1

FORCE AND PRESSURE

1. **Effects of force:** To define force, first of all, one has to see the effects of force. By 'effects of force', we mean what can force do or what changes can a force bring about.

(i) **Force can set a stationary object in motion:** When force is applied to a stationary object, it can make it move. For example, if you push a book placed on a table, it starts moving. When you pull a chair, it starts moving. When you ush a handcart, it starts moving.

However, it is not necessary that force always makes a stationary body move. For example, if you try to push the wall of your classroom, it will not move. For that matter even if all the boys in your class push the wall, it will not move. The reason is that the force applied by all of you is not sufficient to move the wall. Hence, a force can move or tend to move a body at rest.

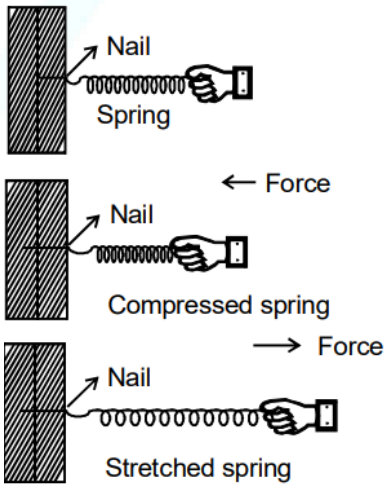
(ii) **Force can stop the moving objects or slow them down:** Imagine your friend is riding a bicycle. If you pull his bicycle from behind, it is going to slow down. It means that if you apply a force in the direction opposite to the direction of the moving body, the body slows down and may stop.

Now, if you push his bicycle from behind, it will increase its speed. But if you try the same with a truck, no observable change in its motion occur. Hence, a force can change or tend to change the state of uniform motion of a body.

From the above examples, it is clear that a force may stop a moving body or may reduce the speed of the moving body.

(iii) **Force can change the direction of moving objects:** When a cricket player hits the ball with a bat, his force changes the speed as well as the direction of the ball. Similarly, a football player changes the direction of a moving ball by angling his foot. You change the direction of your moving bicycle by applying force on its handle in the desired direction.

(iv) **Force can change the shape and size of objects:** Imagine a spring fixed in a wall with a nail. When we pull the spring, it gets stretched and hence, its shape changes, Similarly, when we crumple a paper, its shape changes. Thus by applying force, we can change the shape of object. But same is not true for a stone. Hence, a force can change or tend to change the shape and size of a body.



Force changes the shape of objects

2. **Definition of force:** Based on the effects of force, it may be defined as: Force is an effort in form of pull or push, which changes or tends to change the state of rest or uniform motion of a body, its direction or shape and size.

(i) Mathematical Representation of Force: Mathematically, force (F) is equal to the product of mass (m) of a body and acceleration (a) produced in the body due to that force. i.e., F = ma

$$\text{where, } a = \frac{\text{final velocity - initial velocity}}{\text{time}}$$

(ii) Units of Force:

(a) C.G.S. system:

F = ma → gram × cm/s^2 = dyne

If, m = 1 gram, a = 1 cm/s^2

then, F = 1 dyne

When a force is applied on a 1 gram body and the acceleration produced in the body is 1 cm/s^2, then the force acting on the body will be one dyne.

(b) S.I. system:

F = ma → kg × m/s^2 = newton

If, m = 1 kg and a = 1 m/s^2

then, F = ma,

F = 1 × 1 = 1 kg × m/s^2 = 1 newton.

If a force is applied on a body of mass 1 kg and acceleration produced in the body is 1 m/s^2, then, the force acting on the body will be one Newton.

(c) Relationship between the newton and dyne:

1 N = 1 kg × 1 m s^{-2} = 1000 g × 100 cm s^{-2} = 100000 g cm s^{-2} = 10^5 dyne

Thus, 1 N = 10^5 dyne

(1) Example:

A force produces an acceleration of 5.0 cm/s^2 in a body of mass 20g. Then find out the force acting on the body in newton.

Solution:

Acceleration of the body, a = 5 cm/s^2 = 0.05 m/s^2

Mass of the body, m = 20 g = 0.02 kg

∴ F = ma

⇒ F = 0.05 × 0.02 = 10^{-3} N

(2) Example:

A force of 15 N acts on a body of mass 5 kg for 2s. What is the change in velocity of body?

Solution:

Given: F = 15 N, t = 2s, m = 5 kg

F = ma

or, $a = \frac{F}{m} = \frac{15}{5} = 3 m/s^2$

$a = \frac{v-u}{t}$

⇒ v – u = a t = 3 × 2 = 6 m/s

3. Cause of force – The main cause of force is the interaction of an object with another at least two objects must interact with each other for a force to come into play.

4. Balanced and unbalanced forces: A number of forces acting on an object may either be balanced or unbalanced.

(i) Balanced Forces: If a number of forces acting on an object does not produce any change in its state of rest or uniform motion or direction of motion, then they are called as balanced forces.

Example:

- A person holding a briefcase in hand.
- A book resting on table.

(ii) Unbalanced Forces: If a number of forces acting on an object produce a change in its state of rest or uniform motion or direction of motion, then they are termed as unbalanced forces.

Example:

- A briefcase released from a persons hand.
- A stone dropped etc

5. Resultant force: If a number of forces act on an object then, a single force that produces same change in its state of rest or motion is called as resultant force.

For example, if a number of people push a large almirah and the same almirah can also be pushed by a single person then the force of this single person is the resultant force of all these people.

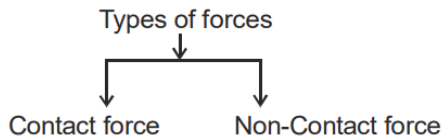
If two forces act on an object in the same direction, then the resultant force is obtained by adding them.

If two forces act on an object in the opposite direction, then the resultant force is obtained by subtracting them.

Boost your knowledge –

- If resultant force is zero, it means either object is in rest or in uniform motion.

6. Types of forces:



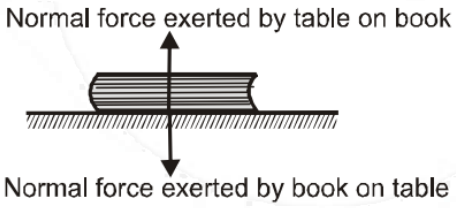
(i) Contact Force: Force which acts on a body only when the body is in contact with another body (exerting force), the force is known as contact force.

Types of contact forces:

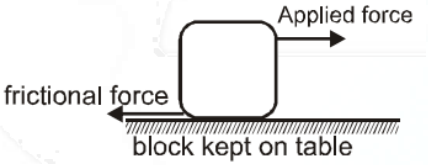
(a) Normal force: If contact forces between the bodies are perpendicular to the surface in contact, then the forces are known as normal forces.

Example:

Consider a book on a table. The table pushes the book upwards and book pushes the table downwards, these forces are perpendicular to the surfaces of book and table. Thus the table applies a normal forces on book in the upward direction and book applies a normal force on table in downward direction.



(b) Force of friction: Two bodies placed in contact can also exert forces parallel to the surfaces in contact, such a force is contact force of friction or simply friction. It is force which always opposes relative motion of the surfaces in contact.



(c) Muscular force: This is the force which can be exerted with our bodies by using muscles,

Example:

pull, push, kick, etc. Such forces are also called mechanical forces. These are contact forces.

(ii) Non-Contact force: Force which acts on a body when the body is not in contact with another body (exerting force), force is known as non-contact force.

Types of non-contact forces:

(a) Gravitational force: Newton said that every object in this universe attracts every other object with a certain force. The force with which two objects attract each other is called the force of gravitation. The force of gravitation acts even if the two objects are not connected by any means. If, however, the masses of the objects are small, the force of gravitation between them is small and cannot be detected easily.

The force of attraction between any two particles in the universe is called gravitation or gravitational force.

Force of gravity: The earth attracts all the bodies towards its center. The force exerted by the earth on the body is known as weight of the body or force of gravity.

It acts in vertically downward direction. If mass of the body is m and acceleration due to gravity is g. Then force of gravity or weight = mg.

The value of g is 9.8 m/s^2. For a body moving downward, g is taken as positive while for a body moving upward, g is taken as negative.

Brain Teaser /

- Why two objects do not get attracted to each other on the surface of the earth?
- **Gravitational units of force:** The force due to gravity on a body of mass m at a place where acceleration due to gravity is g, is given as F = mg The above relation can be used to define the gravitational units of force.

