CHAPTER 08

MECHANICAL PROPERTIES OF MATTER

Many of the greatest advances that have been made from the beginning of the made in the earnest desire to turn the knowledge of the proprerties of matter to some purpose useful to mankind.

"LORD KELVIN"

INTRODUCTION

Mechanical properties are also used to help classify and identify material. The most common properties considered are strength, ductility, hardness, impact resistance, and fracture toughness. Most structural materials are anisotropic, which means that their material properties vary with orientation.

A body is said to be rigid if the relative positions of its constituent particles remains unchanged when external deforming forces are applied to it. The nearest approach to a rigid body is diamond or carborundum.

Actually no body is perfectly rigid and every body can be deformed more or less by the application of suitable forces. All these deformed bodies however regain their original shape or size, when the deforming forces are removed.

The property of matter by virtue of which a body tends to regain its original shape and size after the removal of deforming forces is called elasticity.

ELASTICITY

Some Terms Related to Elasticity :

1. **Deforming Force**

   External force which try to change in the length, volume or shape of the body is called deforming force.

2. **Perfectly Elastic Body**

   The body which perfectly regains its original form on removing the external deforming force, is defined as a perfectly elastic body. Ex. : quartz – Very nearly a perfect elastic body.

3. **Plastic Body**

   (a) The body which does not have the property of opposing the deforming force, is known as a plastic body.

   (b) The bodies which remain in deformed state even after removed of the deforming force are defined as plastic bodies.

4. **Internal restoring force**

   When a external force acts at any substance then due to the intermolecular force there is a internal resistance produced into the substance called internal restoring force.

   At equilibrium the numerical value of internal restoring force is equal to the external force.

STRESS

The internal restoring force acting per unit area of cross–section of the deformed body is called stress.

$$\text{Stress} = \frac{\text{Internal restoring force}}{\text{Area of cross section}} = \frac{F_{internal}}{A} = \frac{F_{external}}{A}$$

Stress depends on direction of force as well as direction of area of application so it is tensor.

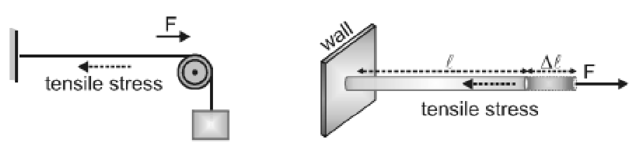
SI Unit : $N–m^{-2}$

Dimensions : $M^1 L^{-1} T^{-2}$

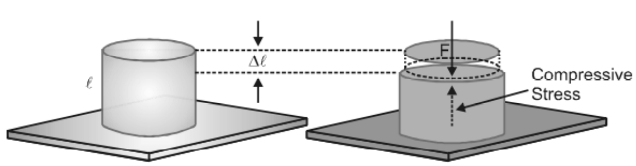
There are three types of stress :-

(a) **Longitudinal Stress** : When the stress is normal to the surface of body, then it is known as longitudinal stress. There are two types of longitudinal stress

(i) **Tensile Stress** : The longitudinal stress, produced due to increase in length of a body, is defined as tensile stress.



(ii) **Compressive stress** : The longitudinal stress, produced due to decrease in length of a body, is defined as compressive stress.



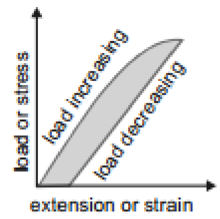
Elastic Fatigue :

The loss of strength of the material due to repeated strains on the material is called elastic fatigue. That is why bridges are declared unsafe after a long time of their use.

Creep :

If a small force is applied for a long time then it causes breaking of metal. For example A fan is hung for 200 years then the shaft will break.

Elastic Hysteresis :



The strain persists even when the stress is removed. This lagging behind of strain is called elastic hysteresis. This is the reason why the values of strain for same stress are different while increasing the load and while decreasing the load.

Breaking Stress :

The stress required to cause actual facture of a material is called the breaking stress Breaking stress = F/A

ETOOS KEY POINTS

(i) Breaking stress also measures the tensile strength.

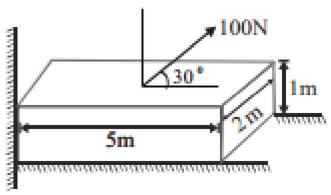
(ii) Metals with small plastic deformation are called brittle.

