.** *Magnetic force is used to close the door of a refrigerator. A crane with a powerful electromagnet is used to lift heavy loads of iron bars in order to move them from one place to another.* **4.** *Gravity is acting on the parachutist in all the three positions.* **5.** *The force of gravity on the moon is only one-sixth that on the Earth. This means that if an object weighs 36 N on earth, then it will weigh only 6 N on the moon.* ***Activity 3:*** *The plasticine ball reaches the bottom of the jar of water later than the ball in the other jar. The second jar contains air. This shows that friction is greater in liquids than in gases.* **6.** *i. Nidhi removes her bangles easily by applying soap to her hands. ii. Rashmi put some talcum powder on the carom board. iii. Piyush applies grease on the chains of his bicycle to prevent wear and tear. iv. A surgeon powders his hands before pulling on his plastic gloves. v. Saliva in our mouth helps us to swallow food.* **7.** *Troublesome: iv, v, vii; Helpful: i, ii, iii, vi* **8.** *A piece of chalk gets smaller and smaller on repeated use because friction between the chalk and the blackboard causes it to wear out.* **9.** *The treads on vehicle tyres increase friction with the road, providing a good grip and preventing the car from skidding on the road.* **10.** *i. In a tug of war there is friction between the rope and the* ***hands****, and also between the ground and the* ***feet****. ii. A car must stop when the traffic lights are* ***red****. The driver uses the brakes and* ***friction*** *stops the car. iii.* ***Friction*** *between the rope and hands*

helps climbers to climb up with a rope. **11.** Gravitational force is a non-contact force. **12.** The box will not move. The resultant force will be zero. Both the forces are equal but act in opposite directions. **13.** The box will move towards Varun. Arun's push is stronger than Varun's. The resultant force is 60 N − 50 N = 10 N. **14.** Force exerted by team A = 100 N + 120 N + 135 N = 355 N. Force exerted by team B = 130 N + 105 N + 120 N = 355 N. Both teams are pulling with the same force. The resultant force is zero. Neither team will win. **15.** Force = **20 N;** Area = **4 cm²;** Pressure = **20/4 = 5 N/m²** or **5 Pa** **16.** The pressure is 50 N/m². Thus on every 1 m², the force acting is 50 N. Therefore, on 5 m², the force acting is 50 × 5 = **250 N.** **17.** Force = 800 N; Pressure = **40 N/m²;** Area = Force/Pressure = 800/40 = 20 m² **18.** Force = 600 N; Area = 0.02 m²; Pressure = Force/Area = 600/0.02 = 30000 N/m² **19.** For the brick standing on its end: Force = 50 N; Area = 50 cm²; Pressure = Force/Area = 50/50 = 1 N/cm²; For the brick lying on its base: Force = 50 N; Area = 200 cm² ; Pressure = Force/Area = 50/200 = 0.25 N/cm² **20.** If the knives, axes and cutting tools have blunt edges, the effect of the force applied would be spread out on a greater area and the pressure would be less. When the edges are sharp, the effect of the force is the most and they cut well. **21.** There is no air in outer space. Hence there is no atmospheric pressure acting on the astronaut's body. The special, pressurised spacesuit creates this external pressure on the body. **22.** The height of mercury in the barometer is likely to be 74 cm. As we go higher up, the atmospheric pressure decreases. The decreased atmospheric pressure is no longer able to balance 76 cm of mercury. So some mercury will flow down into the trough. ***Activity 7:*** When the atmospheric pressure is higher, it makes the stretched balloon cave in so that the end of the straw goes up. Lower pressure outside causes the balloon to puff up or move outwards, so that the end of the straw is lowered. **23.** A vacuum cleaner works by removing some of the air inside itself. This reduces the **pressure** inside it. So the air pressure outside is **greater** than the air pressure inside. The air pressure **outside** the vacuum cleaner pushes air into it, taking in bits of dirt with it. ***Activity 8:*** You will find that both the tins are stuck together. When the burning paper is put into the tin, the air inside heats up and expands. This decreases the pressure inside. When the two tins are placed together, the burning of paper stops. The air inside cools and contracts. The pressure inside is greatly reduced. The greater atmospheric pressure outside pushes the tins from outside and keeps them together. ***Activity 9:***