In **M.K.S.** system, the unit of force is the kilogram force (kg f). One kilogram force is the force due to gravity on a mass of 1 kilogram.

Thus, 1 kg f = force due to gravity on a mass of 1 kg = 1 kg mass × acceleration due to gravity g (m s^{-2}) = g newton.

Since, the average value of g is 9.8 m s^{-2}, 1 kgf = 9.8 newton (or 9.8N)

In **C.G.S.** system, the gravitational unit of force is the gram force (gf)

One gram force is the force due to gravity on a mass of 1 gram.

Thus, 1 gf = force due to gravity on a mass of 1 g

= 1g mass × acceleration due to gravity g (cms^{-2})
= g dyne
Since, the average value of g is 980 cms^{-2}, 1 gf = 980 dyne
Further, 1 kgf = 1000 gf

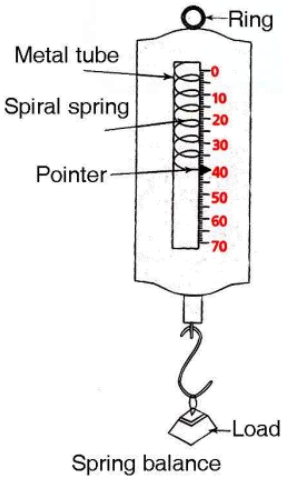
To an approximation 1 kgf can be treated to be nearly equal to 10 N. Then,
1 N = 0.1 kg f or 1 N = 100 gf.

(3) Example : What is the main cause of force?
Solution: Force is caused by the interaction between two bodies.

(4) Example: Find out the weight of an object of mass 25kg in newton, dyne, kg f and gf. (g=10 m /s^2).

Solution: Mass = 25 kg
Weight = mg
W = 25 × 10= 250 N
= 250 × 10^5 dyne
(1N = 10^5 dyne) = 250/10 =25 kgf
(1kgf = 10 N) = 25 × 1000 =25000gf
(1kgf = 1000 gf)

Spring balance: Spring balance is a device used for measuring the force acting on an object. It consists of a coiled spring which gets stretched when a force is applied to it. Stretching of the spring is measured by a pointer moving on a graduated scale. The reading on the scale gives the magnitude of the force.

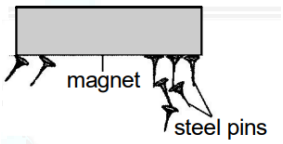


Spring balance

(b) Electrostatic force: The force exerted by a charged body on another charged or uncharged body is known as electrostatic force. When a plastic comb is rubbed with silk, it can pick up small bits of paper. This is because the comb acquires an electric charge due to which it can exert a force called electrostatic force. Electrostatic force can also act from a distance and is therefore a non contact force. A body with electrostatic charge can either attract or repel another charged body. Electrostatic force is used to separate solid pollutant particles from smoke given out from factories.


Electrostatic force

(c) Magnetic force: A magnet attracts iron filings, nails and other objects made of iron, steel, nickel and cobalt. Magnets exert forces of attraction or repulsion on other magnets. An important feature of magnetic force is that it can act from a distance and is therefore a non–contact force.



Magnetic force

Boost your knowledge –

- Earth behaves like a natural magnet.

(5) Example : What kind of charges attract each other?

Solution: Unlike charges attract each other.

(6) Example : What kind of magnet's pole repel each other?

Solution: Like pole repel each other.

Note: So far, we know of only four fundamental forces in the universe. They are gravitational force,
electromagnetic force, weak force and strong interactions. We are familiar with the first two. Weak forces come into play during radioactivity. Strong interactions are responsible for holding the nucleus of an

atom together. All other forces are manifestations of these fundamental forces. For example, forces such as friction between bodies, muscular action, etc. viewed on an atomic scale arise chiefly from electrical attraction and repulsion of the electrons and nuclei making up the atoms of the material.

Difference between mass and weight:

Mass	Weight
(i) It is the quantity of matter possessed by a body. It is represented by m.	(i) It is the force with which a body is attracted towards the center of the earth. It is represented by W = mg.
(ii) A mass is a constant quantity and is same (for a body) everywhere.	(ii) It varies from place to place due to variation in value of g.
(iii) Mass is never zero.	(iii) A body has zero weight at the center (g = 0) of the earth .
(iii) Its unit is Kilogram	(iv) Its unit is newton.
(v) It is a scalar quantity.	(v) It is a vector quantity.

FUNDAMENTAL UNLOCKED- (FU#1)

Q.1 For electrostatic force to act between two objects
(A) Both of them must be charged
(B) Neither should be charged
(C) At least one of them must be charged
(D) Both of them should be metals

Q.2 Find the odd one out
(A) Gravitational force
(B) Magnetic force
(C) Muscular force
(D) Electrostatic force

Q.3 Everybody in this universe attracts every other body by a force, which depends upon
(A) The mass of the bodies
(B) The distance between the two bodies
(C) Neither (A) nor (B)
(D) Both (A) & (B)

Q.4 Which of the following forces can change the speed of a moving object?
(A) Muscular force (B) Friction
(C) Gravity (D) All of these

Q.5 All the objects near the surface of earth are attracted towards the earth because
(A) Only earth attracts everybody
(B) Of the gravitational pull
(C) Of the atmosphere
(D) All of these

Q.6 If the resultant force applied on a body is zero, then
(A) The shape of the body may change
(B) It can start moving
(C) It can accelerate
(D) It can slow down

Pressure

We have studied in the previous chapter about the main effects produced by various forces. However, common experience tells us that the effect of a force also depends on the area over which it acts.

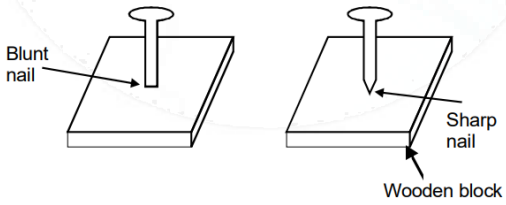
1. **Examples giving the feel of pressure:**

(i) **A wide strap school bag is more comfortable to carry:** Children daily carry school bags from home to school and school to home on shoulders. You hang your bag on right shoulder and after some time you happen to hang it on your left one; because your shoulder gets tired. What makes your shoulder get tired? Of course, it is the force exerted by the strap of the school bag which you put over your shoulder. The entire weight (force) of the bag is balanced by the strap. But if you notice, if you choose a bag with broader strap, you feel comfortable and do not get tired easily. So bag A and bag B with equal number of

books exert equal weight or force on the shoulder. But bag B with broader strap (larger area) gives you less feel of effort to carry the bag. So here comes the concept of effect of force, which in some way depends upon the area over which it acts. More is the area, lesser is the effect of force.

School bags have wide strap to reduce pressure

(ii) It is more difficult to fix a blunt nail than a sharp nail: We all know that it is more difficult to fix a blunt nail than a sharp nail. Why? It is because the sharper the nail is, the smaller is its area of contact with wood and, therefore, the greater is the effect of a given force on it.



Nail fixing in wooden block

(iii) It is easy to cut fruits and vegetables with a sharp knife: Daily experience tells us that it is easy to cut fruits and vegetables with a sharp knife than with a blunt one. Why? The reason is the same that area of contact of a sharp knife with fruit is less than that of a blunt knife. Therefore, the effect of force applied by a sharp knife is more.

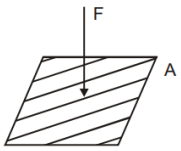
2. Definition of pressure: The examples given above show that the overall effect produced by the same given force becomes more when it is acting over a smaller area and is less when it is acting over a larger area. Thus, to get a clear idea of the effect of a given force, we must know not only the magnitude of the given force but also the area over which this force acts. The above discussion makes us able to define a useful, new quantity called pressure.

Pressure is the ratio of the force acting perpendicular to a given area to the area over which it acts. Pressure equals the normal force acting per unit area.

3. Mathematical expression for pressure:

If F is perpendicular force acting on area A then

$$P = \frac{F}{A}$$



Normal force on an area

Where,

P is the pressure, F is the normal force acting on area A

A is the area over which force acts

4. Units of pressure:

(i) S.I. unit: The SI unit of pressure is pascal (Pa). It is the pressure exerted by a force of 1N acting normally on an area of $1m^2$.