(iii) Metals with large plastic deformation are called ductile.

(iv) Elasticity restoring forces are strictly conservative only when the elastic hysteresis is zero. i.e. the loading and unloading stress – strain curves are identical.

(v) The material which have low elastic hysteresis have also low elastic relaxation time.

Ex. Find out longitudinal stress and tangential stress on a fixed block.



Sol. Longitudinal or normal stress $\sigma_1 = \dfrac{100 \sin 30^0}{5 \times 2} = 5\ \text{N/m}^2$

Tangential stress $\sigma_2 = \dfrac{100 \cos 30^0}{5 \times 2} = 5\sqrt{3}\ \text{N/m}^2$

Ex. The breaking stress of aluminium is 7.5×10^8 dyne cm^{-2}. Find the greatest length of aluminium wire that can hang vertically without breaking. Density of aluminium is 2.7 g cm^{-3}. [Given : g = 980 cm s^{-2}]

Sol. Let ℓ be the greatest length of the wire that can hang vertically without breaking.

Mass of wire m = cross–sectional area (A) × length (ℓ) × density (ρ), Weight of wire = mg = $A\ell\rho g$

This is equal to the maximum force that the wire can withstand.

$$\therefore \text{ Breaking stress} = \frac{\ell A \rho g}{A} = \ell \rho g \Rightarrow 7.5 \times 10^8 = \ell \times 2.7 \times 980$$

$$\Rightarrow \ell = \frac{7.5 \times 10^8}{2.7 \times 980}\ \text{cm} = 2.834 \times 10^5 \text{cm} = 2.834\ \text{km}$$

Etoos Tips & Formulas

ELASTICITY

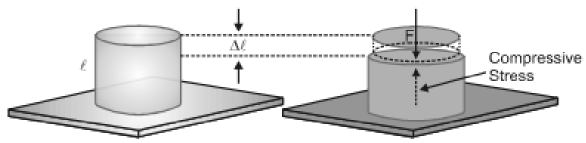
1. $$\text{STRESS} = \frac{\text{Internal restoring force}}{\text{Area of cross section}} = \frac{F_{Res}}{A}$$

There are three types of stress :

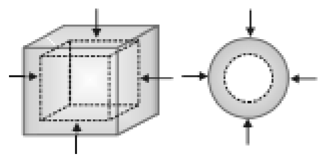
(i) Longitudinal Stress

(a) Tensile Stress :

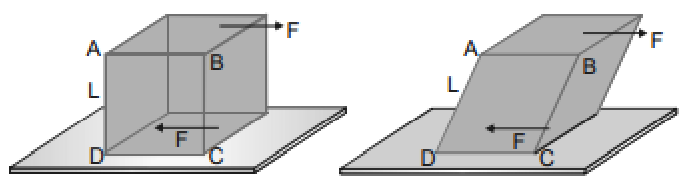
(b) Compressive stress :



(ii) Volume Stress :



(iii) Tangential Stress or Shear Stress :

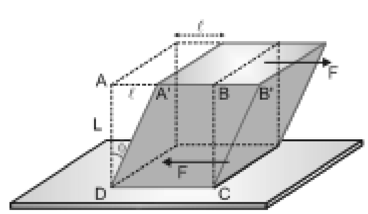


2. $$\textbf{Strain} = \frac{\text{change in size of the body}}{\text{original size of the body}}$$

(i) $$\textbf{Longitudinal strain} = \frac{\text{change in length of the body}}{\text{initial length of the body}} = \frac{\Delta L}{L}$$

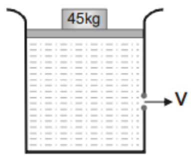
(ii) $$\textbf{Volume strain} = \frac{\text{change in volume of the body}}{\text{original volume of the body}} = \frac{\Delta V}{V}$$

(iii) $$\textbf{Shear strain} = \tan\phi = \frac{\ell}{L} \text{ or } \phi = \frac{\ell}{L} = \frac{\text{displacement of upper face}}{\text{distance between two faces}}$$