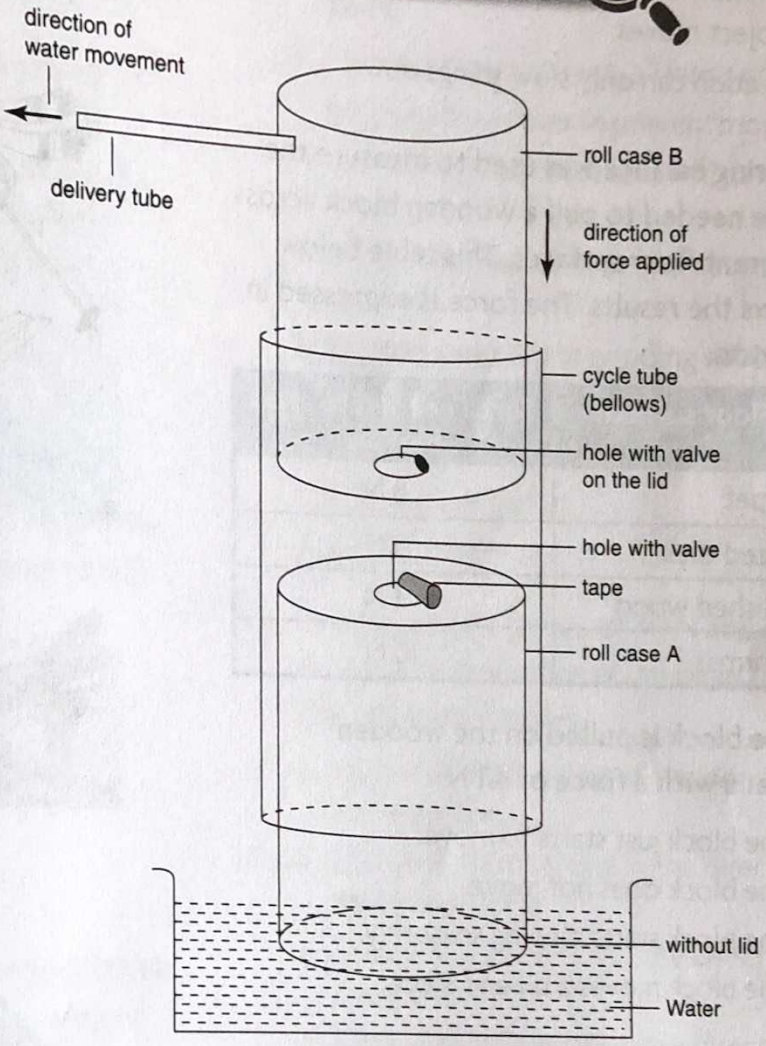
24. The water pressure on the base of the dam is much greater than at the top. To withstand this pressure the dam has to be much thicker at its base. **25.** The liquid will rise up in this limb and move down in the other. **26.** The pressure of water increases with depth. Deep-sea divers have to wear special suits to withstand the increasing pressure as they go down to great depths.

BECOME A YOUNG SCIENTIST

Do you know that a lift pump works because of air pressure? Let's make one and understand how it works.

You will need: two empty plastic film roll cases, 15 cm of an old cycle tube, an old ball point refill with nib removed, some brown tape

What to do: Use a pointed object to make a hole about 1 cm in diameter in the base of case A. Make a similar hole in the cap of case B. Make sure the edges of the holes are smooth. Now, to make a valve, take 4 cm of brown tape, fold 1.5 cm of the sticky part on itself. Stick the tape in such a way that it forms a valve over the hole in the cap of case B. Repeat the steps to make a valve for the outer side of the hole made in case A. Make a small hole in the cylindrical side of case B. Fix the shortened refill in the hole, to serve as a delivery pipe. Cut a length of the cycle tube. Stretch and slide it over both cases as shown. About 7-8 cm of rubber tube should separate the two cases A and B. The rubber tube will act as bellows. You will use case A without its lid. Hold the open end of case A in water and press case B downwards. After a few initial strokes, water will start flowing out of the delivery pipe.