Thus, 1 Pa = 1 N/m^2

(ii) CGS unit : dyne / cm^2

(iii) Gravitational unit: If the force is expressed in kg wt, then the unit of pressure is kg wt/m^2.

Since, 1 kg wt = 9.8 newton we have, 1 kg wt/m^2

$$= 9.8 \frac{\text{Newton}}{m^2} = 9.8 \text{ pascal} = 9.8 \text{ Pa}$$

(iv) Another unit to measure pressure is atmosphere (atm).

1 atmosphere = 1.01×10^5 pascal

1 atmosphere is the pressure exerted by the weight of entire atmosphere on the surface of earth.

(v) 1 Bar = 10^5 Pa

(vi) 1 Torr = 1 mm of Hg

1 Torr = 133.33 Pa

5. **Pressure is a scalar quantity**: Pressure is a scalar quantity because at 1 level inside the liquid the pressure is exerted equally in all direction, which shows that direction is not associated with hydrostatic pressure or pressure due to static fluid

Brain Teaser

- Have you been to a place where you feel atmospheric pressure

Note: If the force acting on given area increases, the pressure increases. ($P \propto F$)
If the area over which the force acts decreases, the pressure increases. $\left(P \propto \frac{1}{A}\right)$

(7) Example: If a force of 5N is applied over an area of 2.5 m^2, calculate the pressure produced.

Solution: Given: Force = 5N
Area = 2.5 m^2

We know, pressure = $\frac{\text{Force}}{\text{Area}} = \frac{5}{2.5} = 2\,\text{Pa}$

(8) Example: If the pressure produced by a force over an area of 100 cm^2 is 30 Pa, then calculate the force applied.

Solution: Given: Pressure = 30 Pa

Area = 100 cm^2 = $\frac{100}{10000} m^2 = 10^{-2}\, m^2$

We know, Pressure = $\frac{\text{Force}}{\text{Area}}$

Force = Pressure × Area = $30 \times 10^{-2} = 0.3$ N

5. **Some facts involving pressure**

(i) Nails have a flat top but pointed end: A small pressure applied on the flat top through falling hammer becomes a large thrust. The same thrust acts on the wooden board through the pointed end of the nail. It results in a large pressure. The nail can easily be fixed in the wooden board.

(ii) Sewing needles have pointed tips: A small force of fingers makes the needle pierce into the cloth easily and sewing becomes quicker.

(iii) Cutting items (knives and blades) have sharp edge. Cutting becomes easier.

(iv) An angry child in arms prefers biting her mother with her tiny sharp teeth rather than punching her with fist.

(v) The studs on football boot have only a small area of contact with the ground. The pressure under the studs is high enough for them to sink into the ground, which gives extra grip.

6. **Reducing pressure**

(i) Vehicle brakes have flat surface: This reduces pressure on the vehicle tyres and avoids their tearing.

(ii) Broad sole shoes: They make walking easier on a soft land.

(iii) Wide steel belt over the wheels of an army tank: It makes its movement easier over marshy land by reducing it's pressure on ground and do not sink into it because pressure decreases with increasing area.

(iv) Tractor tyres are broad: Tractors do not sink in the soft land of the field while operating them.

(v) Camel foot are broad and soft: They walk swiftly on sand.

(vi) Hanging bags have wide straps: They reduce pressure on the shoulders.

(vii) Skis have a large area to reduce the pressure on the snow so that they do not sink in too far.

(9) Example : Why a balloon bursts when too much air is blown into it?

Solution: When we blow air inside a balloon, it expands. The air inside the balloon exerts a pressure on the inner wall of the balloon. If we blow in too much air and the material of the balloon is not capable of expanding further, increasing the pressure inside can cause the wall of the balloon to break at one or more points. This is why a balloon bursts when too much air is blown into it.

(10) Example : Why a camel can run easily on desert sand and man cannot?

Solution: It is difficult for us to walk on sand because our feet will sink into sand. But a camel can walk on sand very easily. A camel has flat broad feet that increase the area of contact with the sand because of which the pressure exerted by the camel on the sand is reduced and its feet sink very little in sand. This makes a camel move fast on sand.

(11) Example : Do liquids and gases also exert pressure?

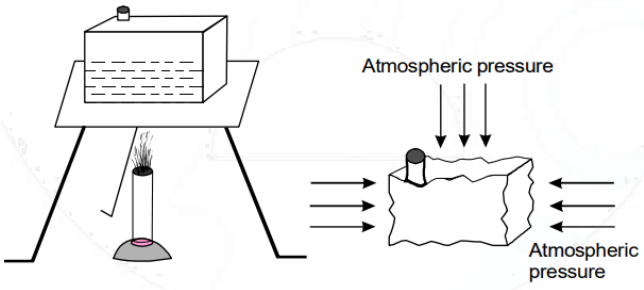
Solution: Yes, liquids and gases also exert pressure.

Atmospheric pressure

The discovery of atmospheric pressure gives a fact that air has weight. The weight of the atmosphere presses down on the earth's surface and creates a pressure on it. The pressure at any point exerted by the weight of the air above, it is called atmospheric pressure.

The atmospheric pressure on the earth's surface at sea level is approximately one hundred thousand pascal i.e., 100 kPa.

1. **Activity:** Tin can crushed by atmospheric pressure: Take a tin can with a tight fitting stopper. First pour a little water into the tin can and heat it over a burner. Keep on heating until steam starts forming so that it drives out most of the air from the tin can. Remove the tin can from the burner and fit the stopper at its mouth tightly



Atmospheric pressure can crush a tin can

What happens to the tin can after sometime? We find that after sometime the tin can gets badly crushed. When the tin cools, the steam inside the tin can condenses. Now, there is nothing inside the tin can to balance the outside atmospheric pressure. Therefore, the atmospheric pressure acting from outside crushes the tin can.

(12) Example : Define atmospheric pressure.

Solution: The envelope of air around the earth is called atmospheric and the pressure exerted by this air is called the atmospheric pressure.

(13)Example : Why a rubber sucker pressed on a surface sticks?

Solution: When we press the rubber sucker, most of the air between its cup and the surface escapes out and it sticks to the surface due to the atmosphere pressure acting on it.

(14) Example : What is the unit of pressure?

Solution: As we know,

$$P = \frac{F}{A}, \text{ where F is in N and A is in } m^2$$

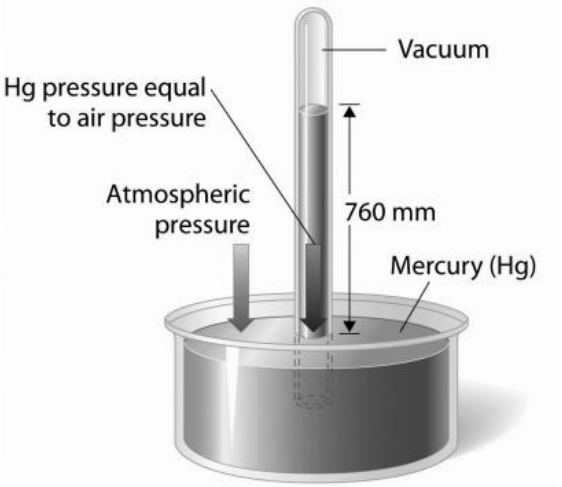
Then unit of pressure is N/m^2 or Pa.

(15) Example : A body of mass 50 kg and area of cross-section 1 m^2 is kept on a sand floor. Calculate the pressure exerted by the body on the sand floor due to its weight. Take g = 10 m/s^2.

Solution: We have

$$P = \frac{F}{A} = \frac{\text{weight}}{\text{area}} = \frac{50 \times 10N}{1m^2}$$
$$= 500N/m^2$$
$$= 5 \times 10^2 \text{ pascal}$$

(i) Measurement of Atmospheric Pressure:



An instrument used to measure atmospheric pressure is a barometer. It consists of a long glass tube, which is sealed at one end. It is filled with mercury, a silvery liquid metal. The open end of the tube (filled with mercury) is placed in a small trough full of mercury. The air exerts pressure on the mercury in the trough and is able to hold certain height of mercury column. When the air pressure reduces, the column of the mercury moves down and when the air pressure increase , the height of the mercury column increases. In this way, the pressure is measured by the height of the mercury column, in mm of Hg, i.e., the height of the mercury column in millimeters. A sea level, it is 760mm of Hg.