SOLVED EXAMPLE

Ex.1 A large cylindrical tank of cross-sectional area $1m^2$ is filled with water. It has a small hole at a height of 1m from the bottom. A movable piston of mass 5 kg is fitted on the top of the tank such that it can slide in the tank freely. A load of 45 kg is applied on the top of water by piston, as shown in figure. The value of v when piston is 7m above the bottom is ($g = 10\ m/s^2$)



(A) $\sqrt{120}$ m/s (B) 10 m/s

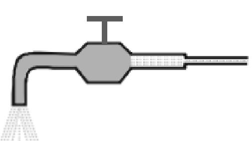
(C) 1 m/s (D) 11 m/s

Sol. $\frac{1}{2}\rho v^2 = \rho g h + \frac{Mg}{A}$

$$\Rightarrow v = \sqrt{2gh + \frac{2Mg}{\rho A}} = \sqrt{2 \times 10 \times 6 + \frac{2 \times 50 \times 10}{10^3 \times 1}}$$

$$= \sqrt{120 + 1} = \sqrt{121} = 11 m/s$$

Ex.2 The pressure of water in a water pipe when tap is opened and closed is respectively $3 \times 10^5\ Nm^{-2}$ and $3.5 \times 10^5\ Nm^{-2}$. With open tap, the velocity of water flowing is



(A) 10 m/s (B) 5 m/s

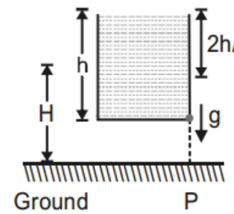
(C) 20 m/s (D) 15 m/s

Sol. $P_{open} + \frac{1}{2}\rho v^2 = P_{closed}$

$$\Rightarrow v = \sqrt{\frac{2\left(P_{closed} - P_{open}\right)}{\rho}}$$

$$= \sqrt{\frac{2 \times (3.5 - 3) \times 10^5}{10^3}} = 10\ m/s$$

Ex.3 An open vessel full of water is falling freely under gravity. There is a small hole in one face of the vessel, as shown in the figure. The water which comes out from the hole at the instant when hole is at height H above the ground, strikes the ground at a distance of x from P. Which of the following is correct for the situation described?



(A) The value of x is $2\sqrt{\frac{2hH}{3}}$

(B) The value of x is $\sqrt{\frac{4hH}{3}}$

(C) The value of x can't be computed from information provided.

(D) The question is irrevalent as no water comes out from the hole.

Sol. As vessel is falling freely under gravity, the pressure at all points within the liquid remains the same as the atmospheric pressure. If we apply Bernoulli's theorem just inside and outside the hole, then

$$P_{inside} + \frac{\rho v_{inside}^2}{2} + \rho g_{eff} y = p_{outside} + \frac{\rho v_{outside}^2}{2} + \rho g_{eff} y$$

$v_{inside} = 0$, $p_{inside} = p_{outside} = p_0$ [atmospheric pressure]

Therefore, $v_{outside} = 0$. i.e., no water comes out.

Ex.4 During blood transfusion the needle is inserted in a vein where the gauge pressure is 2000 Pa. At what height must the blood container be placed so that blood may just enter the vein ? [Density of whole blood = $1.06 \times 10^3\ kg\ m^{-3}$].

(A) 0.192 m (B) 0.182 m

(C) 0.172 m (D) 0.162 m

Sol. Pressure $P = h\rho g$

$$\Rightarrow h = \frac{2000}{1.06 \times 10^3 \times 9.8} = 0.192m$$

Exercise # 1

SINGLE OBJECTIVE | NEET LEVEL

1. Two wires are made of the same material and have the same volume. However wire 1 has cross-sectional area A and wire 2 has cross-sectioanl area 3A. If the length of wire 1 increases by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount

(A) F (B) 4 F
(C) 6 F (D) 9 F

2. A steel rod has a radius R = 9.5 mm and length L = 81 cm. A force F = 6.2×10^4 N stretches it along its length. What is the stress in the rod

(A) 0.95×10^8 N/m^2 (B) 1.1×10^8 N/m^2
(C) 2.2×10^8 N/m^2 (D) 3.2×10^8 Nm^2

3. The dimensions of four wires of the same material are given below. In which wire the increase in length will be maximum when the same tension is applied