Can You Answer These?

Tick the correct answers in Q1 to Q11.

1. **Which of the following is true about friction?**
   a. Friction is a force that occurs only between solids.
   b. Friction is a force that only occurs on rough surfaces.
   c. Friction is a force that only occurs when an object moves.
   d. Friction can only slow things down.

2. **A spring balance was used to measure the force needed to pull a wooden block across different floor surfaces. This table below shows the results. The force is expressed in Newton.**

Floor surface	Force needed to start moving
carpet	8 N
glazed tiles	5 N
polished wood	4 N
doormat	10 N

A. **If the block is pulled on the wooden surface with a force of 4.1 N**
   a. the block just starts to move.
   b. the block does not move.
   c. the block starts moving smoothly.
   d. the block moves a bit and stops.

B. **In which of the above surfaces is the friction greatest?**
   a. carpet
   b. glazed tiles
   c. polished wood
   d. doormat

3. **The two common forces that are acting everywhere around us are**
   a. gravity and friction.
   b. gravity and magnetic force.
   c. friction and magnetic force.
   d. electrostatic force and gravity.

4. **One of these helps to reduce pressure that is applied on a surface. Which one?**

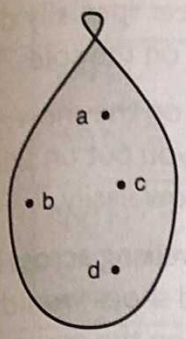

a.


b.


c.


d.

5. The balloon shown here is full of water. Dhruv wants to make a hole in the balloon so that water comes out with maximum pressure. At which point should he make the hole?



6. You want to lift a heavy box. The force of gravity pulls it downwards with a force of 500 N. Your father applies an upward force of 220 N from below. How much force will you have to apply to lift it upwards?

a. 220 N
b. 280 N
c. 300 N
d. less than 220 N

7. Which of the following correctly shows the relation between force, pressure and area?

A. Pressure = Force/Area
B. Force = Pressure/Area
C. Area = Force/Pressure
D. Pressure × Area = Force

a. A, B and D
b. only A
c. A, C and D
d. A and D only

8. A box weighing 2 kg exerts a force of 20 N on the ground. The box covers an area of 2 m^2 on the ground. The pressure exerted by the box on the ground is:

a. 40 N/m^2
b. 80 N/m^2
c. 10 N/m^2
d. 200 N/m^2

9. To open a tightly closed bottle, we often wrap the lid in a thick, rough towel because

a. sweat and grease on our hands makes them slip.
b. this prevents the bottle from breaking.
c. this does not hurt our hands.
d. friction between the lid and towel prevents it from opening easily.

10. Which of the following statements are true?

A. Gravity attracts all objects towards the earth.
B. Magnetic force attracts all kinds of metals.
C. Friction always tries to prevent movement.
D. Lubricants are substances which increase friction.
E. Friction produces heat and causes wear and tear.
F. Friction can help in grinding substances.

a. A, C, E, F are true.
b. A, B, C, D are true.
c. C, D, E, F are true.
d. A, C, D, F are true.

11. Two boys exert forces of 40 N and 60 N in opposite directions on an object. The resultant force is

a. a force of 100 N acting in the direction of the larger force.
b. a force of 100 N acting in the direction of the smaller force.
c. a force of 20 N acting in the direction of the smaller force.
d. a force of 20 N acting in the direction of the larger force.