(ii) **Variation of Atmospheric Pressure with Altitude:** The atmospheric pressure at a place decreases with increase in altitude. The atmospheric pressure at a place is force exerted by the weight of the air column above that place. As we go up, the length of the air column above us decreases. This means that its weight and the atmospheric pressure is smaller at higher places than at sea level.

(iii) **Need of Atmospheric Pressure:** If the pressure of atmosphere is removed suddenly, our blood vessels and tissues will rupture due to the pressure of the blood and other fluids inside. Thus the spacemen also wear special pressurized suits as in space there is no air and hence, no air pressure.

(iv) **Atmospheric pressure on other planets:** Atmospheric pressure will exist on a planet if it has an atmosphere.

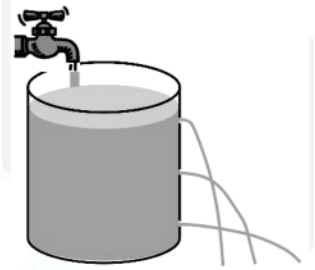
Due to the existence of hydrogen as super hot liquid metal on Jupiter, the atmospheric pressure on Jupiter is very high. Atmospheric pressure on Venus is about 90 times as that on the surface of the Earth due to the presence of CO_2 in its atmosphere.

Note: **(a)** At the top of a mountain, some people can feel their ears " popping" due to decrease in air pressure. The ears pop in order to balance the difference in pressure inside and outside the body.

(b) Hovercraft: It is a vehicle which can travel on ground or water without actually touching the surface. Large fans are used to create an air cushion under the hovercraft. The pressure of the air cushion provides enough force to lift the hovercraft.

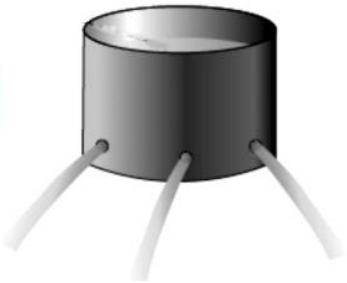
2. **Pressure exerted by fluids (liquids and gases):** When an object is immersed in a liquid, the liquid exerts a net upward force on the object. This upward force determines whether an object will float or sink in a liquid. If the upward force exceeds the weight of the object, the object will float, if the weight of the object exceeds the upward force, the object will sink.

(i) **Pressure in a liquid increases with depth** because the further down you go the greater the weight of liquid above. In figure water spurts out fastest and furthest from the lowest hole.



The pressure experienced by deep-sea divers is so great that they have to wear specially designed suits to protect themselves. They use special suits called diving suits and buoyancy compensators to combat the weight of their diving equipment and the water pressure at great depths. Dams are made stronger and thicker at the bottom than at the top to withstand the high pressures at greater depths.

(ii) **Pressure at one depth acts equally in all directions:** The can of water in figure has similar holes all round it at the same level. Water comes out fast and spurts equally from each hole. Hence the pressure exerted by the water at this depth is the same in all directions.

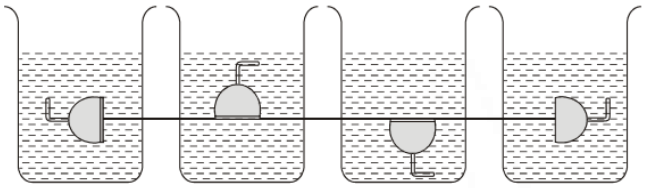


Boost your knowledge

- Pressure at same level is same. It does not depend upon the shape of the vessel.

  Activity: Take a U-tube manometer, a thistle funnel, a rubber tube, a tall vessel or beaker and some water. Cover the mouth of the thistle funnel with a rubber sheet. Connect it to a manometer by using a rubber tube. Now immerse the funnel into the tall vessel containing water. Keeping the funnel at a particular depth, change its position so that its mouth is directed downwards upwards and sideways in turn. Take care to see that the depth of the center of the rubber sheet does not

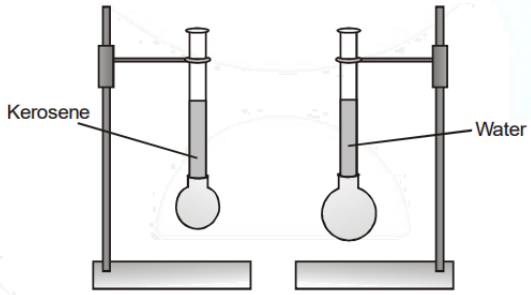
change. Observe the manometer reading in all the positions of the funnel. Is there any difference among the readings?



The manometer reading is the same when the funnel is kept at a given depth upwards, downwards or sideways. We will observe that in all these positions of the funnel (for which the center of the rubber sheet is at the same depth), the manometer reading does not change. This shows that the pressure remains the same in all **directions at a given depth.**

(iii) Liquid pressure depends upon the density of the liquid: The denser the liquid, the greater the pressure at any given depth.

Activity: Take two glass tubes each about 3 cm wide, 10 cm long and open at both ends figure. Tie thin stretched rubber membrances at one end of each tube. Hold the tube in a vertical position. Pour water in one tube and kerosene in the other tube. Note that the volumes of the liquids in both the tubes should be the same. Observe the bulge produced in each case. You will find that the bulge of the tube filled with water is bigger. Water is heavier than kerosene oil. So it exerts more pressure.



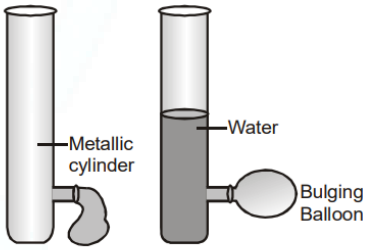
Bigger bulge produce by water than kerosene oil

Boost your knowledge -

- Pressure exerted by a liquid depends upon the depth (height) of liquid and density of the liquid.

(iv) Liquid exerts pressure on the sides of the vessel

Activity: Take a metallic cylinder provided with a small opening near the base Figure Tie a rubber balloon to the side opening. Now, gradually pour water in the cylinder. You will see that with the increase in the level of water, the balloon starts bulging. This shows that pressure is exerted by water on the sides of the containing vessel.



Lateral pressure exerted by liquid

(v) A liquid seeks its own level:

Activity: Take five tubes of various shapes which are connected to each other by a horizontal pipe. Fix the apparatus in a vertical position and pour water through any one of the vertical tubes. You will see that water stands at the same horizontal level in each vessel, regardless of the shape of the vessels.

Liquid seeks its own level

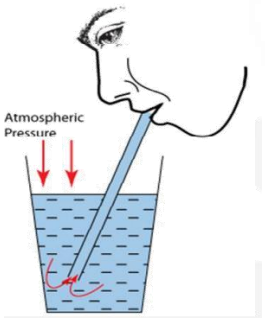
It is on account of this reason that the water reservoirs (storage tanks) are placed at a higher level, that is on top of buildings. The water flowing from these tanks tries to seek its level and hence rises up through pipes fitted in each building.

Boost your knowledge -

- Total pressure in a liquid at a depth is the sum of atmospheric pressure and pressure due to liquid column i.e., $P = P_0 + hdg$

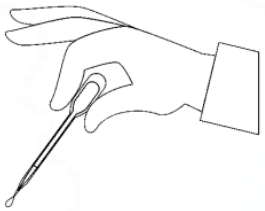
3. Role of atmospheric pressure in our daily life: There are many situations in our day-to-day life where we make use of air pressure. Given below are some examples to illustrate this idea.

(i) **Drinking Straw:** While taking a cold drink, when we suck in through the straw, we take out some air present in it. This lowers the pressure of the air there. The outside air then pushes the cold drink into our mouths through the straw.



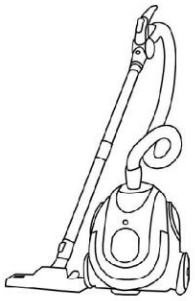
Outside air pushes the cold drink into our mouth

(ii) **Dropper:** While filling a medicine dropper or a fountain pen, we push out the air in them by pressing the rubber cap or the rubber tube. This reduces the inside pressure. Now, the higher pressure of the air outside again pushes the medicine or the ink into the dropper or the fountain pen. The doctors also use the same principle when they fill their syringe for injection purposes.