(A) Length 100 cm, Diameter 1 mm
(B) Length 200 cm, Diameter 2 mm
(C) Length 300 cm, Diameter 3 mm
(D) Length 50 cm, Diameter 0.5 mm

4. Which is the most elastic

(A) Iron (B) Copper
(C) Quartz (D) Wood

5. A toy cart is tiled to the end of an unstretched string of length 'l', when revolved, the toy cart moves in horizontal circle with radius '$2l$' and time period T. If it is speeded until it moves in horizontal circle of radius '$3l$' with period T_1, relation between T and T_1 is (Hooke's law is obeyed)

(A) $T_1 = \frac{2}{\sqrt{3}}$ (B) $T_1 = \sqrt{\frac{3}{2}}T$
(C) $T_1 = \sqrt{\frac{2}{3}}T$ (D) $T_1 = \frac{\sqrt{3}}{2}T$

6. One end of a horizontal thick copper wire of length 2L and radius 2R is welded to an end nof another horizontal thin copper wire of length L and radius R. When the arrangement is stretched by a applying forces at two ends, the ratio of the elongation in the thin wire to that in the thick wire is

(A) 0.25 (B) 0.50
(C) 2.00 (D) 4.00

7. $Y = \frac{mgl}{\pi r^2 L}$ formula would give Y if mg is doubled

(A) 2Y (B) $\frac{Y}{2}$
(C) Y (D) Zero

8. The length and diameter of a metal wire is doubled. The fundamental frequency of vibration will change from 'n' to (Tension being kept constant and material of both the wires is same)

(A) $\frac{n}{4}$ (B) $\frac{n}{8}$
(C) $\frac{n}{12}$ (D) $\frac{n}{16}$

9. Two similar wires under the same load yield elongation of 0.1 mm and 0.05 mm respectively. If the area of cross-section of the first wire is 4mm^2 then the area of cross section of the second wire is

(A) 6mm^2 (B) 8mm^2
(C) 10mm^2 (D) 12mm^2

10. Write Copper, Steel, Glass and Rubber in order of increasing coefficient of elasticity

(A) Steel, Rubber, Copper, Glass
(B) Rubber, Copper, Glass, Steel
(C) Rubber, Glass, Steel, Copper
(D) Rubber, Glass, Copper, Steel

11. A metalic rod of length l and cross-sectional area A is made of a material of Young modulus Y. If the rod is elongated by an amounty y, then the work done is proportional to

(A) y (B) 1/y
(C) y^2 (D) 1/y^2

12. The work done in stretching an elastic wire per unit volume is or strain energy in a stretched string is

(A) Stress × Strain
(B) 1/2 × Stress × Strain
(C) 2 × Stress × Strain
(D) Stress / Strain

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. The lower surface of a cube is fixed. On its upper surface, force is applied at an angle of 30° from its surface. The change will be in its :–

(A) Shape
(B) Size
(C) Volume
(D) Both shape and size.

2. Which one of the following substances possesses the highest elasticity :–

(A) Rubber (B) Glass
(C) Steel (D) Copper

3. A 2m long rod of radius 1 cm which is fixed from one end is given a twist of 0.8 radians. The shear strain developed will be :–

(A) 0.002 (B) 0.004
(C) 0.008 (D) 0.016

4. If the density of the material increase, the value of Young's modulus :–

(A) increases
(B) decreases
(C) first increases, then decreases
(D) first decreases, then increases

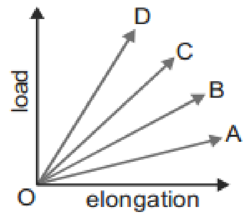
5. A force F is needed to break a copper wire having radius R. The force needed to break a copper wire of radius 2R will be :–

(A) $\frac{F}{2}$ (B) 2F
(C) 4F (D) $\frac{F}{4}$

6. A fixed volume of iron is drawn into a wire of length ℓ. The extension produced in this wire by a constant force F is proportional to :–