12. Name the type of force acting in each of the following cases.

a. attraction of iron pins to a magnet
b. a man pulling a rickshaw

c. a football in air

d. falling raindrops

e. your hair stands on end when you remove a woollen cap

f. a ball rolling on the ground

g. a carpenter driving a nail into wood with a hammer

h. a boy pedalling a cycle

13. In a game of tug of war, three girls of team A pull the rope with forces of 100 N, 120 N and 170 N. In team B, the three members pull the rope with forces of 130 N, 150 N and 155 N. Who will win the tug of war? What is the resultant force?

14. A horse pulls a cart with a force of 1500 N. The force of friction between the cart and the ground is 1500 N. The cart does not move. Why?

15. Match the terms in column I to those in column II.

Column I	Column II
a. Sparks are produced when a pair of scissors is sharpened against a grinding wheel.	**i.** It makes them rough and increases friction.
b. A piece of chalk wears out as it is used	**ii.** Friction produces heat.
c. Trolleys have wheels.	**iii.** Friction causes wear and tear.
d. The leather soles of shoes are rubbed on a rough surface.	**iv.** Powder reduces friction.
e. A surgeon powders his hands before pulling on his plastic gloves.	**v.** Rolling reduces friction.

16. Define pressure. What are the units of pressure in this list:
N/cm^2, N, N/m^2, cm^2, m^2

17. Give reasons for the following:

a. Athletes wear specially designed shoes with spikes on the soles.

b. If you walk on the snow, your feet will sink, but if you put on skis you can move over the snow easily.

c. A woman walking across a lawn in high-heeled shoes would leave a deeper impression on the ground than an elephant.

d. It is easier to sew with a pointed needle than with a blunt needle.

e. It is necessary to keep the bathroom floor clean and free of oily substances.

f. If you are hit with the edge of a ruler it is much more painful than if you are hit with the flat side.

g. Heavy trucks and tractors have rear wheels that are extra wide.

h. The size of the bubbles exhaled by a diver working underwater increases as the bubbles rise to the surface.

i. *Kabaddi* players rub soil on their hands before a game.

18. Give three examples each where friction is a disadvantage and where it is helpful.

19. Describe two ways of reducing friction.

20. Would it be difficult to swallow if you had no saliva in your mouth? Why?

21. Complete the following table:

Pressure	Force	Area
a. _____	50 N	5 cm^2
b. 15 N/cm^2	_____	5 cm^2
c. 5 N/m^2	500 N	_____
d. _____	750 N	25 cm^2
e. 80 N/m^2	800 N	_____
f. 45 N/m^2	_____	10 m^2
g. _____	200 N	10 cm^2
h. 5 N/m^2		20 m^2
i. 20 N/m^2	400 N	_____

22. A force of 500 N acts on a square piece of plywood, each of whose sides is 5 m long. Calculate the pressure acting on the piece of plywood.

23. A boy stands on the ground. The area below his feet is 70 cm^2. The pressure he exerts on the ground is 7 N/cm^2. Calculate the total force acting on the ground.

24. A force exerts a pressure of 45 N/m^2 when it acts on an area of 10 m^2. Calculate the total force.

25. A force of 400 N exerts pressure of 20 N/cm^2. What is the area on which the force acts?

26. Indicate whether the following are true or false. Rewrite the false statements correctly.

a. If we apply the brakes to a moving car, it comes to rest. This shows that force can make a moving object go slower.

b. When a force of 1 N acts on an area of 1 m^2, the pressure exerted is equal to one Pascal.

c. The foundations of high rise buildings are kept wide so that they exert less pressure on the ground and prevent the building from sinking into the ground.

d. A boy throws a ball down from the second floor of a building. In this case, gravitational force is acting only on the ball.

e. Friction helps us to walk more easily on a smooth, highly polished surface.

f. An old truck tyre will cause more friction with the road than a new tyre.

g. In the frozen northern regions of Canada, the Eskimos wear large snowshoes as that helps them to walk on freshly fallen snow.

h. When a force acts on a large area, the pressure it exerts is more.

i. Gravity and friction are both contact forces.