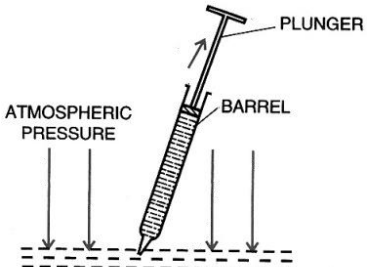
A dropper

(iii) **Vacuum Cleaner:** The vacuum cleaner is a device used for removing the dust and paper pieces quickly and efficiently from homes and offices. Here, the air inside a collecting bag is sucked out by an electric motor. The outside air then rushes into the bag, taking along any dust and paper pieces present on its way



Vacuum cleaner

(iv) **Filling of a syringe with the liquid:** When the syringe is kept with its opening just inside the liquid and the plunger is pulled up in the barrel, the pressure inside the barrel below the plunger becomes much less than the atmospheric pressure acting on the liquid. As a result, the atmospheric pressure forces the liquid to rise up in the syringe.

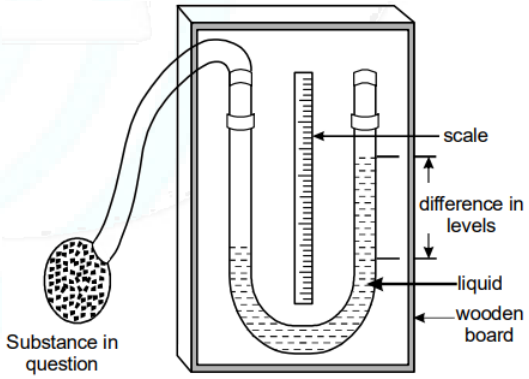


Action of syringe

In a similar manner, in a water pump, water is drawn up from a well on pulling the piston up.

Brain Teaser /

- Why bridge pole is wider at top and thinner at bottom?



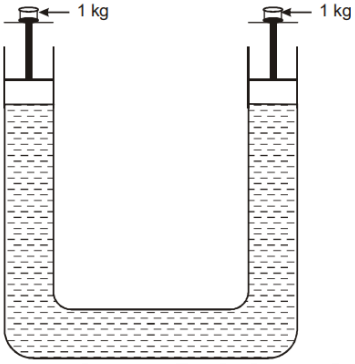
4. **Manometer:** It is an instrument used to measure pressure. An open tube manometer is the simplest type of pressure gauge which measures pressure. It consists of a U-shaped tube containing a liquid. One arm of the tube is open to air and the other arm is connected to the vessel in which we want to measure the pressure. The difference in liquid level represents the applied pressure.

5. **PASCAL'S LAW:** We have noted above that any increase in pressure on a liquid in a closed container is transmitted equally to all parts of the liquid. This basic law was discovered by the French physicist Blaise Pascal (1623-1662) and

is known by his name. According to Pascal's Law, the pressure exerted at any point on an enclosed liquid is transmitted equally in all directions throughout the liquid.

Activity: Take a U-tube (with equal–sized limbs) filled with water and fitted with pistons. If we keep a one kg weight on one piston. we observe that this piston starts moving downwards and the other piston starts moving upwards. This upward movement of the other piston stops only when we keep a one kg weight on it.

This shows that a pressure applied at one end of the water contained in the U-tube is transmitted equally in all directions.



A pressure applied at one end of the tube is transmitted equally in all directions

Hydraulic machines such as hydraulic press, hydraulic jack and hydraulic brakes are based on Pascal's law of transmission of pressure in liquids.

(i) Principle of a hydraulic machine: The principle of each hydraulic machine is that a small force applied on a smaller piston is transmitted to produce a large force on the bigger piston.

Figure below shows two cylindrical vessels P and Q connected by a horizontal tube R. The vessels contain a liquid (or water) and they are provided with water tight pistons A and B. The vessel P is of smaller diameter than the vessel Q. Let area of cross section of the vessel P be A_1 and that of the vessel Q be A_2. A weight is placed on the piston A. It exerts a force F_1 on the piston A. Therefore the pressure applied on the piston A is

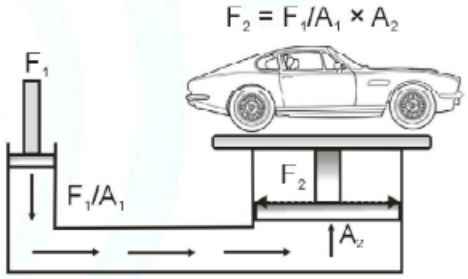
$P_1 = \frac{F_1}{A_1}$ According to Pascal's law, the pressure exerted on piston A is transmitted through the liquid to piston B. Thus, the upward pressure exerted on piston B is – $P_2 = P_1 = \frac{F_1}{A_1}$

$\frac{F_2}{A_2} = \frac{F_1}{A_1}$ or $F_2 = \frac{F_1}{A_1} \times A_2$ or $\frac{F_2}{F_1} = \frac{A_2}{A_1}$

Since $A_2 > A_1$, therefore $F_2 > F_1$

(ii) Hydraulic jack (or Hydraulic lift): A hydraulic jack is used for lifting heavy vehicles such as cars , trucks etc. in service stations for their repairing. It works on the Pascal's principle (or the principle of a hydraulic machine).

(a) Constructions: A simple form of a hydraulic jack is shown in figure. It consists of two cylindrical vessels P and Q connected to each other by a tube R having a valve V. The piston A in the narrow cylinder P is attached to a lever and the piston B of the wider cylinder Q has a platform for lifting the vehicle. The vessels are filled with a liquids (say, water).

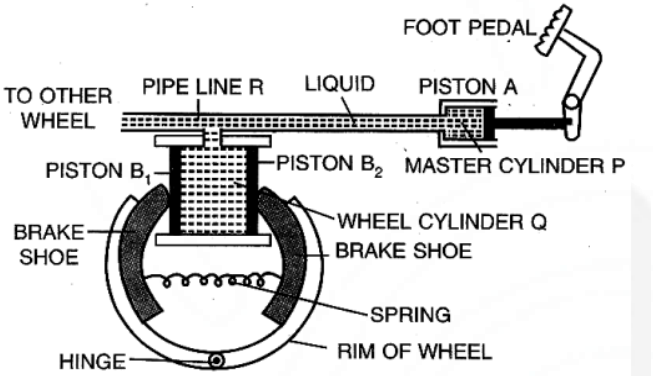


(b) Working: When handle H of the lever is pressed down by applying the effort , the valve V opens because of increase in pressure in the cylinder P. The liquid runs out from the cylinder P to the cylinder Q. As a result, the piston B rises up and it raises the car placed on the platform. When the car reaches the desired height , the handle H of the lever is no longer pressed. The valve gets closed (since the pressure on either side of the valve becomes same) so that the liquid may not run back from the cylinder Q to the cylinder P.

(iii) Hydraulic brakes: The hydraulic brakes used in cars etc. are also based on Pascal's principle.

(a) Construction: Shows the hydraulic brake arrangement of a vehicle. It consists of a pipe line R containing a liquid (oil), one end of which is connected to the master cylinder P fitted with a piston A attached to the foot pedal. The other end

of the pipe is connected to different wheels of the vehicle. In only one wheel is connected. For each wheel, there is a wheel cylinder Q having two pistons B_1 and B_2 attached to the brake shoes. The area of cross section of the wheel cylinder Q is greater than the area of cross section of the master cylinder P. The brake shoes press against the rim of the wheel.



(b) Working: To apply the brakes , the foot pedal is pressed due to which pressure is exerted on the liquid in the master cylinder P. The liquid runs out from the master cylinder P to the wheel cylinder Q. As a result, the pressure is transmitted equally and undiminished through the liquid to the pistons B_1 and B_2 of the wheel cylinder Q.

Therefore the pistons B_1 and B_2 get pushed outwards and the brake shoes get pressed against the rim of the wheel due to which the motion of vehicle retards. Since the area of cross section of piston A in the master cylinder P is less than that in the wheel cylinder Q, a small force applied at the foot pedal produces a large force on the pistons B_1 and B_2 of the wheel cylinder Q this force is responsible for retarding the motion of the vehicle). It should be noted that due to transmission of pressure through the liquid, equal pressure is exerted on all the wheels of the vehicle connected to the pipe line R. On releasing the pressure on the pedal, the liquid runs back from the wheel cylinder Q to the master cylinder P and the spring pulls the break shoes to their original positions and forces the pistons B_1 and B_2 to return back into the wheel cylinder Q. Thus, the brakes are released.