(A) $\frac{1}{L^2}$ (B) $\frac{1}{L}$
(C) L^2 (D) L

7. The load versus elongation graph for four wires of the same material and same length is shown in the figure.



The thinnest wire is represented by the line

(A) OA (B) OB
(C) OC (D) OD

8. The following four wires are made of the same material. Which of these will have the largest extension when the same tension is applied–

(A) Length 50 cm and diameter 0.5 mm
(B) Length 100 cm and diameter 1 mm
(C) Length 200 cm and diameter 2 mm
(D) Length 300 cm and diameter 3 mm

9. Two wires of the same material have lengths in the ratio 1 : 2 and their radii are in the ratio $1 : \sqrt{2}$. If they are stretched by applying equal forces, the increase in their lengths will be in the ratio :–

(A) 2 (B) $\sqrt{2} : 2$
(C) 1 : 1 (D) 1 : 2

10. An increases in pressure required to decreases the 200 litres volume of a liquid by 0.004% in container is : (Bulk modulus of the liquid = 2100 MPa) :–

(A) 188 kPa (B) 8.4 kPa
(C) 18.8 kPa (D) 84 kPa

11. The area of cross–section of a wire of length 1.1 meter is 1 mm^2. It is loaded with 1 kg. If Young's modulus of copper is 1.1×10^{11} N/m^2, then the increase in length will be (If g = 10 m/s^2) :–

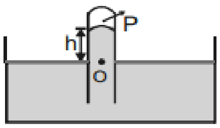
(A) 0.01 mm (B) 0.075 mm
(C) 0.1 mm (D) 0.15 mm

12. The Young's modulus of a rubber string 8 cm long and density 1.5 kg/m^3 is 5×10^8 N/m^2, is suspended on the ceiling in a room. The increase in length due to its own weight will be :–

(A) 9.6×10^{-5} m (B) 9.6×10^{-11} m
(C) 9.6×10^{-3} m (D) 9.6 m

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1. A tube is inverted in a mercury vessel as shown in figure. If pressure P is increased, then :



	Column I		Column II
(A)	Height h	(P)	will increase
(B)	Pressure at O	(Q)	will decrease
(C)	Pressure at 1 cm above O	(R)	will remain same

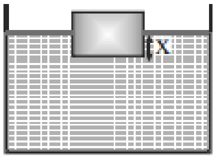
2. Two soap bubbles coalesce to form a single large bubble.:

	Column I		Column II
(A)	Surface energy in the process will	(P)	increase
(B)	Temperature of the bubble will	(Q)	decrease
(C)	Pressure inside the soap bubble will	(R)	remains same

3. A solid is immersed completely in a liquid. The coefficients of volume expansion of solid and the liquid are γ_1 and γ_2 ($<\gamma_1$). If temperatures of both are increased, then

	Column I		Column II
(A)	Upthrust on the solid will	(P)	increase
(B)	apparent weight of the solid will	(Q)	decrease
(C)	Fraction of volume immersed in the liquid if allowed to float	(R)	remains same

4. A cube is floating in a liquid as shown in figure.



	Column I		Column II
(A)	If density of liquid decreases then x will	(P)	increase
(B)	If size of cube is increased then x will	(Q)	decrease
(C)	If the whole system is accelerated upwards then x will	(R)	remains same

Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. To find out degree of freedom, the expression is [2000]

(A) $f=\frac{2}{\gamma-1}$ (B) $f=\frac{\gamma+1}{2}$

(C) $f=\frac{2}{\gamma+1}$ (D) $f=\frac{1}{\gamma+1}$

2. The (W/Q) of a Carnot engine is 1/6, now the temperature of sink is reduced by 62°C, then this ratio becomes twice, therefore the initial temperature of the sink and source are respectively [2000]

(A) 33°C, 67°C (B) 37°C, 99°C

(C) 67°C, 33°C (D) 97 K, 37 K.

