

Chapter 2

Forces and Pressure

I. Choose the best Answer

Question 1.

If we apply a force against the direction of motion of a body, then the body will –

- (a) Stop moving
- (b) Move with an increased speed
- (c) Move with a decreased speed
- (d) Move in a different direction

Answer:

- (a) stop moving

Question 2.

Pressure exerted by a liquid is increased by –

- (a) The density of the liquid
- (b) The height of the liquid column
- (c) Both (a) & (b)
- (d) None of the above

Answer:

- (c) Both (a) & (b)

Question 3.

Unit of pressure is –

- (a) Pascal
- (b) N m^{-2}
- (c) Poise
- (d) Both (a) & (b)

Answer:

- (d) Both (a) & (b)]

Question 4.

The value of the atmospheric pressure at sea level is –

- (a) 76 cm of mercury column
- (b) 760 cm of mercury column
- (c) 176 cm of mercury column
- (d) 7.6 cm of mercury column

Answer:

- (a) 76 cm of mercury column

Question 5.

Pascal's law is used in –

- (a) Hydraulic lift
- (b) Brake system
- (c) Pressing heavy bundles
- (d) All the above

Answer:

- (d) All the above

Question 6.

Which of the following liquids has more viscosity?

- (a) Grease
- (b) Water
- (c) Coconut oil
- (d) Ghee

Answer:

- (a) Grease

Question 7.

The unit of viscosity is –

- (a) N m^2
- (b) Poise
- (c) kg m s^{-1}
- (d) No unit

Answer:

- (b) poise

II. Fill in the blanks

1. The pressure of a liquid column with the depth of the column.
2. Hydraulic lift works under the principle of
3. The property of of a liquid surface enables the water droplets to move upward in plants. [Ans. surface tension]
4. A simple barometer was first constructed by

Answer:

1. Increases
2. Pascal's Law
3. Surface tension
4. Torricelli

III. State whether the following statements are true or false

Question 1.

Force acting on a given area is called pressure.

Answer:

True

Question 2.

A moving body comes to rest due to friction alone.

Answer:

True

Question 3.

A body will sink if the weight of the body is greater than the buoyant force.

Answer:

True

Question 4.

One atmosphere is equivalent to 1,00,000 newton force acting on one square metre.

Answer:

True

Question 5.

Rolling friction is slightly greater than the sliding friction.

Answer:

False

Correct statement:

Rolling friction is slightly lesser than the sliding friction.

Question 6.

Friction is the only reason for the loss of energy.

Answer:

True

Question 7.

Liquid pressure decreases with the decrease of depth.

Answer:

True

Question 8.

Using barometers, one can measure the height of a building.

Answer:

False

Correct statement:

Using barometers, one can measure the atmospheric pressure.

Question 9.

Surface tension causes the spherical nature of a water drop.

Answer:

True

Question 10.

Viscosity depends on the pressure of a liquid.

Answer:

True

IV. Arrange the following in the increasing order

Question 1.

Rolling friction, static friction, sliding friction

Answer:

Static friction, Rolling friction, Sliding friction.

Question 2.

Let a marble roll on the following surfaces. Arrange the choice of the material such that a marble moving over it covers a greater distance.

Cotton cloth, glass plate, paper, card board, silver plate

Answer:

Glass plate, silver plate, paper, cotton cloth, card board.

V. Match the following

Question 1.

Match: I		
Column I		Column II
a)	Static friction	viscosity
b)	Kinetic friction	least friction
c)	Rolling friction	objects are in motion
d)	Friction between the liquid layers	objects are sliding
e)	Sliding friction	objects are at rest

Answer:

- i. e
- ii. c
- iii. b
- iv. a
- v. d

Question 2.

Match: II		
Column I		Column II
a)	Barometer	reduce friction
b)	Increase friction	atmospheric pressure
c)	Decrease friction	cause of friction
d)	Lubricants	increasing area of contact
e)	Irregular surface	decreasing area of contact

Answer:

- i. b
- ii. d
- iii. e
- iv. a
- v. c

VI. Analogy**Question 1.**

Knot in a thread : _____ friction :: ball bearing : friction _____

Answer:

Rolling, Static.

Question 2.

Downward force : weight :: Upward force offered by liquid : _____

Answer:

Buoyant force.

VII. Problems**Question 1.**

A stone weighs 500 N. Calculate the pressure exerted by it if it makes a contact with a surface of area 25 cm².

Answer:

Given : Weight of a stone $F = 500 \text{ N}$

Area $A = 25 \text{ cm}^2 = 25 \times 10^{-4} \text{ m}^2$

To find : Pressure $P = ?$

Formula :

$$\begin{aligned}\text{Pressure } P &= \frac{F}{A} \\ &= \frac{500}{25 \times 10^{-4}}\end{aligned}$$

Solution:

Pressure $P = 20 \times 10^4 \text{ N/m}^2$ (or) $20 \times 10^4 \text{ Pa}$

Question 2.

In a hydraulic lift, the surface area of the input piston is 10 cm^2 . The surface area of the output piston is 3000 cm^2 . A 100 N force applied to the input piston raises the output piston. Calculate the force required to raise the output piston.

Answer:

Solution:

Pressure input on piston,

$$\begin{aligned}P &= \frac{F}{A} \\ &= \frac{100}{10 \times 10^{-4}} = 10^5 \text{ N}\end{aligned}$$

According to Pascal's law

$$\begin{aligned}P &= \frac{F}{A} \\ P &= \frac{F}{A} \\ 10^5 &= \frac{F}{3000 \times 10^{-4}} \\ 10^{-4} \times F &= 10^5 \times 3000 \\ F &= 3000 \times 10^1 \\ &= 3 \times 10^4 \text{ N}\end{aligned}$$

VIII. Assertion & Reason

Mark the correct choice as :

- (a) If both assertion and reason are true and the reason is the correct explanation of the assertion.
- (b) If both assertion and reason are true, but the reason is not the correct explanation of the assertion.
- (c) If the assertion is true, but the reason is false.
- (d) If the assertion is false, but the reason is true.

Question 1.

Assertion : Sharp knives are used to cut the vegetables.

Reason : Sharp edges exert more pressure.

Answer:

(a) Both assertion and reason are true and the reason is the correct explanation of the assertion

Question 2.

Assertion : Broad straps are used in bags.

Reason : Broad straps last for long life.

Answer:

(b) Both assertion and reason are true, but the reason is not the correct explanation of the assertion

Correct explanation:

The weight of the bags falls on larger area of shoulder. So lesser pressure is produced.

Question 3.

Assertion : Water strider slides easily on the surface of water.

Reason : Water strider experiences less buoyant force.

Answer:

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion

Correct explanation :

It is due to the surface tension of water.

IX. Answer the following in one or two sentences (LOT)

Question 1.

Give two examples to verify that a force changes the shape of a body.

Answer:

Force can change the static condition of a body.

1. If you squeeze a sponge, its shape changes.
2. If you pull a rubber band, it becomes longer.

Question 2.

Give two examples to verify that a force tends to change the static condition of a body.

Answer:

Force can change the static condition of a body.

1. A rest rubber ball begins to move, when a force applied on it.
2. Player applies a force on the stationary football while taking a penalty kick in football match. The force applied by player makes the football move towards the goal.

Question 3.

Taking out paste from a tooth paste tube is an example to highlight which physical

property?

Answer:

Pascal's law.

Question 4.

What do you feel when you touch a nail immediately after it is hammered into a wooden plank? Why?

Answer:

The nail becomes hot due to friction. Friction changes kinetic energy to heat.

Question 5.

How does the friction arise between the surfaces of two bodies in relative motion?

Answer:

The force of friction is arised by the interlocking of the irregularities of the two surfaces.

Question 6.

Name two instruments, which help to measure the pressure of a fluid.

Answer:

1. Manometer
2. Pressure gauge.

Question 7.

Define one atmosphere.

Answer:

The pressure exerted by this mercury column is considered as the pressure of magnitude 'one atmosphere' (1 atm).

Question 8.

Why are heavy bags provided with broad straps?

Answer:

Broader straps are provided on a back – pack for giving less pressure on the shoulders by providing a larger area of contact with the shoulder.

Question 9.

How does surface tension help a plant?

Answer:

Water molecules rise up due to surface tension. Xylem tissues are very narrow vessels present in plants. Water molecules are absorbed by the roots and these vessels help the water to rise upward due to “capillarity action” which is caused by the surface tension of water.

Question 10.

Which has greater viscosity, oil or honey? Why?

Answer:

Honey has greater viscosity.

Reason : Thicker liquids are more viscous than thinner liquids. As honey has greater viscosity, more frictional force will be acting on it.

X. Answer the following Questions with a few sentences (MOT)

Question 1.

Define friction. Give two examples of the utility of friction in day to day life.

Answer:

Friction : Friction is a force that slows down moving objects or prevents stationary objects from moving.

Examples of the utility of friction in day to day life.

- Cars and buses are able to move safely on the road because of friction between the treaded tyres and the surface of the road.
- We are able to write on paper only with the help of friction between the pencil or pen and paper.

Question 2.

Write down three ways of minimising friction.

Answer:

1. By using lubricants:

These are applied to surfaces to reduce the friction between the surfaces. Example Oil, wax, grease and castor oil.

2. With the help of polishing the surface:

We sprinkle fine powder on the carrom board and then we polish its surface to make smooth so that the striker slides easily on the surface.

3. By using ball bearing:

We use ball bearings in bearing of a cycle hub because rolling friction is smaller than sliding friction.

Question 3.

How do sailors protect their ship during a heavy storm?

Answer:

During a heavy storm, sailors pour soap powder or oil into the sea near their ship to decrease the surface tension of sea water. This process reduces the impact of the violent water current against the wall of ship.

Question 4.

Write down three applications of Pascal's law.

Answer:

1. In an automobile service station, the vehicles are lifted upward using the hydraulic lift, which works as per Pascal's law.

2. The automobile brake system works according to Pascal's law.
3. The hydraulic press is used to make the compressed bundles of cotton or cloth so as to occupy less space.

Question 5.

Why is a ball bearing used in a cycle hub?

Answer:

The rolling friction is smaller than sliding friction, sliding is replaced by rolling with the usage of ball bearings. So lead shots are used in the bearing of a cycle hub.

XI. Answer the following Questions in detail

Question 1.

"Friction is a necessary evil"- explain.

Answer:

Friction is a necessity in most of our day to day activities. It is desirable in most situations of our daily life.

1. We can hold any object in our hand due to friction.
2. We can walk on the road because of friction. The footwear and the ground help us to walk without slipping.
3. Writing easily with a pen on paper is due to friction.
4. Automobiles can move safely due to friction between the tyres and the road. Brakes can be applied due to frictional resistance on brake shoes.
5. We are able to light a matchstick, sew clothes, tie a knot or fix a nail in the wall because of friction.

Though it is giving a negative effect, in most of our day to day life friction helps us to make our life easy. So, it is called as "necessary evil".

Disadvantages of friction:

1. Friction wears out the surfaces rubbing with each other, like screws and gears in machines or soles of shoes.
2. To overcome the friction an excess amount of effort has to be given to operate a machine. This leads to wastage of energy.

Question 2.

Give the different types of friction and explain each with an example.

Answer:

Friction can be classified into two basic types:

1. Static friction
2. Kinetic friction.

1. Static friction : The friction experienced by the bodies, which are at rest is called static friction. (E.g : All the objects rigidly placed to be at rest on the Earth, a knot in a thread.

2. Kinetic friction : Friction existing during the motion of bodies is called kinetic friction.

Further, kinetic friction can be classified into two:

- Sliding friction
- Rolling friction.

1. Sliding friction : When a body slides over the surface of another body, the friction acting between the surfaces in contact is called sliding friction.

2. Rolling friction : When a body rolls over another surface, the friction acting between the surfaces in contact is called rolling friction. Rolling friction is less than sliding friction. That is why wheels are provided in vehicles, trolleys, suitcases etc.

Question 3.

Describe an experiment to prove that friction depends on the nature of a surface.

Answer:

To understand about the frictional force between the layers of liquid in motion.

Materials required : Different kinds of liquid (coconut oil, honey, water, ghee), glass plates – 4 nos.

Procedure :

- Take a small quantity of different kinds of liquid like coconut oil, honey, water and ghee etc., in a cup.
- Place one drop of each liquid on a separate glass plate.
- Next, gently raise one end of the glass plate, one by one, so as to allow the liquid to slide down the smooth surface of the plate.
- Observe the speed of each liquid.

Observation:

Each liquid moves with a different speed. Water flows faster than other liquids. Coconut oil flows with a moderate speed. Ghee flows very slowly.

Inference:

Between the layers of each liquid, in motion, there is a frictional force parallel to the layers of the liquid. This frictional force opposes the motion of the liquid layers while they are in motion.

Question 4.

Explain how friction can be minimised.

Answer:

1. Using lubricants:

- A substance, which reduces the frictional force, is called a lubricant. Example: Grease, coconut oil, graphite, castor oil, etc.
- The lubricants fill up the gaps in the irregular surfaces between the bodies in contact. This provides a smooth layer thus preventing a direct contact between their rough surfaces.

2. Using ball bearing:

Since, the rolling friction is smaller than sliding friction, sliding is replaced by rolling with the usage of ball bearings. We can see lead shots in the bearing of a cycle hub.

Question 5.

Describe an experiment to prove that the pressure in a liquid increases with depth.

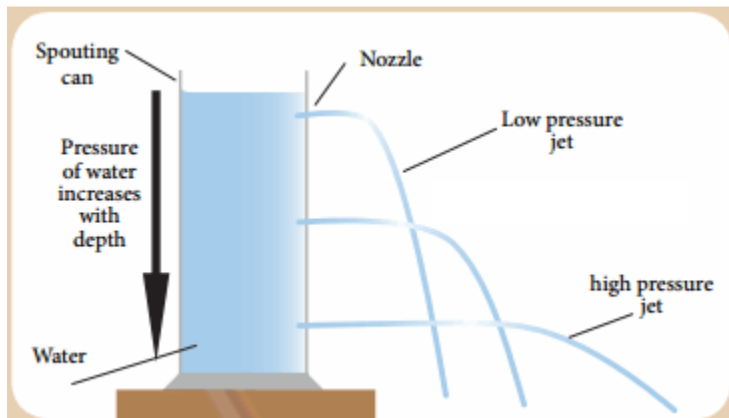
Answer:

Take a plastic bottle. Punch three holes on its side in the same direction, but at different heights. Now pour some water into it and let it flow through the holes. Observe the flow of water.

Inference:

The water comes out from all the holes with a different force and falls on the table at points that are at variable distances from the bottle. Water from the lowest hole comes out with the greatest force and falls at a point that is at the maximum distance from the bottle.

Water from the topmost hole comes out with the least force and falls at the point that is at the minimum distance from the bottle.



Reason:

This activity confirms that the pressure in a liquid varies with the depth of the point of observation in it.

XII. Hot Corner

Question 1.

Why is it not advisable to take a fountain pen while travelling in an aeroplane?

Answer:

Fountain pens are built in such a way that the pressure inside them balances the atmospheric pressure at sea level. Since atmospheric pressure decreases with an increase

in height above sea level, the pressure inside the pen turns out to be much greater than the air pressure in an aeroplane and the pen starts leaking.

Question 2.

Is there any possibility of making a special device to measure the magnitude of friction directly?

Answer:

Yes. Tribometer is a special device to measure the magnitude of friction directly.

Question 3.

Vidhya posts a question: Mercury is costly. So, instead of mercury can we use water as a barometric liquid? answer to Vidhya and explain, the difficulty of constructing a water barometer.

Answer:

1. Mercury is commonly used in barometers because of its high density means the height of the column can be a reasonable size to measure atmospheric pressure.
2. A barometer using water, for instance, would need to be 13.6 times taller than a mercury barometer to obtain the same pressure difference.
3. This is because mercury is 13.6 times more dense than water.

Question 4.

A bubble rises from the bottom of a pond to its surface by increasing its radius by 3 times its value when it was at the bottom. Calculate the depth of the pond. (Hint: Pressure depends on the depth of the pond. Volume is inversely related to pressure.)[Science Olympiad]

Answer:

Solution:

From Boyle's law $P \propto \frac{1}{V}$ (Pressure is inversely proportional to volume)

Initial pressure $P_1 = \text{Atmospheric pressure} + \text{Pressure of liquid column}$

$$\therefore p_1 = h\rho g + H\rho g$$

$h = \text{depth of the pond}$

$H = 10 \text{ m of water}$

$$V_1 = \frac{4}{3} \pi r^3$$

$$P_2 = H\rho g$$

$$V_2 = \frac{4}{3} \pi (3r)^3 = \frac{4}{3} \times 27 r^3 \times \pi$$

Hence by substituting these values,

$$P_1 V_1 = P_2 V_2$$

$$\frac{4}{3} \pi r^3 \rho g (h + 10) = 10 \rho g \times \frac{4}{3} \pi \times 27r^3$$

$$\cancel{\frac{4}{3}} \pi \cancel{r^3} \cdot \cancel{\rho g} (h + 10) = 10 \cancel{\rho g} \times \cancel{\frac{4}{3}} \pi \cancel{27} \cancel{r^3}$$

$$h + 10 = 10 \times 27$$

$$h + 10 = 270$$

$$h = 270 - 10$$

$$h = \mathbf{260 \text{ m}}$$