FUNDAMENTAL UNLOCKED- (FU#2)

Q.1 It is difficult to cut vegetables with a blunt knife because

(A) The pressure exerted by the blunt knife is more for a given force

(B) The sharp edge decreases the pressure exerted by the knife for a given force

(C) Blunt knife decreases the pressure for a given force

(D) Blunt knife decreases the area of cross-section

Q.2 Railway tracks are laid on wooden or cemented sleepers. This is because they

(A) Increase the pressure of the train

(B) Increase the speed of the train

(C) Increase the area so as to reduce pressure

(D) Decrease the area in order to increase pressure

Q.3 The pressure in human body is maximum

(A) At feet (B) On head

(C) On hands (D) On knees

Q.4 Four cylindrical beakers, having base areas in the order A > B > C > D, contain equal volume water. The pressure exerted at the bottom is maximum for the beaker

(A) A (B) B

(C) C (D) D

Q.5 It is not advisable to keep a fountain pen on a flight because

(A) It does not work at higher altitude

(B) It starts leaking as the atmospheric pressure reduces at higher altitude

(C) The fountain pen becomes heavier in Aeroplan

(D) The atmospheric pressure is greater at high altitude

Q.6 Pressure inside an inflated balloon is

(A) Less than atmospheric pressure
(B) Greater than atmospheric pressure
(C) Equal to atmospheric pressure
(D) May be less than or equal to atmospheric pressure

Q.7 The liquid pressure 10 meter below the open surface of water is
(A) Equal to the atmospheric pressure
(B) More than the atmospheric pressure
(C) Less than the atmospheric pressure
(D) Equal to 10 times of the atmospheric pressure

ANSWER KEY

FUNDAMENTAL UNLOCKED- (FU#1)

Q.1 (C) **Q.2** (C) **Q.3** (D) **Q.4** (D) **Q.5** (B) **Q.6** (A)

FUNDAMENTAL UNLOCKED- (FU#2)

Q.1 (C) **Q.2** (C) **Q.3** (A) **Q.4** (D) **Q.5** (B) **Q.6** (B)
Q.7 (B)

EXERCISE - I

Single Correct Type Questions

1. Force is a
(A) Vector quantity (B) Scalar quantity
(C) Both (A) & (B) (D) None of these

2. When an object undergoes acceleration:
(A) its speed always increases
(B) its velocity always increases
(C) it always falls towards the earth
(D) a force always acts on it

3. External forces are
(A) always balanced
(B) never balanced
(C) may or may not be balanced
(D) none of these

4. The net force acting on a body of mass 1 kg moving with a uniform velocity of 5 ms-1 is
(A) 5 N
(B) 0.2 N
(C) 0 N
(D) None of these

5. How many dynes are equal to 1N?
(A) 10^6 (B) 10^4 (C) 10^5 (D) 10^3

6. A force can:
(A) Change the direction of a moving body
(B) Change the state of rest or uniform motion of a body
(C) Change the shape of a body
(D) All of the above

7. SI unit of force is
(A) dyne (B) newton
(C) gf (D) can't say

8. If a rock is brought from the surface of the moon
(A) its mass will change
(B) its weight will change, but not mass
(C) both mass and weight will change
(D) its mass and weight will remain the same

9. A body is moving with certain velocity towards right. A force of 5N is applied on it towards right and a force of 6N is applied on it towards left then:
(A) Speed of body increases towards right
(B) Speed of body increases towards left
(C) Speed of body remains the same
(D) Speed of body decreases

10. How much force is required to lift a mass of 100g:
(A) 10 N (B) 1 N (C) 100 N (D) 1000 N

11. The S.I. unit of pressure is:
(A) newton (B) dyne/cm^2
(C) pascal (D) joule

12. Which among the following will exert maximum pressure when pushed with the same amount of force?
(A) An eraser of area 2 cm^2
(B) A sharpened pencil tip
(C) The blunt end of a pencil
(D) The rear portion of a closed safety pin

13. When a force is applied over a larger area, the pressure produced will:
(A) increase
(B) decrease
(C) both (A) and (B)
(D) none of these

14. Pressure is also measured in:
(A) joule (B) mm of Hg
(C) mm of Ag (D) meter

15. Force per unit area is called:
(A) Energy (B) work
(C) pressure (D) thrust

16. Pressure in solids:
(A) increases with increase in area of cross section
(B) increases with decrease in area of cross section
(C) is independent of area of cross section
(D) none of these

17. For a fixed area of contact, the pressure exerted:
(A) increases with increase in force
(B) increases with decrease in force
(C) is independent of force
(D) none of these

18. Sharper knives cut fruits easily because:
(A) the area of contact is more
(B) the area of contact is less
(C) it shines more
(D) none of these

19. A force of 50 N is applied normally on a table top of area 2 m^2. Then the pressure exerted on the table top is:
(A) 25 Nm^{-2} (B) 50 Nm^{-2}
(C) 10 Nm^{-2} (D) 100 Nm^{-2}

20. Pressure cannot be measured in :
(A) Nm^{-2} (B) bar
(C) Pa (D) Kg wt

21. Atmospheric pressure is measured by:
(A) barometer
(B) manometer
(C) screw gauge
(D) none of these

22. Pressure exerted by liquids depend on the
(A) shape of the container
(B) size of the container
(C) depth of the container
(D) colour of the container

23. How does pressure vary as we come from mountain top to sea level?
(A) increases
(B) decreases
(C) remains same
(D) depends on weather

24. As we go deeper beneath the surface of a liquid, the pressure:
(A) remains same
(B) increases
(C) decreases
(D) depends on weather

25. A vacuum cleaner works on the principle of:
(A) Electro magnetic Induction
(B) Suction
(C) Mutual Induction
(D) Energy conservation

Very Short Answer Type Questions

1. Write the SI and CGS unit of force.

2. What are the different types of non contact forces?

3. What do you mean by Resultant force?

4. What are the gravitational units of force?

5. Force can change the direction of a moving body. Explain with the help of some examples.

6. What do you mean by 1atm pressure?

7. What are the factors on which pressure depends?

8. What is the gravitational unit of pressure?

9. What kind of charges repel each other?

10. What kind of magnet's pole attract each other?

Short Answer Type Questions

1. What are Balanced and Unbalanced Forces?

2. A force can change the shape of object. Explain.

3. Differentiate between contact and non-contact force.

4. An inflated balloon was pressed against a wall after it has been rubbed with a piece of synthetic cloth. It was found that the balloon sticks to the wall. What force might be responsible for the attraction between the balloon and the wall?

5. A rocket has been fired upwards to launch a satellite in its orbit. Name the two forces acting on the rocket immediately after leaving the launching pad.

6. A camel can move fast on sand but we can't. Give reason.

7. Explain Thrust with the help of an example.

8. What are the ways through which pressure can be reduced?

9. Explain pressure in liquids with suitable examples.

10. Write two applications of pressure in our daily life

Long Answer Type Questions

1. State the effect of the force-
(i) squeezing a lemon
(ii) taking out paste from a toothpaste tube.
(iii) A lump of dough on a plate.
(iv) Hit a ball by a cricket player with bat.
(v) Brakes is applied to a moving car

2. Write five instances which is used to reduce pressure.

3. Define atmospheric pressure and explain variation of atmospheric pressure with altitude.

4. What is manometer? Write its construction also.

5. In the following statements, mark T against those which are true and F against those which are false:
(i) Atmospheric pressure is increase with altitude.
(ii) Pressure is increases by depth.
(iii) Pressure of water is equal to pressure of kerosine.
(iv) The atmospheric pressure on moon is double of earth.
(v) Pressure is inversely proportional to the area.

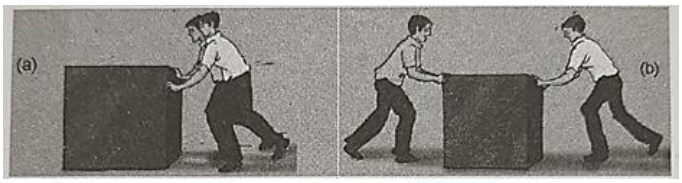
6. Explain with the help of example pressure exerted by the water at same depth is same in all direction?

7. (a) Why spacemen wear special type of suits in space?
(b) Why Dams are made stronger and thicker at the bottom?

8. Define contact force and non-contact force give all its example?

Case Based Question

1. **Read the following and answer the questions from (I) to (V).**
A block is placed on a smooth horizontal surface. In first case, two boys A and B push it in the same direction as shown in figure (a). Now in second case, both boys A and B push in opposite directions such that the block remains in the state of rest as shown in figure (b).



(I) What kind of force is applied by the earth on the box?
(A) Gravitational
(B) Electrostatic
(C) Muscular
(D) Magnetic

(II) In first case the block
(A) Will remain at rest
(B) Will move with constant speed in the direction of applied force
(C) Will move with increasing speed in the direction of applied force
(D) Will move with increasing speed in the direction opposite to the applied force

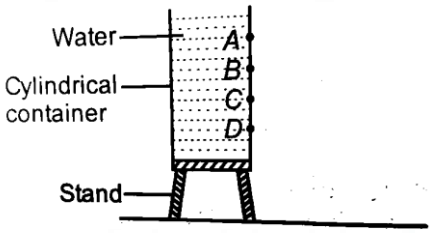
(III) What kind of force is applied by boys?
(A) Magnetic
(B) Gravitational
(C) Friction
(D) Muscular

(IV) Which of the following statement is correct regarding second case?
(A) Boy-A is pushing with greater force
(B) Boy-B is pushing with greater force
(C) Both are pushing with equal amount of forces
(D) Both are pushing with unequal amount of forces

(V) Which of the following is a non-contact force?
(A) Frictional force (B) Normal reaction
(C) Muscular force (D) Magnetic force

2. Read the following and answer the questions from (I) to (V).

Tushar was observing a cylindrical container which placed on stand have four holes. Container was filled. with water, the water was flowing through the holes marked as A, B, C and D. Water jets coming out of holes fall on ground at different horizontal distances from stand. He went to is teacher and asked some questions as mentioned below.



(I) The jet from which hole has covered the maximum horizontal distance?
(A) A (B) B (C) C (D) D

(II) Pressure is the lowest at hole
(A) A (B) B
(C) C (D) D

(III) Pressure in the container with increase in depth
(A) Increases
(B) Decreases
(C) Remains same
(D) May increase or decrease

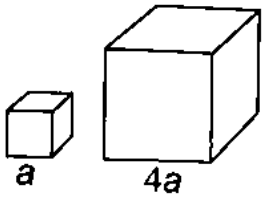
(IV) If the same container is filled with oil, then the pressure will be maximum at hole
(A) A (B) B
(C) C (D) D

(V) Choose the correct statement(s) from the following:
(A) A liquid exerts pressure at the bottom of the container
(B) A liquid exerts pressure on the walls of the container
(C) A liquid exerts equal pressure in all directions at a given depth
(D) All of these

EXERCISE - II

HOTS

1. A cube of side a, rests on the floor as shown in the given figure. Given that the pressure exerted by this cube on the floor is P, what is the pressure exerted by another cube of the same material of side 4a ? (Take g= 10 N kg-I)

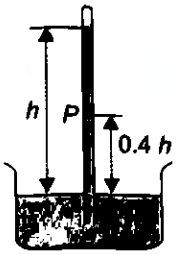


(A) P (B) 2P (C) 4P (D) 16P

2. The surface area of the base of a brick X is 100 cm^2. The surface area of the base of the brick Y is 250 cm^2. Each brick weighs 100 N. Which of the following is correct if P_1 and P_2 are the pressures exerted by the bricks X and Y respectively?

(A) $P_1 = P_2$ (B) $P_1 > P_2$
(C) $P_1 < P_2$ (D) $P_1 = P_2 = 0$

3. The diagram shows a simple mercury barometer. The mercury level is at a height h when the atmospheric pressure is 100000 Pa. What is the pressure at P?

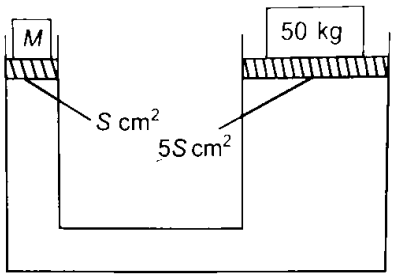


(A) 40000 Pa
(B) 60000 Pa
(C) 100000 Pa
(D) 140000 Pa

4. As we go higher up on mountains, our ears pop because

(A) Air pressure outside our ears increases
(B) The pressure exerted by the blood near ears increases
(C) Air pressure outside our ears decreases
(D) None of these.

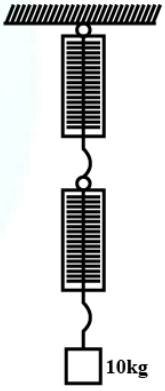
5. The diagram shows a hydraulic system in equilibrium. The cross-sectional areas of the smaller piston and the larger piston are S cm^2 and 5 S cm^2 respectively.



The mass M required to balance the load of 50 kg is

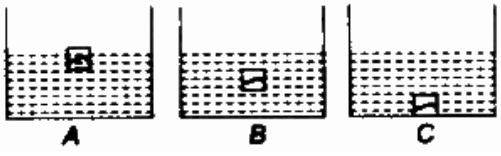
(A) 2 kg (B) 5 kg (C) 8 kg (D) 10 kg

6. A block of mass 10 kg is suspended through two light spring balances as shown in figure. Then (Neglect the mass of spring balance.)



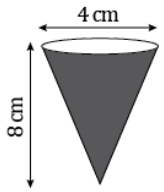
(A) Both the scales will read 10 kg
(B) Both the scales will read 5 kg
(C) The upper scale will read 10 kg and the lower scale zero
(D) The individual reading may be anything but their sum will be 10 kg.

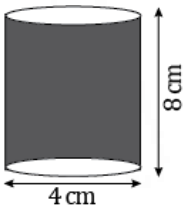
7. Three identical vessels P, Q and R contain same quantity of liquid. In each vessel, blocks with different densities but same masses are placed as shown in figure. If Fp, F_Q and F are the total forces acting on the base Of vessels P, Q and R respectively, then

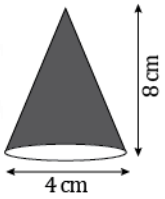


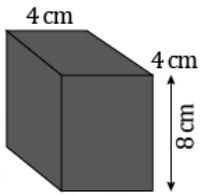
(A) $F_P = F_Q = F_R$ (B) $F_P < F_Q < F_R$
(C) $F_P = F_Q < F_R$ (D) $F_P > F_Q > F_R$

8. Which of the following objects exerts the maximum pressure on the floor? (All objects have the same mass.)

(A) 

(B) 

(C) 

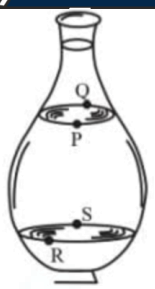
(D) 

9. Match the following column:

Sr. No	Objects		Nature of force
1	Force on falling ball	A	Frictional force
2	Force on moving charge	B	Muscular force
3	Force on lifting objects	C	Electrostatic force
4	Force on sliding ball	D	Gravitational force

(A) 1-D , 2-C ,3-B, 4-A
(B) 1-A , 2-D ,3-B, 4-C
(C) 1-B, 2-C ,3-D, 4-A
(D) 1-C , 2-D ,3-A, 4-D

10. In the adjoining diagram, a pot is riled with water. P, Q, R and S are the points as shown in the diagram. About liquid pressure at P and Q which statement is correct from the following?



(A) Liquid pressure at both points P and Q is equal.
(B) Liquid pressure at points P and Q is different.
(C) Liquid pressure at points P and Q is greater than the pressure at point R.
(D) Liquid pressure at point S is less than the pressure of liquid at points P and Q.

11. What is the change in pressure if the force is doubled and the area on which force applied is halved?
(A) Double (B) Remains same
(C) Four times (D) Half

12. Select the correct group of units of pressure from the following:
(P) Pascal
(Q) N/m^2
(R) dyne cm^2
(S) bar
(A) P, Q, S (B) P, R, S
(C) P, Q, R (D) P, Q, R, S

13. In which of the following positions the person exerts minimum pressure on the earth?
(A) Standing erect on head
(B) Seating on the floor
(C) Standing on one leg
(D) Sleeping on the back

14. Select the correct factor on which the pressure exerted by a body on the surface does not depend?
(A) Weight of body
(B) Area of surface in contact
(C) Volume of body
(D) Nature of surface in contact

15. A piston applies a force of 36 N on a square area having length 12 cm. Find the pressure acting on this plate.
(A) 25 Pa
(B) 250 Pa
(C) 2,500 Pa
(D) 25,000 Pa

Assertion & Reason Type Questions

In the following questions, a statement of assertion (A) is followed by a statement of reason (R).

(1) If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).
(2) If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2).
(3) If Assertion is true statement but Reason is false, then mark (3).
(4) If both Assertion and Reason are false statements, then mark (4).

1. **Assertion (A):** The net force acting on a body is zero, if it is moving in a straight line, with constant speed.
Reason (R): A force can change the state of motion of an object.

2. **Assertion (A):** A ball rolling on the ground gradually slows down and finally comes to rest.
Reason (R): The friction force opposes the relative motion of a body.

3. **Assertion (A):** Two charged bodies attract each other even when they are not in actual contact.
Reason (R): The force acting between two objects without any physical contact between them is called a non-contact force.

4. **Assertion (A):** Shoulder bags are provided with broad straps.
Reason (R): If the area of contact is increased keeping the magnitude of force constant, then the pressure decreases.

5. **Assertion (A):** Deep sea divers wear armored suits while diving.
Reason (R): The pressure below the ocean surface is much higher than the atmospheric pressure.

Numerical Type Questions

1. When a force of 40 N is applied on a body, it moves with an acceleration of 5 ms^{-2}. Calculate the mass of the body.

2. It is required to increase the velocity of a scooter of mass 80 kg from 5 ms^{-1} to 25 ms^{-1} in 2 second. Calculate the force required.

3. A car of mass 1000 kg is moving with a velocity of 10 m/s and is acted upon by a forward force of 1000 N due to engine and retarding force of 500 N. Calculate the velocity after 10 seconds.

4. A car of mass 500 kg is starts from rest and is acted upon by a forward force of 200 N due to engine and retarding force of 50 N. Calculate the velocity after 5 seconds.

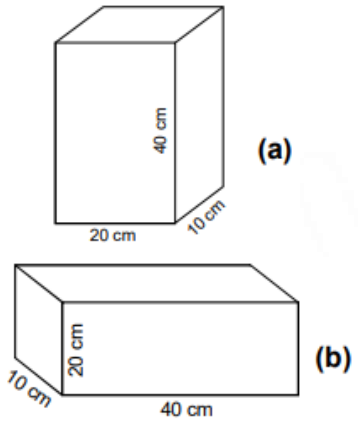
5. If a force of 100 dyne is applied over an area of 2 cm^2. Calculate the pressure produced in Pascal.

6. In a hydraulic machines, a force of 2 N is applied on the piston of area of cross section 10 cm^2. What force is obtained on its piston of area of cross section 100 cm^2.

7. If the area of my head were 10 cm × 10 cm, how much weight of air would I be carrying on my head?

8. A block of wood is kept on a tabletop. The mass of wooden block is 5 kg. and its dimensions are 40 cm × 20 cm × 10 cm. Find the pressure exerted by the wooden block on the table top if it is made to lie on the table top with its sides of dimensions
(a) 20 cm × 10 cm and (b) 40 cm × 10 cm.

(Take g = 10 m/s^2)



9. Imagine a girl of mass 50kg standing on pencil heels, each of area of cross–section of 1 cm^2, and an elephant of mass 2000 kg and foot area of 250 cm^2 standing on floor. Find the pressure exerted by each of them
assuming acceleration due to gravity is 10 m/s^2. Which of the two exerts more pressure on the floor?

10. A cubical block of mass 2.5 kg is kept on a levelled horizontal surface. If it exerts a pressure of 100 Pa on the surface, then find the volume of the block. [Take g = 10m/s^2]

EXERCISE - III

Previous Year Questions

1. Read the given statements and select the correct option.

Statement 1 : When deep-sea fish are brought to the surface of the sea, their bodies burst.

Statement 2 : Blood in the blood vessels of the deep-sea fish flows at very high pressure.

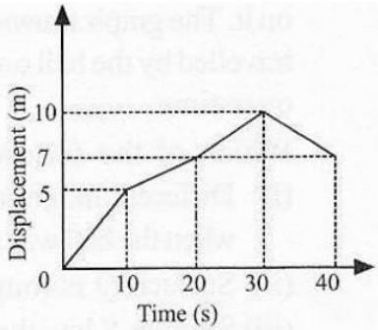
(A) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.

(B) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.

(C) Statement 1 is true but statement 2 is false.

(D) Statement 1 is false but statement 2 is true.

2. Study the displacement- time graph of a toy car given here and choose the correct statement(s) from the following.



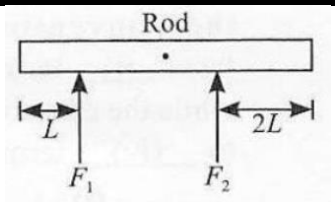
(A) The toy car is slowest during first 10 seconds.

(B) The toy car is slowest in between 10 to 20 seconds.

(C) The toy car is fastest during first 10 seconds.

(D) Both B and C.

3. A 100 N uniform rod of length 6L is supported by two forces F_1 and F_2 as shown here. What is the ratio for F_1 to F_2



(A) 2 : 1 (B) 1 : 2 (C) 3 : 1 (D) 1 : 3

4. If a body travels a total distance of 15 km in first hour, 30 km in the second hour and 45 km at the end of third hour, the body

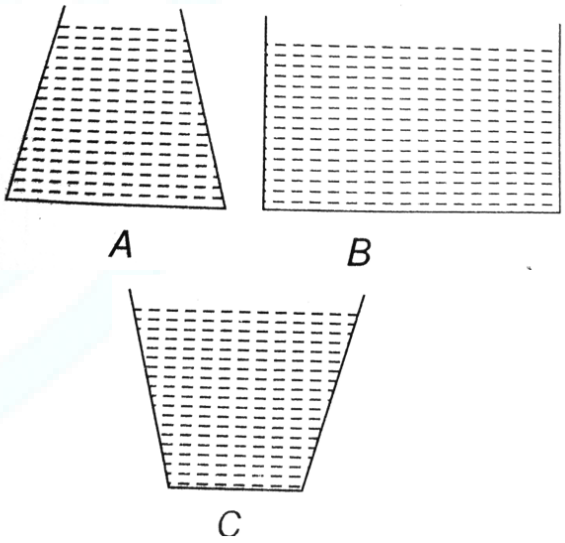
(A) Is in uniform motion

(B) Is in non-uniform motion

(C) May be in uniform or non-uniform motion

(D) Is moving with non-zero acceleration.

5. The same liquid is filled in vessels of three different shapes up to the same height, as shown in figures (a), (b) and (c). Each vessel has equal base area.



Let P_a, P_b and P_c are the values of liquid pressure on the base of vessels in figure (a), (b) and (c)respectively. W_a, W_b and W_c are the weights of liquid contained in vessels in figure (a), (b) and (c) respectively. Choose the correct option

(A) $P_a < P_b < P_c$ and $W_a < W_b < W_c$

(B) $P_a = P_b = P_c$ and $W_a = W_b = W_c$

(C) $P_a < P_b < P_c$ and $W_a = W_b = W_c$

(D) $P_a = P_b = P_c$ and $W_a < W_b < W_c$

ANSWER KEY

EXERCISE-I

Single Correct Type Questions

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	A	D	C	C	C	D	B	B	D	B	C	B	B	B	C
Que.	16	17	18	19	20	21	22	23	24	25					
Ans.	B	A	B	A	D	A	C	A	B	B					

Case Study Questions

Case-1					
Que.	1	2	3	4	5
Ans.	A	C	D	C	D
Case-2					
Que.	1	2	3	4	5
Ans.	D	A	A	D	D

EXERCISE-II

HOTS

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	B	B	C	D	A	A	A	A	A	B	A	D	C	C

Assertion and Reason

Que.	1	2	3	4	5	
Ans.	B	A	B	A	A	

Numerical Answer Type Questions

1. m = 8 kg **2.** F = 800 N **3.** V = 15 m/s

4. V = 1.5 m/s **5.** P = 5 Pa **6.** F = 20 N

7. F = 1010 N **8.** (a) P = 2500 Pa, (b) P = 1250 Pa.

9. A girl exert more pressure on floor **10.** V = ½

EXERCISE-III

Previous Year Questions

Que.	1	2	3	4	5	
Ans.	A	B	B	A	D	