3. A scientist says taht the efficiency of his heat engine which work at source temperature 127°C is 26%, then

(A) it is impossible [2001]

(B) it is possible but less probable

(C) it is quite probable

(D) data are incomplete

4. The efficiency odf Carnot engine is 50% and temperature of sink is 500 K. If temperature of source is kept constant and its efficiency raised to 60%, then the required temperature of sink will be [2002]

(A) 100 K (B) 600 K

(C) 400 K (D) 500 K

5. An ideal gas heat engine operates in a Carnot cycle between 227°C and 127°C. It absorbs 6 kcal at the higher temperature. The amount of heat (in kcal) converted into work is equal to

(A) 4.8 (B) 3.5

(C) 1.6 (D) 1.2

6. One mole of an ideal gas at an initial temperature of T K does 6R joule of work adiabatically. If the ratio of specific heats of this gas at constant pressure and at constant volume is 5/3, the final temperature of gas will be [2004]

(A) (T + 2.4) K (B) (T – 2.4) K

(C) (T + 4) K (D) (T – 4) K

7. The equation of state for 5 g of oxygen at a pressure P and temperature T, when occupying a volume V, will be [2004]

(A) PV = (5/32) RT (B) PV = 5RT

(C) PV = (5/2)RT (D) PV = (5/16)RT

(where R is the gas constant)

8. Which of the following processes is reversible?

(A) Transfer of heat by conduction [2005]

(B) Transfer of heat by radiation

(C) Isothermal compression

(D) Electrical heating of a nichrome wire.

9. An ideal gas heat engine operates in Carnot cycle between 227°C and 127°C. It absorbs 6×10^4 cal of heat at higher temperature. Amount of heat converted to work is [2005]

(A) 4.8×10^4 cal (B) 6×10^4 cal

(C) 2.4×10^4 cal (D) 1.2×10^4 cal

10. The molar specific heat at constant pressure of an ideal gas is (7/2)R. The ratio of specific heat at constant pressure to that at constant volume is

(A) 9/7 (B) 7/5 [2006]

(C) 8/7 (D) 5/7

11. A Carnot engine whose sink is at 300 K has an efficiency of 40%. By how much should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency?

(A) 380 K (B) 275 K [2006]

(C) 325 K (D) 250 K

12. An engine has an efficiency of 1/6. When the temperature of sink is reduced by 62°C, the efficiency is doubled. Temperature of the source is

(A) 37°C (B) 62C [2007]

(C) 99°C (D) 124°C

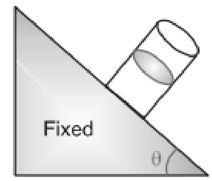
13. If Q, E and W denote respectively the heat added, chantge in internal energy and the work done in a closed cycle process, then [Prelims 2008]

(A) E = 0 (B) Q = 0

(C) W = 0 (D) Q = W = 0

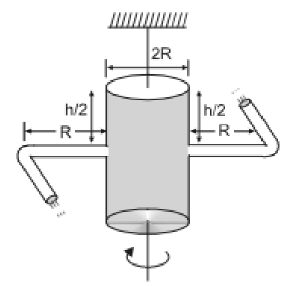
MOCK TEST

STRAIGHT OBJECTIVE TYPE



1. A cylindrical vessel filled with water is released on an inclined surface of angle θ as shown in figure. The friction coefficient of surface with vessel is μ ($< \tan\theta$). Then the constant angle made by the surface of water with the incline will be:

(A) $\tan^{-1}\mu$ **(B)** $\theta - \tan^{-1}\mu$ **(C)** $\theta + \tan^{-1}\mu$ **(D)** $\cot^{-1}\mu$



2. A cylindrical container of radius 'R' and height 'h' is completely filled with a liquid. Two horizontal L shaped pipes of small cross-section area 'a' are connected to the cylinder as shown in the figure. Now the two pipes are opened and fluid starts coming out of the pipes horizontally in opposite directions. Then the torque due to ejected liquid on the system is:

(A) $4\,a g h \rho R$ **(B)** $8\,a g h \rho R$

(C) $2\,a g h \rho R$ **(D)** none of these

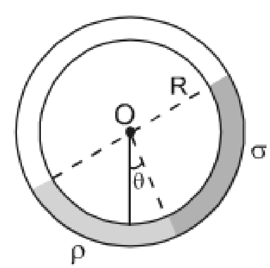
3. A block of silver of mass 4 kg hanging from a string is immersed in a liquid of relative density 0.72. If relative density of silver is 10, then tension in the string will be:[take $g = 10\text{ m/s}^2$]

