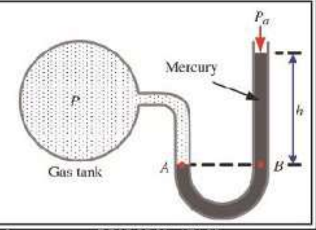
6 CHAPTER

MECHANICAL PROPERTIES OF MATTER



6.1 DEFORMATION OF SOLIDS

Q.1 Write a note on Deforming Force.

Ans: <u>Definition:</u>

We have observed that an external force applied on an object can change its size or shape. Or volume Such a force is known as deforming force.

<u>Example:</u>

For example, an appropriate force applied to a spring can increase its length called extension or cause compression thus reducing its length. If this force is removed, the spring will restore its original size and shape. Similarly, stretched rubber strip or band comes to its original shape and size on removing the applied force.

Elasticity:
An object is said to be elastic, if after removal of the deforming force, it restores to its original size and shape. This property of the material is known as elasticity.

Example:
When a tennis ball is hit by a racket, the shapes of tennis ball and also racket strings are distorted or deformed. They regain their original shape after bouncing of the ball by the racket.

Elastic Limit:
Most of the materials are elastic up to a certain limit known as elastic limit. Beyond the elastic limit, the change becomes permanent. The object or material does not regain its original shape or size even after the removal of the deforming force.

6.2 HOOKE'S LAW

LONG QUESTIONS

Q.1 State and explain the Hooke's Law. ***(K.B+U.B+A.B)***

Ans:

Introduction:
It has been observed that deformation in length, volume or shape of a body depends upon the stress acting on the body. The mathematical relationship between stress and strain was first of all formulated by Hooke in the form of a law.

Statement:
According to Hook's law:
"The **strain** produced in a body by the **stress applied** to it is **directly proportional** to the **stress** within the **elastic limit** of the body.**"**

Mathematical Formula:

$$\text{Stress} \ \alpha \ \text{strain}$$

$$\text{Stress} = \text{constant x strain}$$

Or $$\frac{\text{Stress}}{\text{Strain}} = \text{constant}$$

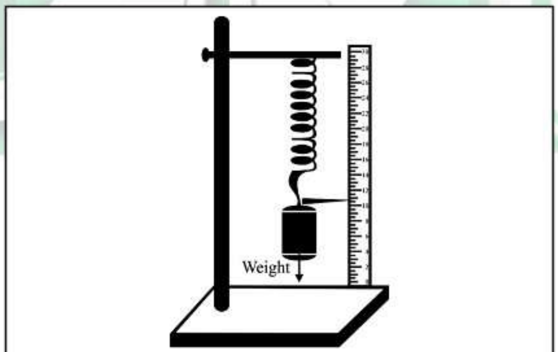


Figure: Extension in The Spring Depends Upon the Load

Applications:
Hooke's law is applicable to all kinds of deformation and all types of matter i.e. solids, liquids or gases within certain limit. This limit tells the maximum stress that can be safely applied on a body without causing permanent deformation in its length, volume or shape.

Elastic Limit:
It is a **maximum value of elasticity** within which a body **recovers** to **original length**, **volume** or **shape** after deforming force is removed. This value of elasticity is called the **elastic limit**.
When a stress crosses this limit, called the elastic limit, a body is permanently deformed and is unable to restore its original state after the stress is removed as shown in the figure:

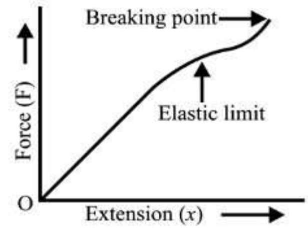


Figure: Graph Between Force And Extension

Application of Hooke's Law:
Hooke's law serves as the basic principle in wide range of applications. In the field of technology and engineering, springs in many devices rely on Hooke's law for their functions such as spring scales, balance wheel of the mechanical clocks, galvanometer, suspensions system in vehicles and motorbikes, door hinges, mattresses, material testing machines, etc. However, Hooke's law applies with in a specific range of forces. Exceeding the range or limit results in permanent deformation and no longer follows Hooke's law. Some of the uses are elaborated below:

1. Spring scales:
Spring scales use the extension or compression of a spring to determine the weight of objects. In a common spring balance the extension or elongation produced is a measure of the weight. In compression balance, the spring is compressed by the load (force) and the compression produced is measured by means of a pointer moving over a scale. Weighing machine usually use this type of balance.

2. Balance wheel of mechanical clocks:
The balance wheel in mechanical clocks use spring to control the back and forth motion that regulates the speed of the hands of a clock.

3. Galvanometer:
Galvanometer is a current detecting device. It makes use of a tiny spring called hair spring which provides electrical connections to the galvanometer coil and also restores the pointer back to zero position. The deflection of the pointer is proportional to the current flowing through it within the range

Q.1 Define density. Write its formula and unit? *(K.B+U.B+A.B)*

Ans:

DENSITY

Definition:
"Density of a substance is defined as its mass per unit volume."

Formula:

$$\text{Density} = \frac{\text{mass of a substance}}{\text{volume of that substance}}$$

Unit:
SI unit of density is kilogramme per cubic meter ($kg\ m^{-3}$).

Density Equations:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Mass} = \text{Density} \times \text{Volume}$$

$$\text{Volume} = \frac{\text{Mass}}{\text{Density}}$$

Table 7.1

Substance	Density ($kg\ m^{-3}$)
Air	1.3
Patrol	800
Water	1000
Concrete	2400
Aluminum	2700
Steel	7800
Lead	11400
Gold	19300
Osmium	22600

USES:
The architects and engineers take special care of the density of the building material to be used in designing and constructing roads, bridges and buildings. The density of building material is essential for estimating the strength required in foundations and supporting pillars

Density Measurement:

Density of a substance can be determined by measuring its mass and volume. The mass can be easily measured by a physical balance.

If the substance is solid and has a regular shape, its volume can be found by measuring its dimensions. For example, if the substance is in the form of a sphere, its diameter can be measured by a Vernier Callipers and volume is there by calculated. Knowing mass and volume, the density can be found out.

Q.2 Find density of 5 litre of water. *(U.B)*

Solution:

Given Data:

As 1 litre of water = 1kg of water

So Mass of water = m =5 kg

Volume of water = V = 5 litre = 5×10^{-3} m^3

To Find:

Density of Water = d =?

Solution:

We know

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Putting values

$$\text{Density} = \frac{5}{5\times10^{-3}} = 1000\text{kgm}^{-3}$$

Results:

The density of water is 1000kgm^{-3}.

Q.3 What do you know about density of the Earth's atmosphere? *(K.B)*

Ans: **DENSITY OF THE EARTH'S ATMOSPHERE**

Earth's atmosphere extends upward about a few hundred kilometres with continuously decreasing density. Nearly half of its mass is between sea level and 10 km. Up to 30 km from sea level contains about 99% of the mass of the atmosphere. The air becomes thinner and thinner as we go up.

6.4 PRESSURE

SHORT QUESTIONS

Q.1 Define the term pressure write its formula and unit. *(K.B+U.B)* **(GRW 2014)**

Ans: **PRESSURE**

Definition:

"The **force acting** normally **per unit area** on the surface of a body is called pressure."

Formula:

$$P=\frac{Force}{Area}$$

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

Quantity:

Pressure is a scalar and derived quantity.

Unit:

In SI units, the unit of pressure is N m^{-2} also called Pascal (Pa). Thus, 1N m^{-2} = 1Pa

For Your Information!

The force in both the pictures is same, equal to weight of the bag. In right hand picture, the area of contact is the greater than in the left hand picture. We say that the pressure is less in the right hand picture.

Q.2 Write daily life examples of Pressure.

Ans:

The edge of the blade of a chopper is made very sharp. When we apply force on the handle of the chopper to cut an object, the pressure on the object, at the contact surface, due to its small area becomes very high and the object is easily cut.

The top of a thumb pin is flat but the end of the pin is very sharp. So, the contact area is very small. When we apply a force at the top, the pressure at the end of pin is so high that it pierces into the wooden board.

When we walk on ground, we exert a force on it due to which we experience a reaction force. When the ground is flat, this reaction force is spread over the whole area of the foot and the pressure due to reaction force is not painful. But when we walk on pebbles, the contact area is reduced. Then the pressure due to reaction force becomes so high that it becomes painful.

Heavy animals like elephant have thick legs and large flat feet so that due to large contact area, pressure becomes less Otherwise, their bones would not tolerate the pressure.

Q.2 Write factors effecting pressure: *(K.B)*

Ans:

FACTORS EFFECTING PRESSURE

As we know

$$P=\frac{Force}{Area}$$

Above relation shows that two factors effect pressure:

- **Force:**
  Pressure is directly proportional to force. Greater the force on the surface greater will be the pressure on that surface.
- **Area:**
  Pressure is inversely proportional to area. Greater the Area of the surface smaller will be the pressure on that surface.

Example:

Press a pencil from its ends between the palms. The palm pressing the tip feels much more pain than the palm pressing its blunt end. We can push a drawing pin into a wooden board by pressing it by our thumb. It is because the force we apply on the drawing pin is confined just at a very small area under its sharp tip. A drawing pin with a blunt tip would be very difficult to push into the board due to the large area of its tip. In these examples, we find that the effectiveness of a small force is increased if the effective area of the force is reduced. The area of the tip of pencil or that of the nail is very small and hence increases the effectiveness of the force. The quantity that depends upon the force and increases with decrease in the area on which force is acting is called pressure.

Effect of area on pressure is shown in figure below:

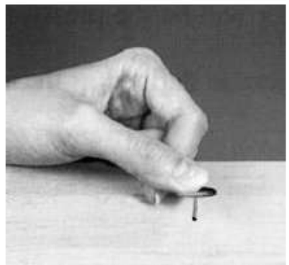


Figure: A Drawing Pin With Sharp Tip Enters Easily When Pressed On A Wooden Table

Q.3 Write working of vacuum cleaner. ***(K.B)*** **(Do you know Pg. # 150)**

Ans:

VACUUM CLEANER

The fan in a vacuum cleaner lowers air pressure in its bucket. The atmospheric air rushes into it carrying dust and dirt with it through its intake port. The dust and dirt particles are blocked by the filter while air escapes out as shown in the figure:

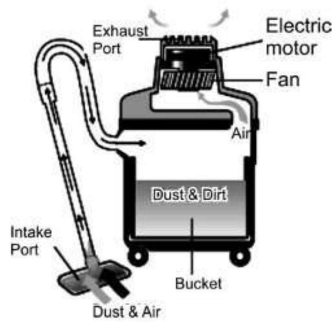


Figure: Construction of Air Cleaner

Q.4 How do we suck juice with the help of a straw? ***(K.B+A.B)***

Ans:

SUCKING A LIQUID WITH STRAW

When air is sucked through straw with its other end dipped in a liquid, the air pressure in the straw decreases. This causes the atmospheric pressure to push the liquid up the straw as shown in the figure:

Figure: Sucking a Liquid with Straw

MULTIPLE CHOICE QUESTIONS

1. **The force exerted perpendicularly on unit area of an object is called:** ***(K.B)***
   (A) Strain (B) Constant
   (C) Pressure (D) Work
2. **The unit of pressure is:** ***(K.B)***
   (A) Nm^{-2} (B) Nm^{-1}
   (C) Pa **(D) Both A & C**
3. **Pressure depends upon:** ***(K.B)***

(A) Density (B) Depth
(C) Temperature **(D) Both A & B**

4. The law about pressure on the object is presented by: ***(K.B)***
(A) Joule **(B) Pascal**
(C) Newton (D) Galileo

5. When temperature of the gas increases, gas pressure: ***(K.B)***
(A) Increases (B) Decreases
(C) Remains same (D) None of above

6. If quantity of the gas is increased in the container then gas pressure: ***(K.B+U.B)***
(A) Increases (B) Decreases
(C) Remains same (D) None of above

7. Pressure depend upon: ***(K.B)*** **(LHR 2013)**
(A) Force (B) Area
(C) Length **(D) Both A&B**

8. The instrument used to measure atmospheric pressure ***(K.B)***
(A) Colorimeter (B) Hypsometer
(C) Barometer (D) None of these

9. At sea level atmospheric pressure is: ***(K.B)*** **(LHR 2017)**
(A) 10107 Pa (B) 10300 Pa
(C) 101300 Pa (D) 10107 Pa

6.5 PRESSURE IN LIQUIDS

LONG QUESTIONS

Q.1 Derive an expression for Pressure in liquids. ***(K.B+U.B+A.B)***

Ans:

PRESSURE IN LIQUIDS

Liquids exert pressure. The pressure of a liquid acts in all directions. If we take pressure sensor (a device that measures pressure) inside a liquid, then the pressure of the liquid varies with the depth of sensor.

Mathematical Derivation:

Consider a surface area **A** in a liquid at a depth **h** as shown in figure.

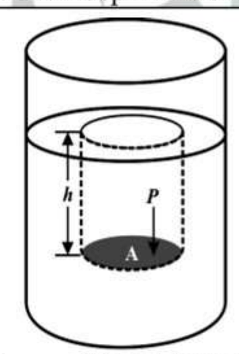


Figure: **Pressure of The Liquid At A Depth h**

The length of the cylinder of liquid over this surface will **be h**. The force acting on this surface will be the **weight** w of the liquid above this surface.

If ρ is the **density** of the liquid and m is **mass** of the liquid above the surface, then

Mass of the liquid = m = volume x density

= m = (A x h) x ρ

Force acting on area A = F = w = mg

= A h ρ g

As pressure = P = F/A

So $= \frac{Ah\rho g}{A}$

Therefore, Liquid pressure at depth h =P = ρ g h

The above equation gives the pressure at a depth h in a liquid of density ρ. It show that its pressure in a liquid increases with depth.

Conclusion:

Pressure of the liquid increases with:

- Increase in depth of the liquid **(h)**
- Increase in the density of the liquid **(ρ)**
- Increases in the value of gravitational acceleration **(g)**

6.6 ATMOSPHERIC PRESSURE

LONG QUESTIONS

Q.1 What is atmospheric pressure? And explain atmospheric pressure with the help of an experiment.

OR Show that atmosphere exert pressure. ***(K.B+U.B+A.B)***

Ans: **ATMOSPHERIC PRESSURE**

Definition:

"The **earth** is **surrounded** by a **cover of air** is called atmosphere.**"**

Atmosphere extends to a few hundred kilometers above sea level. Just as certain sea creatures live at the bottom of ocean, we live at the bottom of a huge ocean of air.

Atmospheric Pressure Decreases With Height:

Air is the mixture of gases. The density of air in the atmosphere is not uniform. It decreases continuously as we go up due to this reason atmospheric pressure decreases with height. The atmospheric pressure at sea level is greater as compared to hilly areas.

Atmospheric Pressure Acts in All Directions:

Atmospheric pressure acts in all directions.

Examples:

- Soap bubbles expand till the pressure of air in them is equal to the atmospheric pressure. Soap bubbles so formed have spherical shapes because the atmospheric pressure acts on a bubble equally in all directions.

Figure: **The Air Pressure Inside The Bubble is Equal To The Atmospheric Pressure**

- A balloon expands as we fill air into it. The balloon will expand in all directions it is because of the fact that atmospheric pressure acts in all directions equally as shown in the figure.

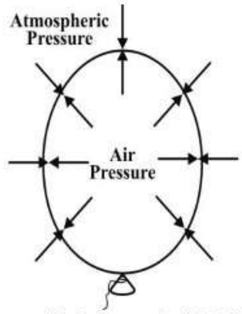


Figure: **Air Pressure Inside The Balloon is Equal To The Atmospheric Pressure.**

Experiment:

The fact that atmosphere exerts pressure can be explained by simple experiment.

- Take an empty tin can with a lid.
- Open its cap and put some water in it. Place it over flame.
- Wait till water begins to boil and the steam expels the air out of the can.
- Remove it from the flam*e.*
- Close the can firmly by its cap.
- Now place the can under tape water as shown in the figure:

Figure: **Crushing Can Experiment**

Observations:

The can will squeeze due to atmospheric pressure.

Reasons:

When the can is cooled by tap water, the steam in it condenses. As the steam changes into water, it leaves an empty space behind it. This lowers the pressure inside the can as compared to the atmospheric pressure outside the can. This will cause that can to collapse from all directions. This experiment shows that atmosphere exerts pressure in all directions.

Q.2 Which device is used to measure the atmospheric pressure? Explain the measurement of atmospheric pressure by using barometer. ***(K.B+U.B+A.B)***

Ans:

MEASUREMENT OF ATMOSPHERIC PRESSURE

Introduction:

At sea level, the atmospheric pressure is about **101,300 Pa** or **101,300 Nm^{-2}.** The instruments that measure atmospheric pressure are called **barometers**. One of the simple barometers is a **mercury barometer**. Its construction and working is given below:

Construction:

It consists of a glass tube **1m long** closed at one end. After filling it with mercury, it is inverted in a mercury trough. Mercury in the tube descends and stops at a certain height as shown in the figure:

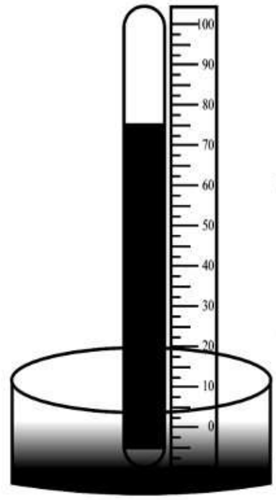


Figure: A Mercury Barometer

Working:
The column of mercury held in the tube exerts pressure at its base. At sea level the height of mercury column above the mercury in the trough is found to be about 76 cm. Pressure exerted by 76 cm of mercury column is nearly 101,300 Nm^{-2} equal to atmospheric pressure. It is common to express atmospheric pressure in terms of the height of mercury column. As the atmospheric pressure at a place does not remains constant, hence, the height of mercury column also varies with atmospheric pressure.

Mercury in Barometer Instead of Water:
Mercury is **13.6** times denser than water. Atmospheric pressure can hold vertical column of water about 13.6 times the height of mercury column at a place. Thus, at sea level, vertical height of water column would be 0.76 m x 13.6 = 10.34 m. Thus, a glass tube more than 10 m long is required to make a water barometer that is difficult to handle and manage practically. So water is not suitable for constructing barometer.

Q.3 Write a note on variation in atmospheric pressure. ***(K.B+U.B)***

Ans: **VARIATION IN ATMOSPHERIC PRESSURE**

The atmospheric pressure decreases as we go up due to decrease in the density of the air. The atmospheric pressure on mountains is lower than at sea level. At a height of about **30 km**, the atmospheric pressure becomes only **7 mm** of mercury which is approximately **1000 Pa**. It would become zero at an altitude where there is no air. Thus we can determine the altitude of a place by knowing the atmospheric pressure at that place.

Effect of Weather on Atmospheric Pressure:
Atmospheric pressure may also indicate a change in the weather as:

- On a hot day, air above the Earth becomes hot and expands. This causes a fall of atmospheric pressure in that region.
- During cold chilly nights, air above the Earth cools down. This causes an increase in atmospheric pressure.

Expected Weather Changes Due to Variation of Atmospheric Pressure:
The changes in atmospheric pressure at a certain place indicate the expected changes in the weather conditions at that place.

Decrease in Atmospheric Pressure:

- A gradual and average drop in atmospheric pressure means a low pressure in a neighboring locality.
- Minor but rapid fall in atmospheric pressure indicates a windy and showery condition in the nearby region.

- A decrease in atmospheric pressure accompanied by breeze and rain.
- A sudden fall in atmospheric pressure often followed by a storm, rain and typhoon to occur in few hours' time.

Increase in Atmospheric Pressure:

- An increasing atmospheric pressure with a decline later on predicts an intense weather conditions.
- A gradual large increase in the atmospheric pressure indicates a long spell of pleasant weather.
- A rapid increase in atmospheric pressure means that it will soon be followed by a decrease in the atmospheric pressure indicating poor weather ahead.

MEASUREMENT OF PRESSURE BY MANOMETER

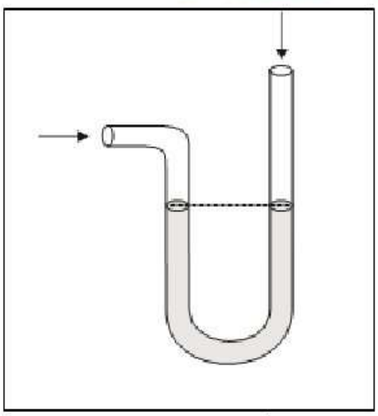
Q.1 How Pressure can be measured by Manometer?

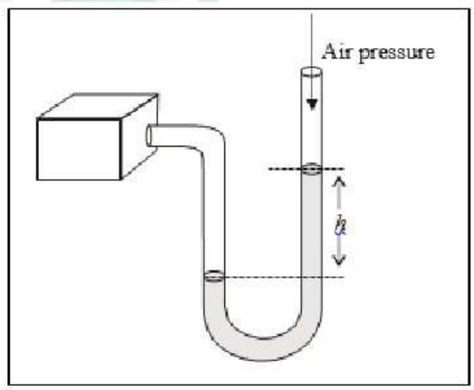
Ans: Construction:

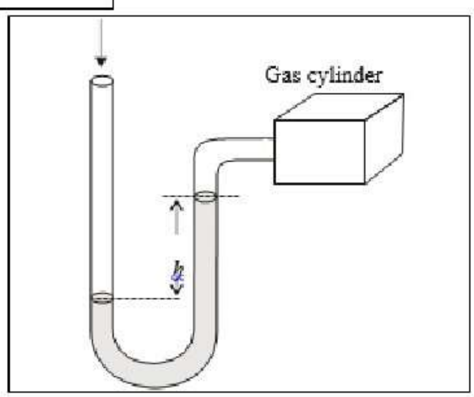
A simple manometer consists of a U-shaped glass tube which contains mercury.

Working:

In the beginning, the atmospheric pressure at the two open ends of the tube is the same and hence, mercury level in the two arms remains same(Fig.6.10). If on connecting a gas cylinder with short arm keeping the longer arm of the tube open, the mercury level in short arm is lower than that in the long arm(Fig.6.11),then the unknown pressure is more than the atmospheric pressure. If the mercury level in the short arm is more than the long arm (Fig.6.12), then the unknown pressure is less than the atmospheric pressure.







Q.2 State and explain Pascal's law. ***(K.B)***

Ans:

PASCAL'S LAW

Introduction:

An external force applied on the surface of a liquid increases the liquid pressure at the surface of the liquid. This increase in liquid pressure is transmitted equally in all direction and to the walls of the container in which it is filled this result is called Pascal's law.

Statement:

According to Pascal's law:

"Pressure applied at any point of a **liquid enclosed** in a container, is **transmitted** without **loss** to all other parts of the liquid.**"**

Explanation:

Pascal's law can be demonstrated with the help of a glass vessel having holes all over its surface as shown in figure.

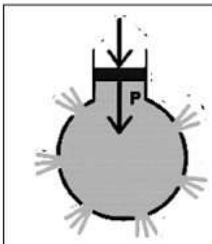


Figure: Demonstrating Pascal's Law

Fill the glass vessel with water. Push the piston. The water rushes out of the holes in the vessel with the same pressure. The force applied on the piston exerts pressure on water. This pressure is transmitted equally throughout the liquid in all directions.

Applications of Pascal's Law:

In general, Pascal's law holds good for fluids both for liquids as well as gases. Pascal's law finds numerous applications in our daily life such as automobiles, hydraulic brake system, hydraulic jack, hydraulic press and other hydraulic machine.

Q.3 What is hydraulic press? Write its construction and working. ***(K.B+U.B+A.B)***

(GRW 2014,2017)

Ans: **HYDRAULIC PRESS**

Introduction:

Hydraulic press is a machine that works on Pascal's law. It is used to compress heavy cotton bales for ease in transportation and storing.

Construction:

It consists of two cylinders of different cross sectional areas which are fitted with pistons of cross – sectional area **a** and **A** as shown in the figure:

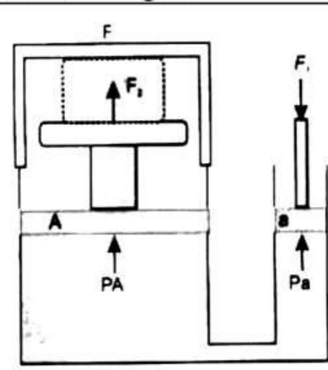


Figure: A Hydraulic Press

Working:

The object is to be compressed is placed over the piston of large cross – sectional area **A**. The Force $\mathbf{F_1}$ is applied on the piston of small cross – sectional area **a.** The pressure **P** produced by small piston is transmitted equally through the liquid and acts on the on the large piston and a force F_2 acts on **A** which is much larger than F_1.

Mathematical Form:

Pressure on piston of small area a is given by,

$$P = \frac{F_1}{a}$$

By applying Pascal's law, the pressure on the larger piston of area A will be same as on the small piston.

$$P = \frac{F_2}{A}$$

By comparing the above equations, we have

$$\frac{F_2}{A} = \frac{F_1}{a}$$

Force Multiplier:

$$\therefore \quad F_2 = F_1 \times \frac{A}{a}$$

Since the ratio $\frac{A}{a}$ is greater than **1**, hence the force F_2 acts on the larger piston is greater than the force F_1 on the smaller piston. Hydraulic systems working in this way are known as force multipliers.

Q.4 Explain the braking system of the vehicles. ***(K.B)***

Ans:

BRAKING SYSTEM OF VEHICLES

The brakes of cars, buses etc. work on the principle of Pascal's law. In such a type of brakes, when brake pedal is pushed, it exerts pressure on the master cylinder, which increases the liquid pressure in the cylinder. The liquid pressure is transmitted equally through the liquid in the metal pipes to all the pistons of other cylinders. Due to the increase pressure of the liquid pressure, the pistons in the cylinder mover outwards pressing the brakes pad with brake drums. The force of friction between frictions the brake pads and the brake drum stops the wheels as shown in the figure:

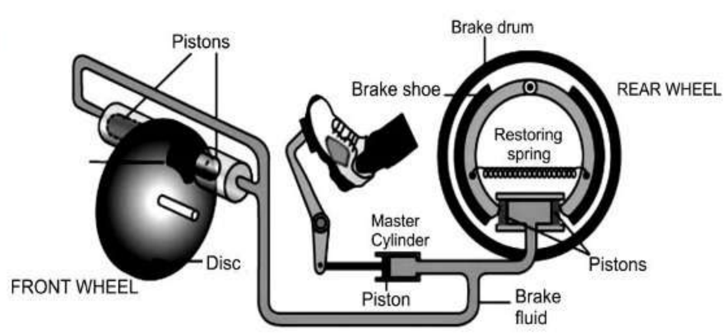


Figure: A Hydraulic Brake of A Car

7.5 SHORT QUESTIONS

Q.1 On what factors pressure of the liquids depends? ***(K.B)***

Ans: Given on Page #257

Q.2 How is a syringe filled with a liquid? ***(K.B)***

Ans: **FILLING A SYRINGE**

The piston of the syringe is pulled out. This lowers the pressure in the cylinder. The liquid from the bottle enters into the piston through the needle as shown in figure:

Figure: Filling A Syringe

Write some applications of Pascal's law. ***(A.B)***

Ans: **APPLICATIONS OF PASCAL'S LAW**

In general, Pascal's law holds good for fluids both for liquids as well as gases. Pascal's law finds numerous applications in our daily life such as automobiles, hydraulic brake system, hydraulic jack, hydraulic press and other hydraulic machine.

Q.3 Why hydraulic press is called as force multiplier. ***(K.B)***

Ans: **FORCE MULTIPLIER**

We know working equation of hydraulic press

$$\frac{F_1}{a} = \frac{F_2}{A}$$

So $$F_2 = F_1 \times \frac{A}{a}$$

Since the ratio $\frac{A}{a}$ is greater than **1**, hence the force $\mathbf{F_2}$ acts on the larger piston is greater than the force $\mathbf{F_1}$ on the smaller piston. Hydraulic systems working in this way are known as force multipliers.

TEXT BOOK EXERCISE

MULTIPLE CHOICE QUESTIONS

6.1 A wire is stretched by a weight w. If the diameter of the wire is reduced to half of its previous value, the extension will become:

(a) one half (b) double
(c) one fourth (d) four times

6.2 Four wires of the same material are stretched by the same load. Their dimensions are given below. Which of them will elongate most?

(a) Length1m, diameter1mm (b) Length2m, diameter2mm
(c) Length3m, diameter3mm (d) Length4m, diameter0.5mm

6.3 Two metal plates of area 2 and 3 square metres are placed in a liquid at the same depth. The ratio of pressures on the two plates is:

(a) 1:1 **(b)** $\sqrt{2}$
(c) 2:3 (d) 4:9

6.4 The pressure at any point in a liquid is proportional to:

(a) Density of the liquid
(b) Depth of the point below the surface of the liquid

(c) Acceleration due to gravity
(d) All of the above

6.5 Pressure applied to an enclosed fluid is:
(a) Increased and applied to every part of the fluid
(b) Diminished and transmitted to the walls of container
(c) Increased in proportional to the mass of fluid and then transmitted to each part of the fluid
(d) transmitted unchanged to every portion of the fluid and walls of containing vessel

6.6 The principle of a hydraulic press is based on:
(a) Hooke's law
(b) Pascal's law
(c) Principle of conservation of energy
(d) Principle of conservation of momentum

6.7 When a spring is compressed, what form of energy does it possess?
(a) Kinetic
(b) Potential
(c) Internal
(d) Heat

6.8 What is the force exerted by the atmosphere on a rectangular block surface of length 50cm and breadth 40cm? The atmospheric pressure is 100kPa.
(a) 20kN
(b) 100kN
(c) 200kN
(d) 500kN

SHORT ANSWER QUESTIONS

6.1 Why heavy animals like an elephant have a large area of the foot?

Ans: Heavy animals like elephant have thick legs and large flat feet so that due to large contact area, pressure becomes less otherwise, their bones would not tolerate the pressure,

6.2 Why animals like deer who run fast have a small area of the foot?

Ans:

The small area of the foot in fast-moving animals like deer is an **adaptation** that minimizes friction, enhances agility, and improves efficiency in high-speed running. Smaller feet allow them to run faster, make quick turns, and react swiftly to their surroundings, which is crucial for evading predators or navigating through challenging terrain.

6.3 Why is it painful to walk bare footed on pebbles?

Ans:

When we walk on pebbles, the contact area is reduced. Then the pressure due to reaction force becomes so high that it becomes painful.

6.4 State Pascal's law. Give an application of Pascal's law.

Ans:

Statement:
According to Pascal's law:
"Pressure applied at any point of a **liquid enclosed** in a container, is **transmitted** without **loss** to all other parts of the liquid.**"**

HYDRAULIC PRESS

Introduction:
Hydraulic press is a machine that works on Pascal's law. It is used to compress heavy cotton bales for ease in transportation and storing.

Construction:
It consists of two cylinders of different cross sectional areas which are fitted with pistons of cross – sectional area **a** and **A.**

6.5 State what do you mean by elasticity of a solid?

Ans: **ELASTICITY**

The property of a body to **restore** its **original size** and **shape** as the **deforming force** ceases to act is called elasticity.

Example:

When we stretch a rubber with a small force and then release that force the rubber attains it original size and shape due to elasticity.

6.6 What is Hooke's law? Does an object remain elastic beyond elastic limit? Give reason.

Ans:

HOOKE'S LAW

Introduction:

It has been observed that deformation in length, volume or shape of a body depends upon the stress acting on the body. The mathematical relationship between stress and strain was first of all formulated by Hooke in the form of a law.

Statement:

According to Hook's law:

"The **strain** produced in a body by the **stress applied** to it is **directly proportional** to the **stress** within the **elastic limit** of the body.**"**

Mathematical Formula:

$$\text{Stress} \ \alpha \ \text{strain}$$

$$\text{Stress} = \text{constant} \times \text{strain}$$

Or $$\frac{\text{Stress}}{\text{Strain}} = \text{constant}$$

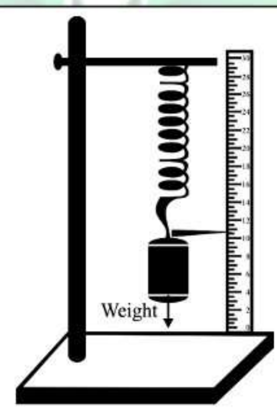


Figure: **Extension in The Spring Depends Upon the Load**

Applications:

Hooke's law is applicable to all kinds of deformation and all types of matter i.e. solids, liquids or gases within certain limit. This limit tells the maximum stress that can be safely applied on a body without causing permanent deformation in its length, volume or shape.

Elastic Limit:

It is a **maximum value of elasticity** within which a body **recovers** to **original length**, **volume** or **shape** after deforming force is removed. This value of elasticity is called the **elastic limit**.

When a stress crosses this limit, called the elastic limit, a body is permanently deformed and is unable to restore its original state after the stress is removed as shown in the figure:

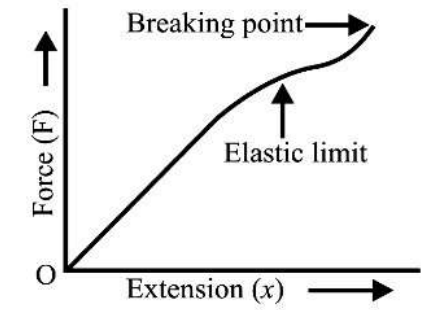


Figure: Graph Between Force And Extension

6.7 Distinguish between force and pressure.

Ans:

Force is an agent due to which objects starts to move or comes to rest and if the force acting normally on unit are of a substance then it will become pressure.

6.8 What is the relationship between liquid pressure and the depth of the liquid?

Ans:

Liquids exert pressure. The pressure of a liquid acts in all directions. If we take pressure sensor (a device that measures pressure) inside a liquid, then the pressure of the liquid varies with the depth of sensor.

Therefore, Liquid pressure at depth h = P = ρ g h

6.9 What is basic principle to measure the atmospheric pressure by a simple mercury barometer?

Ans:

The basic principle of a **mercury barometer** is that it measures **atmospheric pressure** by balancing it against the pressure exerted by a column of mercury. The height of the mercury column in the barometer tube reflects the atmospheric pressure, and the measurement is made by reading the height of mercury in the tube. The **higher the mercury column**, the higher the atmospheric pressure.

6.10 State the basic principle used in the hydraulic brake system of the automobiles.

Ans:

Pressure applied at any point of a **liquid enclosed** in a container, is **transmitted** without **loss** to all other parts of the liquid

CONSTRUCTED RESPONSE QUESTIONS

6.1 A spring having spring constant k hangs vertically from a fixed point. A load of weight L, when hung from the spring, causes an extension x, the elastic limit of the spring is not exceeded. Some identical springs, each with spring constant *k*, are arranged as shown below:

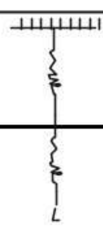
For each arrangement, complete the table by determining:

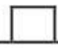
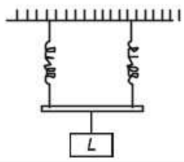
(i) The total extension in terms of x.

(ii)The spring constant in terms of k.

Ans:

Arrangement	Total Extension *x*	Spring constant(*k*)of the arrangement



6.2 Springs are made of steel instead of iron. Why?

Ans: Springs are made of **steel** rather than iron because steel has superior strength, elasticity, corrosion resistance, and the ability to withstand repeated stress and strain without permanent deformation. These properties make steel much better suited for the demanding applications of springs, which need to return to their original shape after repeated compression or tension. Iron's brittleness and lower durability make it less suitable for spring manufacturing.

6.3 Which of the following material is more elastic?
(a) Iron or rubber (b) Air or water

Ans: Iron and air are more elastic than rubber and water due to their property of restoring themselves.

6.4 How does water pressure one metre below the surface of a swimming pool compare to water pressure one metre below the surface of a very large and deep lake?

Ans: Because the density of the water, the gravitational field, and the depth are the same in both a swimming pool and a deep lake, the water pressure one meter below the surface of the two bodies of water would be essentially the same.
Thus, the water pressure one meter below the surface of a swimming pool is the same as the water pressure one meter below the surface of a very large and deep lake.

6.5 What will happen to the pressure in all parts of a confined liquid if pressure is increased in one part? Give an example from your daily life where such principle is applied.

Ans: If pressure is increased in one part of a confined liquid, that increased pressure will be transmitted equally throughout the entire liquid. An example from daily life is the hydraulic system used in brakes or car lifts, where a small force can be applied to lift heavy loads or stop vehicles by applying pressure to the liquid, which is transmitted throughout the system.

6.6 If some air remains trapped within the top of the mercury column of the barometer which is supposed to be vacuum, how would it affect the height of the mercury column?

Ans: If air remains trapped at the top of the mercury column in a barometer, it would exert a pressure that reduces the height of the mercury column. As a result, the barometer would show a lower than actual atmospheric pressure.

6.7 How does the long neck is not a problem to a giraffe while raising its neck suddenly?

Ans:

From a physics perspective, the long neck of a giraffe presents some challenges related to gravity, blood flow, and pressure when the giraffe raises or lowers its neck suddenly. However, giraffes have evolved several mechanisms to counteract the physical forces involved and prevent problems, such as fainting or a drop in blood pressure.

6.8 The end of glass tube used in a simple barometer is not properly sealed, some leak is present. What will be its effect?

Ans:

If there is a leak in the glass tube of a mercury barometer, the mercury column will be lower than it should be because of the additional air pressure entering the tube. This will result in an inaccurate measurement of atmospheric pressure, typically showing a lower value than the true atmospheric pressure.

6.9 Comment on the statement, "Density is a property of a material not the property of an object made of that material."

Ans:

The statement is largely correct in emphasizing that density is a material property rather than an object property. While objects made of the same material will have the same density, the overall density of an object can vary depending on its size, shape, and composition, especially if it's made of more than one material. Thus, the density of an object can be considered as an average property that reflects the materials it's composed of.

6.10 How the load of a large structure is estimated by an engineer?

Ans:

Estimating the load of a large structure is a multi-step process that involves analyzing various types of loads (dead, live, environmental), and by analyzing the material used in it its density and by calculating its volume.

COMPREHENSIVE QUESTIONS

6.1 What is Hook's law? Give three applications of this law.

Ans: **HOOKE'S LAW**

Introduction:

It has been observed that deformation in length, volume or shape of a body depends upon the stress acting on the body. The mathematical relationship between stress and strain was first of all formulated by Hooke in the form of a law.

Statement:

According to Hook's law:

"The **strain** produced in a body by the **stress applied** to it is **directly proportional** to the **stress** within the **elastic limit** of the body."

Mathematical Formula:

$$\text{Stress} \propto \text{strain}$$

$$\text{Stress} = \text{constant} \times \text{strain}$$

Or $$\frac{\text{Stress}}{\text{Strain}} = \text{constant}$$

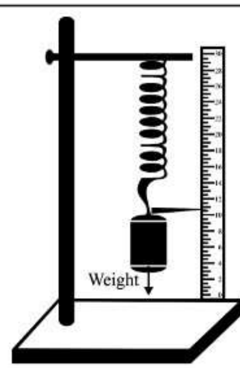


Figure: **Extension in The Spring Depends Upon the Load**

Applications:

Hooke's law is applicable to all kinds of deformation and all types of matter i.e. solids, liquids or gases within certain limit. This limit tells the maximum stress that can be safely applied on a body without causing permanent deformation in its length, volume or shape

6.2 Describe the working and applications of a simple mercury barometer and a manometer.

Ans: **<u>Construction</u>:**

It consists of a glass tube **1m long** closed at one end. After filling it with mercury, it is inverted in a mercury trough. Mercury in the tube descends and stops at a certain height as shown in the figure:

Figure: <u>A Mercury Barometer</u>

Working:

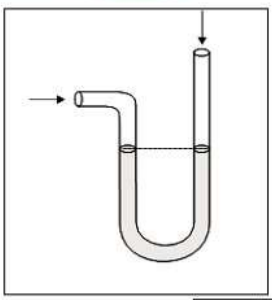
The column of mercury held in the tube exerts pressure at its base. At sea level the height of mercury column above the mercury in the trough is found to be about 76 cm. Pressure exerted by 76 cm of mercury column is nearly 101,300 Nm^{-2} equal to atmospheric pressure. It is common to express atmospheric pressure in terms of the height of mercury column. As the atmospheric pressure at a place does not remains constant, hence, the height of mercury column also varies with atmospheric pressure.

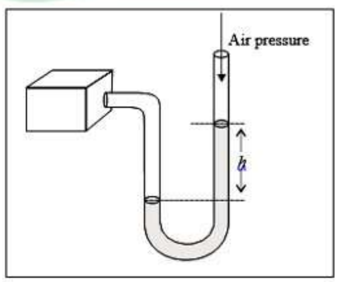
<u>Construction:</u>

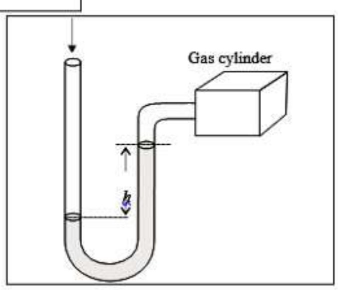
A simple manometer consists of a U-shaped glass tube which contains mercury.

<u>Working:</u>

In the beginning, the atmospheric pressure at the two open ends of the tube is the same and hence, mercury level in the two arms remains same(Fig.6.10). If on connecting a gas cylinder with short arm keeping the longer arm of the tube open, the mercury level in short arm is lower than that in the long arm(Fig.6.11),then the unknown pressure is more than the atmospheric pressure. If the mercury level in the short arm is more than the long arm (Fig.6.12), then the unknown pressure is less than the atmospheric pressure.







6.3 Describe Pascal's Law. State its applications with examples.

Ans: **PASCAL'S LAW**

Introduction:
An external force applied on the surface of a liquid increases the liquid pressure at the surface of the liquid. This increase in liquid pressure is transmitted equally in all direction and to the walls of the container in which it is filled this result is called Pascal's law.

Statement:
According to Pascal's law:
"Pressure applied at any point of a **liquid enclosed** in a container, is **transmitted** without **loss** to all other parts of the liquid.**"**

Explanation:
Pascal's law can be demonstrated with the help of a glass vessel having holes all over its surface as shown in figure.

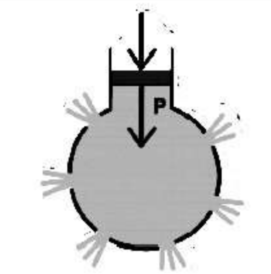


Figure: Demonstrating Pascal's Law

Fill the glass vessel with water. Push the piston. The water rushes out of the holes in the vessel with the same pressure. The force applied on the piston exerts pressure on water. This pressure is transmitted equally throughout the liquid in all directions.

Applications of Pascal's Law:
In general, Pascal's law holds good for fluids both for liquids as well as gases. Pascal's law finds numerous applications in our daily life such as automobiles, hydraulic brake system, hydraulic jack, hydraulic press and other hydraulic machine.

Q.5 What is hydraulic press? Write its construction and working. ***(K.B+U.B+A.B)***

Ans: **HYDRAULIC PRESS**

Introduction:
Hydraulic press is a machine that works on Pascal's law. It is used to compress heavy cotton bales for ease in transportation and storing.

Construction:
It consists of two cylinders of different cross sectional areas which are fitted with pistons of cross – sectional area **a** and **A** as shown in the figure:

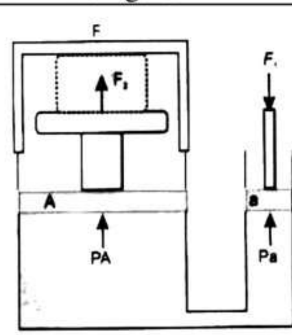


Figure: A Hydraulic Press

Working:
The object is to be compressed is placed over the piston of large cross – sectional area **A**. The Force $\mathbf{F_1}$ is applied on the piston of small cross – sectional area **a.** The pressure **P** produced by

small piston is transmitted equally through the liquid and acts on the on the large piston and a force $\mathbf{F_2}$ acts on **A** which is much larger than $\mathbf{F_1}$.

Mathematical Form:

Pressure on piston of small area a is given by,

$$P = \frac{F_1}{a}$$

By applying Pascal's law, the pressure on the larger piston of area A will be same as on the small piston.

$$P = \frac{F_2}{A}$$

By comparing the above equations, we have

$$\frac{F_2}{A} = \frac{F_1}{a}$$

Force Multiplier:

$$\therefore \quad F_2 = F_1 \times \frac{A}{a}$$

Since the ratio $\frac{A}{a}$ is greater than **1**, hence the force $\mathbf{F_2}$ acts on the larger piston is greater than the force $\mathbf{F_1}$ on the smaller piston. Hydraulic systems working in this way are known as force multipliers.

Q.6 Explain the braking system of the vehicles. ***(K.B)***

Ans: **BRAKING SYSTEM OF VEHICLES**

The brakes of cars, buses etc. work on the principle of Pascal's law. In such a type of brakes, when brake pedal is pushed, it exerts pressure on the master cylinder, which increases the liquid pressure in the cylinder. The liquid pressure is transmitted equally through the liquid in the metal pipes to all the pistons of other cylinders. Due to the increase pressure of the liquid pressure, the pistons in the cylinder mover outwards pressing the brakes pad with brake drums. The force of friction between frictions the brake pads and the brake drum stops the wheels as shown in the figure:

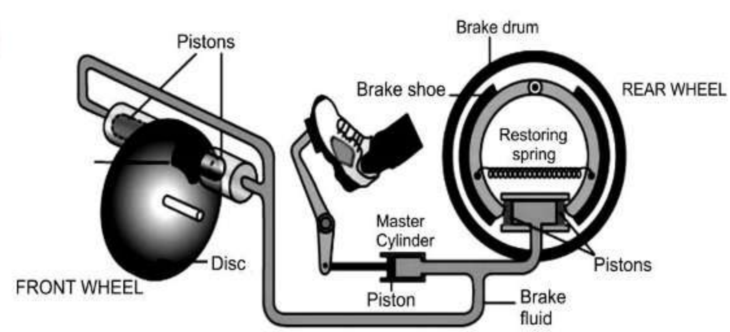


Figure: **A Hydraulic Brake of A Car**

6.4 On what factors the pressure of a liquid in a container depend? How is it determined?

Ans: **PRESSURE IN LIQUIDS**

Liquids exert pressure. The pressure of a liquid acts in all directions. If we take pressure sensor (a device that measures pressure) inside a liquid, then the pressure of the liquid varies with the depth of sensor.

Mathematical Derivation:

Consider a surface area **A** in a liquid at a depth **h** as shown in figure.

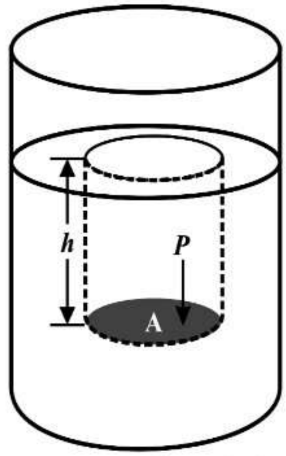


Figure: **Pressure Of The Liquid At A Depth h**

The length of the cylinder of liquid over this surface will **be h**. The force acting on this surface will be the **weight** w of the liquid above this surface.

If ρ is the **density** of the liquid and m is **mass** of the liquid above the surface, then

Mass of the liquid = m = volume x density

= m = (A x h) x ρ

Force acting on area A = F = w = mg

= A h ρ g

As pressure = P = F/A

So $= \frac{Ah\rho g}{A}$

Therefore, Liquid pressure at depth h =P = ρ g h

The above equation gives the pressure at a depth h in a liquid of density ρ. It show that its pressure in a liquid increases with depth.

Conclusion:

Pressure of the liquid increases with:

- Increase in depth of the liquid **(h)**
- Increase in the density of the liquid **(ρ)**
- Increases in the value of gravitational acceleration **(g)**

6.5 Explain that atmosphere exerts pressure. What are its applications. Give at least three examples.

Ans: Soap bubbles expand till the pressure of air in them is equal to the atmospheric pressure. Soap bubbles so formed have spherical shapes because the atmospheric pressure acts on a bubble equally in all directions.

Figure: **The Air Pressure Inside The Bubble is Equal To The Atmospheric Pressure**

- A balloon expands as we fill air into it. The balloon will expand in all directions it is because of the fact that atmospheric pressure acts in all directions equally as shown in the figure.

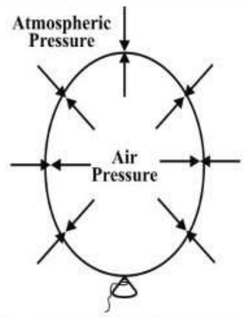


Figure: **Air Pressure Inside The Balloon is Equal To The Atmospheric Pressure.**

Experiment:

The fact that atmosphere exerts pressure can be explained by simple experiment.

- Take an empty tin can with a lid.
- Open its cap and put some water in it. Place it over flame.
- Wait till water begins to boil and the steam expels the air out of the can.
- Remove it from the flame.
- Close the can firmly by its cap.
- Now place the can under tape water as shown in the figure:

Figure: **Crushing Can Experiment**

6.1 A spring is stretched 20 mm by a load of 40 N. Calculate the value of spring constant. If an object cause an extension of 16 mm, what will be its weight?

Given Data:

Mass = m = 4.5 kg

Volume = V = 5 litres $\Rightarrow 5\times10^{-3}m^3 \quad \therefore 1Litre = 10^{-3}m^3$

To Find:

Density = ρ = ?

Solution:

Formula:

$$D = \frac{m}{V} = \frac{4.5}{5\times10^{-3}}$$

$$D = 900kgm^{-3}$$

$$\boxed{D = 0.9\times10^3 kgm^{-3}}$$

Result:

Density will be 0.9×10^3 kgm^{-3}

6.2 The mass of 5 litres of milk is 4.5 kg. Find its density in SI units.

Given Data:

Initial water level = V_1 = $40cm^3$

Final water level = V_2 = $440cm^3$

$$Mass\ m = 60g \Rightarrow \frac{60}{1000}kg \Rightarrow 0.06kg$$

To Find:

Density of solid = D = ?

Solution:

Formula:

Displaced volume = Final volume – Initial volume $V = V_2 - V_1$

$$D = \frac{m}{V}$$

$$V = 44cm^3 - 400m^3$$

$$V = 4cm^3 \Rightarrow 4\times10^{-6}m^3 \quad \therefore 1cm^3 = 10^{-6}m^3$$

$$D = \frac{0.06}{4\times10^{-6}} \Rightarrow 15000kgm^{-3} \Rightarrow 15\times10^3 kgm^{-3}$$

Result:

Density of solid will be $15 \times 10^3 kgm^{-3}$.

6.3 When a solid of mass 60 g is lowered into a measuring cylinder, the level of water rises from 40 cm³ to 44 cm³. Calculate the density of the solid.

Given Data:

Density of block = D = $8 \times 10^3 kgm^{-3}$

Volume $= V = 60cm^3 \Rightarrow 60\times10^{-6}m^3 \quad \therefore 1cm^3 = 10^{-6}m^3$

To Find:

Mass of block = m = ?

Solution:

Formula:

$$m = V \times D$$

$$m = \left(60\times10^{-6}\right)\left(8\times10^{3}\right)$$

$$\boxed{m = 0.48kg}$$

Result:

Mass of the block will be 0.48 kg.

6.4 A block of density 8×10^3 kg m^{-3} has a volume 60 cm3. Find its mass.

Given Data:

Volume of brick = V = 5cm × 10cm × 20cm ⇒ $1000cm^3$

Mass of brick = m = 5 kg

To Find:

i. Maximum pressure = P_{Max}= ?

ii. Minimum pressure = P_{Min}= ?

Solution:

Formula:

$$F = W = mg$$

$$Area_{max} = 20cm \times 10cm = 200cm^2 \Rightarrow 200\times10^{-4}m^2$$

$$Area_{Min} = 5cm \times 10cm = 50cm^2 \Rightarrow 50\times10^{-4}m^2$$

$$P_{max} = \frac{F}{Area_{max}}$$

$$P_{min} = \frac{F}{Area_{min}}$$

$$F = (5)(10) \quad \therefore g = 10ms^{-2} \quad \boxed{F = 50N}$$

$$P_{max} = \frac{50}{200\times10^{-4}} \Rightarrow 10,000\,Pa \Rightarrow \boxed{1\times10^{4}\,Pa}$$

$$Pmin = \frac{50}{50\times10^{-4}} \Rightarrow 2500Pa \Rightarrow \boxed{25\times10^{2}\,Pa}$$

Result:

Maximum and minimum pressure exerted by the brick will be 1×10^4Pa and 25×10^2PaRespectively.

6.5 A brick measures 5 cm × 10 cm × 20 cm. If its mass is 5 kg, calculate the maximum and minimum pressure which the brick can exert on a horizontal surface.

Given Data:

Larger cross –sectional Area $= A = 20cm^2 \Rightarrow 20 \times 10^{-4}m^2$

Smaller cross –sectional Area $= A = 5cm^2 \Rightarrow 5 \times 10^{-4}m^2$

Force on smaller piston = F_1 = 500N

To Find:

i. Pressure on smaller piston = P_1= ?

ii. Force on larger piston = F_2= ?

Solution:

Formula:

$$i.\ P_1 = \frac{F_1}{a}$$

$$ii.\ F_2 = \frac{A}{a} \times F_1$$

$$P_1 = \frac{500}{5 \times 10^{-4}} \Rightarrow \boxed{1 \times 10^6\ Pa}$$

$$F_2 = \frac{20 \times \cancel{10^{-4}}}{5 \times \cancel{10^{-4}}} \times 500$$

$$\boxed{F_2 = 2000N}$$

Result:

Pressure on smaller piston will be 1×10^6Pa and force on larger piton will be 2000N.

6.6 What will be the height of the column in barometer at sea level if mercury is replaced by water of density 1000 kg$^{-3,}$, where density of mercury is 13.6×10^3 kgm^{-3}.

Given Data:

Depth of diver = h = 10m

Density of sea water = ρ = 1030kgm^{-3}

To Find:

Pressure on diver by sea –water = P = ?

Solution:

Formula:

$$P = \rho gh$$

$$P = (1030)(10)(10)\ \therefore g = 10ms^{-2}$$

$$P = 103000Pa \Rightarrow \boxed{1.03 \times 105Pa / Nm^{-2}}$$

Result:

Pressure of sea-water on diver will be 1.3×10^5Nm^{-2}.

6.7 Suppose in the hydraulic brake system of a car, the force exerted normally on its piston of cross-sectional area of 5 cm² is 500 N. What will be the pressure transferred to the brake oil? What will be the force on the second piston of area of cross-section 20 cm^2 ?

Given Data:

Area of small piston = $A = 10cm^2 \Rightarrow 10 \times 10^{-4} m^2$

Area of large Piston = $A = 100cm^2 \Rightarrow 100 \times 10^{-4} m^2$

Force on large piston = F_2 = 4000N

To Find:

Force on small piston = F_1= ?

Solution:

Formula:

$$F_1 = \frac{a}{A} \times F_2$$

$$F_1 = \frac{10 \times \cancel{10^{-4}}}{100 \times \cancel{10^{-4}}} \times 4000$$

$$F1 = (0.1)(4000) \Rightarrow \boxed{400N}$$

Result:

Force on small
Piston will be 400N.

6.8 Find the water pressure on a deep-sea diver at a depth of 10 m, where the density of sea water is 1030 kg m^{-3}.

Given Data:

Depth = h = 10m
Density = ρ = 1030 kgm^{-3}
Gravitational acceleration = g = $10ms^{-2}$.

To Find:

Water pressure = P = ?

Solution:

Formula:

$$P = \rho g h$$

$$P = (1030)(10)(10)$$

$$P = 10300$$

$$P = 1.03 \times 10^5\, Nm^{-2}$$

Result:

The water pressure on the deep-sea water is 1.03 × 105 Nm^{-2}.

6.9 The area of cross-section of the small and large pistons of a hydraulic press is respectively 10 cm^2 and 100 cm^2. What force should be exerted on the small piston in order to lift a car of weight 4000 N?

Given Data:

Change in pressure ΔP = $10Ncm^2$
Area = A = $50cm^2$

To Find:

Load/Force = F = ?

Solution:

Formula:

$$F = \Delta P \times A$$

$$F = (10)(50) \Rightarrow \boxed{500N}$$

Result:

Force will be 500N

6.10 In a hot air balloon, the following data was recorded. Draw a graph between the altitude and pressure and find out:
(a) What would the air pressure have been at sea level?
(b) At what height the air pressure would have been 90 kPa?
Given Data

Altitude (m)	Pressure (kPa)
150	**99.5**
500	**95.7**
800	**92.4**
1140	**88.9**
1300	**87.2**
1500	**85.3**

To Find:

(a) What would the air pressure have been at sea level = P = ?

(b) At what height the air pressure would have been 90 kPa?

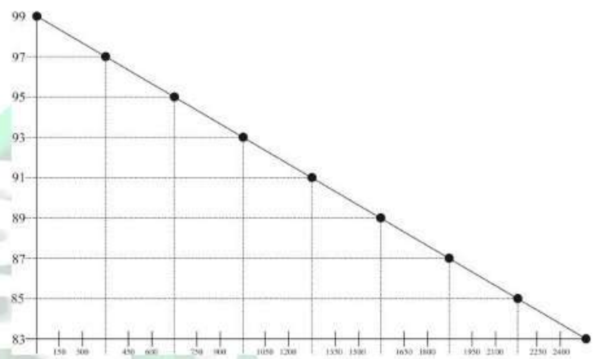
Solution:

(a) The rate of pressure change with altitude is

$$\frac{P}{h}=\frac{95.7-99.5}{500-150}$$

$$=-\frac{3.8}{350}$$

$$\frac{P}{h}=-0.01086\,\text{kpa/m}$$



Now pressure at sea level h = 0m

$$P=99.5+(-0.01086)(0-150)$$

$$P=99.5+1.629$$

$$\text{P}=101.1\text{Kpa}$$

$$\text{P}=101.1\times10^{2}\times10^{3}\,\text{Pa}$$

$$\text{P}=101.1\times10^{5}\text{Pa}$$

(b) Using the data points for 92.4 Kpa at 800m and 88.9 Kpa at 1140m.

The rate of pressure change.

$$\frac{P}{h}=\frac{88.9-92.4}{1140-800}=-\frac{3.5}{340}$$

$$\frac{P}{h}=-0.01029\text{kpa/m}$$

Now

$$90=92.4+(-0.01029)(h-800)$$

$$-\frac{2.4}{0.01029}=h-800$$

$$233.3=h-800$$

$$233.3+800=h$$

$$H=1033.3m\approx1.02km$$

6.11 If the pressure in a hydraulic press is increased by an additional 10 N cm^{-2}, how much extra load will the output platform support if its cross-sectional area is 50 cm^{2} ?

Given Data

Area of smaller piston $=A=50cm^{2}\Rightarrow5\times10^{-4}m^{2}$

Force on smaller piston = F_1 = 500N

Area of larger piston $= A = 20cm^2 \Rightarrow 20\times10^{-4}m^2$

To Find:

i. Pressure on smaller piston = P = ?

ii. Force on larger piston = F_2= ?

Solution:

Formula:

i- $P = \frac{F_1}{a}$

ii- $F_2 = P \times A$

$$P = \frac{500}{5\times10^{-4}} \Rightarrow \boxed{1\times10^4 cm^{-2}}$$

$$F_2 = \left(1\times10^6\right)\left(20\times10^{-4}\right)$$

$$\boxed{F_2 = 2000N}$$

Result:

Pressure on smaller piston will be $1\times 10^6 Nm^2$ and Force on larger piston will be 2000N.

MCQ'S ANSWER KEY (TOPIC WISE)

DEFORMATION OF SOLIDS

HOOK'S LAW

1	2	3	4	5	6	7	8	9
C	D	D	B	A	A	D	C	C

TEXT BOOK EXERCISE

MULTIPLE CHOICE QUESTIONS

ANSWER KEY

1	2	3	4	5	6	7	8
D	D	A	D	D	B	B	A