(A) 37.12 N **(B)** 42 N **(C)** 73 N **(D)** 21 N

4. A vessel contains oil (density = 0.8 gm/cm^3) over mercury (density = 13.6 gm/cm^3). A uniform sphere floats with half its volume immersed in mercury and the other half in oil. The density of the material of sphere in gm/cm^3 is:

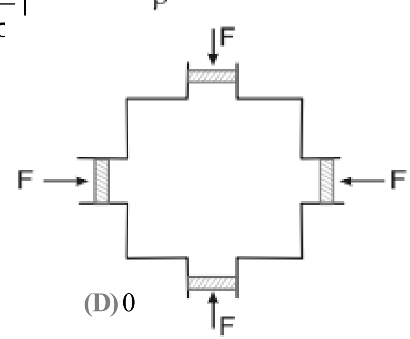
(A) 3.3 **(B)** 6.4 **(C)** 7.2 **(D)** 12.8

5. A small uniform tube is bent into a circular tube of radius R and kept in the vertical plane. Equal volumes of two liquids of densities ρ and σ ($\rho > \sigma$) fill half of the tube as shown in the figure. θ is the angle which the radius passing through the interface makes with the vertical.



(A) $\theta = \tan^{-1}\left(\dfrac{\rho-\sigma}{\rho+\sigma}\right)$ **(B)** $\theta = \tan^{-1}\left(\dfrac{\sigma-\rho}{\sigma+\rho}\right)$

(C) $\theta = \tan^{-1}\left(\dfrac{\rho}{\rho+\sigma}\right)$ **(D)** $\theta = \tan^{-1}\left(\dfrac{\rho}{\rho-\sigma}\right)$



6. In the figure shown water is filled in a symmetrical container. Four pistons of equal area A are used at the four opening to keep the water in equilibrium. Now an additional force F is applied at each piston. The increase in the pressure at the centre of the container due to this addition is

(A) $\dfrac{F}{A}$ **(B)** $\dfrac{2F}{A}$ **(C)** $\dfrac{4F}{A}$ **(D)** 0

11th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS	CHEMISTRY	BIOLOGY
Module-1 1. Physical World & Measurements 2. Basic Maths & Vector 3. Kinematics **Module-2** 1. Law of Motion & Friction 2. Work, Energy & Power **Module-3** 1. Motion of system of particles & Rigid Body 2. Gravitation **Module-4** 1. Mechanical Properties of Matter 2. Thermal Properties of Matter **Module-5** 1. Oscillations 2. Waves	**Module-1(PC)** 1. Some Basic Conceps of Chemistry 2. Atomic Structure 3. Chemical Equilibrium 4. Ionic Equilibrium **Module-2(PC)** 1. Thermodynamics & Thermochemistry 2. Redox Reaction 3. States Of Matter (Gaseous & Liquid) **Module-3(IC)** 1. Periodic Table 2. Chemical Bonding 3. Hydrogen & Its Compounds 4. S-Block **Module-4(OC)** 1. Nomenclature of Organic Compounds 2. Isomerism 3. General Organic Chemistry **Module-5(OC)** 1. Reaction Mechanism 2. Hydrocarbon 3. Aromatic Hydrocarbon 4. Environmental Chemistry & Analysis Of Organic Compounds	**Module-1** 1. Diversity in the Living World 2. Plant Kingdom 3. Animal Kingdom **Module-2** 1. Morphology in Flowering Plants 2. Anatomy of Flowering Plants 3. Structural Organization in Animals **Module-3** 1. Cell: The Unit of Life 2. Biomolecules 3. Cell Cycle & Cell Division 4. Transport in Plants 5. Mineral Nutrition **Module-4** 1. Photosynthesis in Higher Plants 2. Respiration in Plants 3. Plant Growth and Development 4. Digestion & Absorption 5. Breathing & Exchange of Gases **Module-5** 1. Body Fluids & Its Circulation 2. Excretory Products & Their Elimination 3. Locomotion & Its Movement 4. Neural Control & Coordination 5. Chemical Coordination and Integration

12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1

1. Electrostatics
2. Capacitance

Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3

1. Electromagnetic Induction
2. Alternating Current

Module-4

1. Geometrical Optics
2. Wave Optics

Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3

1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5

1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues