DAILY PRACTICE PROBLEM

## Introduction to types of forces and types of bodies DPP-01

**1. Which of the following is near perfect elastic material?**

(1) Copper
(2) Rubber
(3) Steel
(4) Quartz

**2. Which of the following is false?**

(1) Elastic body tends to regain its shape and size after removal of external deforming forces
(2) Restoring forces can be external
(3) If body changes its shape or size in absence of external forces, restoring forces will be zero
(4) A plastic body has no tendency to regain its original shape and size after deformation

**3. The property of the material which opposes the change in shape, volume or length is called**

(1) Intermolecular repulsion
(2) Intermolecular behavior
(3) Plasticity
(4) Elasticity

**4. Which one of the following substances possesses the highest elasticity?**

(1) Rubber
(2) Chalk
(3) Clay
(4) Paraffin wax

**Answer key**

| Question | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Answer | **4** | **2** | **4** | **1** |

## SOLUTIONS DPP-01

**1.** (4)

**2.** (2)

**3.** (4)

**4.** (1)

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**Stress and its types, breaking stress DPP-02**

**1. A and B are two wires. The radius of A is twice that of B. They are stretched by the same load. Then the stress on B is**

(1) Equal to that on A
(2) Four times that on A
(3) Two times that on A
(4) Half that on A

**2. A cable that can support a load of 800 N is cut into two equal parts. The maximum load that can be supported by either part is -**

(1) 100 N
(2) 400 N
(3) 800 N
(4) 1600 N

**3. A lift is tied with thick iron wire and its mass is 314 kg. What should be the minimum diameter of wire if the maximum acceleration of lift is 1.2 $m/sec^2$ and the maximum safe stress of the wire is $1.1 \times 10^7$ $N/m^2$ ?**

(1) 2 cm
(2) 1 cm
(3) 1.5 cm
(4) None of these

**4. Shearing stress causes change in**

(1) Length
(2) Breadth
(3) Shape
(4) Volume

**5. 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**

(1) Shape only
(2) Size only
(3) Volume only
(4) Both shape and size

**6. One end of uniform wire of length L and of weight W is attached rigidly to a point in the roof and a weight $W_1$ is suspended from its lower end. If s is the area of cross-section of the wire, the stress in the wire at a height (L/4) from its lower end is**

(1) $\frac{W_1}{s}$
(2) $\frac{\left[W_1+\frac{W}{4}\right]}{s}$
(3) $\frac{\left[W_1+\frac{3W}{4}\right]}{s}$
(4) $\frac{W_1+W}{s}$

**Answer key**

| Question | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **Answer** | **2** | **3** | **1** | **3** | **4** | **2** |

## SOLUTIONS DPP-02

**1.** **(2)**

Stress $= \frac{\text{Force}}{\text{Area}} \therefore$ Stress $\propto \frac{1}{\pi r^2}$

$\frac{S_B}{S_A} = \left(\frac{r_A}{r_B}\right)^2 = (2)^2 \Rightarrow S_B = 4S_A$

**2.** **(3)**

Breaking stress does not depend upon the length of the cable.

**3.** **(1)**

The tension, T in the rope of the lift when it goes upward is given by

$T = m(g + a) = 314 \times 11$ N

Let r be the radius of the wire, then maximum stress will be $T/\pi r^2$

Hence, $T/\pi r^2 = 1.1 \times 10^7$

Or $r^2 = \frac{T}{\pi \times 1.1 \times 10^7} = \frac{314 \times 11}{3.14 \times (1.1 \times 10^7)} = \frac{1}{10^4}$

Now, $r = \frac{1}{10^2}$ m = 1 cm

$\therefore$ Diameter of the wire = 2r = 2cm

**4.** **(3)**

Fact

**5.** **(4)**

There will be both shear stress and normal stress.

**6.** **(2)**

Total weight at height $\frac{L}{4}$ from its lower end $= W_T$

$W_T$ = weight suspended + weight of $\frac{L}{4}$ of wire

$W_T = W_1 + \frac{W}{4}$

Stress $= \frac{F}{\text{Area}} = \frac{W_T}{S}$

Stress $= \frac{\left(W_1 + \frac{W}{4}\right)}{S}$

DAILY PRACTICE PROBLEM

## Strain and its types DPP-03

**1. When strain is produced in a body within elastic limit, its internal energy**

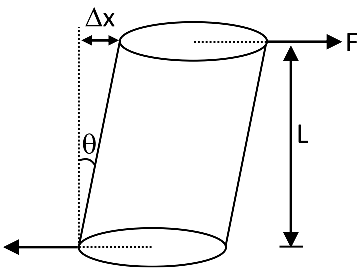
(1) Remains constant

(2) Decreases

(3) Increases

(4) None of the above

**2. If two equal and opposite deforming forces are applied parallel to the cross-sectional area of the cylinder as shown in the figure, there is a relative displacement between the opposite faces of the cylinder. The ratio of $\Delta x$ to L is known as**




(1) Longitudinal strain

(2) Volumetric strain

(3) Shearing strain

(4) Poisson's ratio

**3. A uniform cube is subjected to volume compression. If each side is decreased by 1%, then volumetric strain is**

(1) 0.01

(2) 0.06

(3) 0.02

(4) 0.03

**4. The upper end of a wire of radius 4 mm and length 100 cm is clamped and its other end is twisted through an angle of 30°. Then angle of shear is -**

(1) 12°

(2) 0.12°

(3) 1.2°

(4) 0.012°

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

(1) 0.002

(2) 0.004

(3) 0.008

(4) 0.016

**6.** **The reason for the change in shape of a regular body is**

(1) Volume stress

(2) Shearing strain

(3) Longitudinal strain

(4) Metallic strain

**7.** **A copper wire and a steel wire of the same diameter and length are connected end to end and a force is applied at free end of steel wire and hanged vertically, which stretches their combined length by 1 cm. The two wires will have**

(1) different stresses and strains

(2) the same stress and strain

(3) the same strain but different stresses

(4) the same stress but different strains

**Answer key**

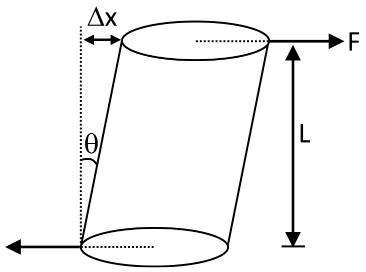
| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Answer | 3 | 3 | 4 | 2 | 2 | 2 | 4 |

## SOLUTIONS DPP-03

**1.** **(3)**

Due to increase in intermolecular distance

**2.** **(3)**




Shearing strain = $\frac{\Delta x}{L}$

**3.** **(4)**

If side of the cube is L then V = $L^3$

$\frac{dV}{V} = 3\frac{dL}{L}$

% change in volume = 3 × (% change in length)

$= 3 \times 1\% = 3\% \therefore$ Bulk strain $\frac{\Delta V}{V} = 0.03$

**4.** **(2)**

Angle of shear $\phi = \frac{r\theta}{L} = \frac{4\times10^{-1}}{100} \times 30°$

$= 0.12°$

**5.** **(2)**

$R\theta = L\phi \Rightarrow 10^{-2} \times 0.8 = 2 \times \phi \Rightarrow \phi = 0.004$

**6.** **(2)**

Fact

**7.** **(4)**

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

In the present case, force applied and area of cross section of wires are same, therefore stress has to be the same.

Strain = $\frac{\text{Stress}}{Y}$

Since the Young's modulus of steel wire is greater than the copper wire, therefore, strain in case of steel wire is less than that in case of copper wire.

## Hooke's law DPP-04

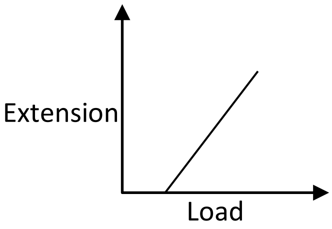
**1. Hooke's law defines**

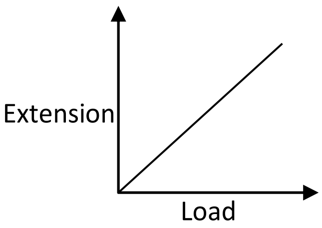
(1) Stress
(2) Strain
(3) Modulus of elasticity
(4) Elastic limit

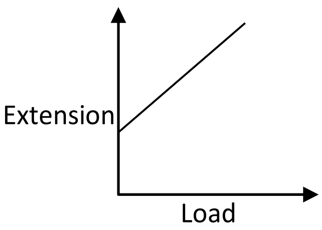
**2. Stress to strain ratio is equivalent to**

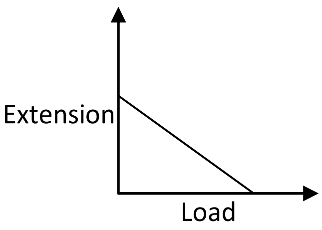
(1) Modulus of elasticity
(2) Poisson’s Ratio
(3) Bulk modulus
(4) Modulus of Rigidity

**3. Within elastic limit, which of the following graphs correctly represents the variation of extension in the length of a wire with the external load ?**

(1) 


(2) 


(3) 


(4) 

**4. The increase in length is $\ell$ of a wire of length L by the longitudinal stress. Then the stress is proportional to**

(1) $L/\ell$

(2) $\ell/L$

(3) $\ell \times L$

(4) $\ell^2 \times L$

**Answer key**

| Question | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Answer | **3** | **1** | **2** | **2** |

**SOLUTIONS DPP-04**

**1.** **(3)**

Stress α Strain or Stress = E × strain

$$E = \frac{\text{Stress}}{\text{Strain}}$$

**2.** **(1)**

Fact

**3.** **(2)**

According to Hooke's law,

Within elastic limit,

Extension $\propto$ Load applied

Hence, option (2) represents the correct graph.

**4.** **(2)**

Stress $\propto$ Strain $\Rightarrow$ Stress $\propto \frac{\ell}{L}$

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## Young's Modulus of Elasticity DPP-05

1. **The length of an iron wire is L and area of cross-section is A. The increase in length is $\Delta L$ on applying the force F on its two ends. Which of the statement is correct?**
   (1) Increase in length is inversely proportional to its length L
   (2) Increase in length is proportional to area of cross-section A
   (3) Increase in length is inversely proportional to A
   (4) Increase in length is proportional to Young's modulus

2. **The unit of Young's modulus of elasticity is**
   (1) $Nm^{-1}$
   (2) N-m
   (3) $Nm^{-2}$
   (4) $N\text{-}m^2$

3. **In the Young's experiment, If length of wire and radius both are doubled then the value of Y will become**
   (1) 2 times
   (2) 4 times
   (3) Remains same
   (4) Half

4. **Young's modulus depends upon**
   (1) Stress applied on material
   (2) Strain produced in material
   (3) Temperature of material
   (4) All of these

5. **The modulus of elasticity of a material does not depend on–**
   (1) Shape
   (2) Temperature
   (3) Nature of material
   (4) Impurities

6. **Three wires P, Q and R of the same material and length have radii 0.1 cm, 0.2 cm and 0.3 cm respectively. Which wire has the highest value of Young's modulus of elasticity?**
   (1) P
   (2) Q
   (3) R
   (4) All have the same value

**7. If the density of the material increases, the value of Young's modulus**

(1) Increases

(2) Decreases

(3) First increases, then decreases

(4) First decreases, then increases

**8. 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 -**

(1) $\frac{1}{L^2}$

(2) $\frac{1}{L}$

(3) $L^2$

(4) L

**9. How much force is required to produce an increase of 0.2% in the length of a brass wire of diameter 0.6 mm ? [Young's modulus for brass = $0.9 \times 10^{11}$ N/m$^2$]**

(1) Nearly 17 N

(2) Nearly 34 N

(3) Nearly 51 N

(4) Nearly 68 N

**10. If the strain in a wire is not more than 1/1000 and Y = $2 \times 10^{11}$ N/m$^2$, Diameter of wire is 1mm. The maximum weight hung from the wire is:-**

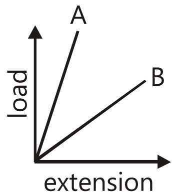
(1) 110 N

(2) 125 N

(3) 157 N

(4) 168 N

**11. The dimensions of two wires A and B are the same. But their materials are different. Their load-extension graphs are shown. If $Y_A$ and $Y_B$ are the values of Young's modulus of elasticity of A and B respectively then**




(1) $Y_A > Y_B$

(2) $Y_A < Y_B$

(3) $Y_A = Y_B$

(4) $Y_B = 2Y_A$

**12. Cross section area of a steel wire (Y=$2.0 \times 10^{11}$ N/m$^2$) is 0.1 cm$^2$. The required force, to make its length double will be –**

(1) $2 \times 10^{12}$N

(2) $2 \times 10^{11}$N

(3) $2 \times 10^{10}$N

(4) $2 \times 10^{6}$N

**13. To increase the length by 0.5 mm in a steel wire of length 2 m and area of cross-section 2 mm$^2$, the force required is [Y for steel = $2.2 \times 10^{11}$ N/m$^2$]**

(1) $1.1 \times 10^5$ N

(2) $1.1 \times 10^4$ N

(3) $1.1 \times 10^3$ N

(4) $1.1 \times 10^2$ N

**14. A wire elongates by x mm when a load W is hanged from it. If the wire goes over a pulley and two weights W each are hung at the two ends, the elongation of the wire will be (in mm)-**

(1) x

(2) 2x

(3) zero

(4) x/2

**Answer key**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Answer | 3 | 3 | 3 | 3 | 1 | 4 | 1 | 3 | 3 | 3 | 1 | 4 | 1 | 1 |

## SOLUTIONS DPP-05

**1.** **(3)**

$\Delta L = \frac{FL}{YA} \Rightarrow \Delta L \propto \frac{L}{A}$

**2.** **(3)**

Fact

**3.** **(3)**

Fact

**4.** **(3)**

Fact

**5.** **(1)**

Fact

**6.** **(4)**

Young's modulus depends upon the nature of material and not the radii of the wires.

**7.** **(1)**

When density increase, mass of material increase, for same strain more stress required. So Young's modulus increases.

**8.** **(3)**

Volume = constant

$A \times L = \text{constant} \Rightarrow A \propto \frac{1}{L}$

$\Delta L = \frac{FL}{AY} \Rightarrow \Delta L \propto \frac{L}{A} \Rightarrow \Delta L \propto L^2 \left(\text{as } A \propto \frac{1}{L}\right)$

**9.** **(3)**

$F = \frac{YA}{L}\Delta L$

$= 0.9 \times 10^{11} \times \pi \times (0.3 \times 10^{-3})^2 \times \frac{0.2}{100} = 51\text{N}$

**10.** **(3)**

$F = \frac{YA}{L}\Delta L = \pi \times \left(\frac{1}{2} \times 10^{-3}\right)^2 \times 2 \times 10^{11} \times \frac{1}{1000}$

= 157 N

**11.** **(1)**

From graph

Slope $= \frac{F}{\Delta L}$

Also, $Y = \frac{FL}{A\Delta L}$

Slope $= \frac{F}{\Delta L} = Y\frac{A}{L} \Rightarrow$ more slope, more Y

So, $Y_A > Y_B$

**12.** **(4)**

Here $\Delta L = L_0$

$L_0$ = initial length

$L_f$ = final length = $2L_0$

$\frac{F}{A} = \frac{Y\Delta L}{L_0}$

$F = \frac{YA(L_0)}{L_0}$

F = YA

$= 2.0 \times 10^{11} \times 0.1 \times 10^{-4} = 2 \times 10^6$ N

**13.** **(1)**

Stress = Y × Strain

$= 2.2 \times 10^{11} \times \frac{0.5}{2} = 5.5 \times 10^{10}$ Nm$^{-2}$

Force = stress × area = $5.5 \times 10^{10} \times 2 \times 10^{-6} = 11 \times 10^4 = 1.1 \times 10^5$

**14.** **(1)**

In both case tension in wire are same and $\Delta L \propto T$

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## Elongation in hanging wire due to its own weight DPP-06

**1. A thick rope of density ρ and length L is hung from a rigid support. The increase in length of the rope due to its own weight is (Y is the Young's modulus)**

(1) $\frac{1}{4Y}\rho L^2 g$

(2) $\frac{1}{2Y}\rho L^2 g$

(3) $\frac{\rho L^2 g}{Y}$

(4) $\frac{\rho L g}{Y}$

**Answer key**

| Question | 1 |
|---|---|
| **Answer** | **2** |

**SOLUTIONS DPP-06**

**1.** **(2)**

As the weight of wire acts at centre of gravity.

$\therefore$ Only half the length of wire gets extended.

Now, $Y = \frac{F}{A} \cdot \frac{(L/2)}{\Delta L} = \frac{Mg(L/2)}{A\Delta L}$

$\Rightarrow \Delta L = \frac{MgL}{2AY} \Rightarrow \Delta L = \frac{AL\rho gL}{2AY}$

$\therefore \Delta L = \frac{\rho L^2 g}{2Y}$

So, the correct choice is (2)

DAILY PRACTICE PROBLEM

## Bulk modulus DPP-07

**1. The dimensions of the bulk modulus of elasticity is the same as that of**

(1) Force

(2) Pressure

(3) Work

(4) Tangential strain

**2. What increase in pressure is required to decrease the volume of 200 litres of water by 0.004% ? Given bulk modulus of water is 2100 MPa.**

(1) 31kPa
(2) 84kPa
(3) 42kPa
(4) None of these

**3. The pressure of a medium is changed from $1.01 \times 10^5$ Pa to $1.165 \times 10^5$ Pa and change in volume is 10% keeping temperature constant. The bulk modulus of the medium is -**

(1) $1.55 \times 10^5$ Pa
(2) $205 \times 10^5$ Pa
(3) $107.4 \times 10^5$ Pa
(4) $53.7 \times 10^5$ Pa

**4. The compressibility of water is $4 \times 10^{-5}$ per unit atmospheric pressure. The decrease in volume of 100 cubic centimetre of water under a pressure of 100 atmosphere will be -**

(1) 0.4 cc
(2) $4 \times 10^5$ cc
(3) 0.025 cc
(4) 0.004 cc

**5. The compressibility of a material is**

(1) Product of volume and its pressure
(2) The change in pressure per unit change in volume strain
(3) The fractional change in volume per unit change in pressure
(4) None of the above

**6. When a pressure of 100 atmosphere is applied on a spherical ball, then its volume reduces to 0.01%. The bulk modulus of the material of the rubber in dyne/cm$^2$ is -**

(1) $10 \times 10^{12}$
(2) $100 \times 10^{12}$
(3) $1 \times 10^{12}$
(4) $20 \times 10^{12}$

**7. A ball falling in a lake of depth 200 shows 0.1% decrease in its volume at the bottom. What is the bulk modulus of the material of the ball ?**

(1) $19.6 \times 10^{8}$ N/m$^2$
(2) $19.6 \times 10^{-10}$ N/m$^2$
(3) $19.6 \times 10^{10}$ N/m$^2$
(4) $19.6 \times 10^{-8}$ N/m$^2$

**8. For a constant hydraulic stress on an object, the fractional change in the object's volume $\left(\frac{\Delta V}{V}\right)$ and its bulk modulus (B) are related as**

(1) $\frac{\Delta V}{V} \propto B$
(2) $\frac{\Delta V}{V} \propto \frac{1}{B}$
(3) $\frac{\Delta V}{V} \propto B^2$
(4) $\frac{\Delta V}{V} \propto B^{-2}$

**9. The average depth of Indian Ocean is about 3000 m. The fractional compression of water at the bottom of the ocean is – (Given : Bulk modulus of the water = $2.2 \times 10^9$ Nm$^{-2}$ and g = 10 m/s$^{-2}$)**

(1) 0.82%
(2) 0.91%
(3) 1.36%
(4) 1.24%

**10. The compressibility of water is $6 \times 10^{-10}$ N$^{-1}$ m$^2$. If one litre is subjected to a pressure of $4 \times 10^7$ Nm$^{-2}$, the decrease in its volume is -**

(1) 10 cc
(2) 24 cc
(3) 15 cc
(4) 12 cc

**11. The volume change of a solid copper cube of edge length 10 cm, when subjected to a pressure of 7 MPa is (Bulk modulus of copper = 140 GPa)**

(1) $5 \times 10^{-2}$ cm$^3$
(2) $10 \times 10^{-2}$ cm$^3$
(3) $15 \times 10^{-4}$ cm$^3$
(4) $20 \times 10^{-2}$ cm$^3$

**12. The only elastic modulus that applies to fluids is**

(1) Young's modulus
(2) Shear modulus
(3) Modulus of rigidity
(4) Bulk modulus

**Answer key**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Answer | 2 | 2 | 1 | 1 | 3 | 3 | 1 | 2 | 3 | 2 | 1 | 4 |

## SOLUTIONS DPP-07

**1.** **(2)**

Fact

**2.** **(2)**

$\Delta V = 0.00004\ (200L) = 0.008\ L$

$\Delta p = B\left(-\frac{\Delta V}{V}\right)$

$= (2100\ MPa)\left(\frac{0.008L}{200L}\right)$

$= 0.084\ MPa = 84kPa$

**3.** **(1)**

$B = \frac{dP}{dV/V} = \frac{(1.165-1.01)\times10^5}{(10/100)}\ Pa$

$= 1.55 \times 10^5\ Pa$

**4.** **(1)**

$C = \frac{1}{K} = \frac{\Delta V/V}{\Delta P} \Rightarrow \Delta V = C\Delta P \times V$

$= 4 \times 10^{-5} \times 100 \times 100 = 0.4\ cc$

**5.** **(3)**

$\frac{1}{K}$ = compressibility $= \left(\frac{-\Delta V/V}{\Delta P}\right)$

**6.** **(3)**

$K = \frac{100}{0.01/100} = 10^6\ atm = 10^{11}\ N/m^2$

$=10^{12}\ dyne/cm^2$

**7.** **(1)**

$B = \frac{\Delta p}{\Delta V/V} = \frac{h\rho g}{0.1/100}$

$= \frac{200\times10^3\times9.8}{1/1000}$

$= 19.6 \times 10^8\ N/m^2$

**8.** **(2)**

$B = \frac{\Delta p}{\Delta V/V} \Rightarrow \frac{1}{B} \propto \frac{\Delta V}{V}$ [$\Delta p$ = constant]

**9.** **(3)**

The pressure exerted by a 3000 m column of water on the bottom layer is

P = hρg

= 3000 m × 1000 $kgm^{-3}$ × 10 $ms^{-2}$

Fractional compression $\frac{\Delta V}{V}$ is

$\frac{\Delta V}{V} = \frac{P}{B} = \frac{3\times10^{7}Nm^{-2}}{2.2\times10^{9}Nm^{-2}}$ = 1.36 × $10^{-2}$

= 1.36%

**10.** **(2)**

Bulk modulus, $B = -\frac{P}{(\Delta V/V)}$

-ve sign shows that with an increase in pressure, a decrease in volume occurs.

Compressibility, $K = \frac{1}{B} = -\frac{\Delta V}{PV}$

Decrease in volume, ΔV = PVK

= 4 × $10^7$ × 1 × 6 × $10^{-10}$

= 24 × $10^{-3}$ litre

= 24 × $10^{-3}$ × $10^3$ $cm^3$ = 24 cc

**11.** **(1)**

Here, L = 10 cm = 10 × $10^{-2}$ m

P = 7 MPa = 7 × $10^6$ Pa

B = 140 GPa = 140 × $10^9$ Pa

As $B = \frac{P}{\Delta V/V}$

$\therefore \Delta V = \frac{PV}{B} = \frac{PL^3}{B}$

$= \frac{(7\times10^{6}Pa)(10\times10^{-2}m)^3}{140\times10^{9}Pa}$

= 5 × $10^{-8}$ $m^3$ = 5 × $10^{-2}$ $cm^3$

**12.** **(4)**

Fact

DAILY PRACTICE PROBLEM

## Modulus of Rigidity DPP-08

**1. Rigidity modulus of steel is $\eta$ and its young's modulus is Y. A piece of steel of cross-sectional area 'A' is changed into a wire of length L and area A/10 then -**

(1) Y increases and $\eta$ decreases

(2) Y and $\eta$ remain the same

(3) Both Y and $\eta$ increase

(4) Both Y and $\eta$ decrease

**2. The ratio of lengths of two rods A and B of same material is 1 : 2 and the ratio of their radii is 2 : 1, then the ratio of modulus of rigidity of A and B will be**

(1) 4 : 1

(2) 16 : 1

(3) 8 : 1

(4) 1 : 1

**3. Modulus of rigidity of a liquid**

(1) Nonzero constant

(2) Infinite

(3) Zero

(4) Can't be predicted

**4. Forces of 100 N each are applied in opposite direction on the upper and lower faces of a cube of side 20 cm. The upper face is shifted parallel to itself by 0.25 cm. If the side of the cube were 10 cm, then the displacement would be -**

(1) 0.25 cm

(2) 0.5 cm

(3) 0.75 cm

(4) 1 cm

**5. For a perfectly rigid body**

(1) Young's modulus is infinite and Bulk modulus is zero.

(2) Young's modulus is zero and Bulk modulus is infinite

(3) Young's modulus is infinite and Bulk modulus is also infinite.

(4) Young's modulus is zero and Bulk modulus is also zero.

**6. In the three states of matter, the elastic coefficient can be**

(1) Young's modulus
(2) Bulk modulus
(3) Modulus of rigidity
(4) Poisson's ratio

**7. The Bulk modulus for an incompressible liquid is**

(1) Zero
(2) Unity
(3) Infinity
(4) Between 0 to 1

**Answer key**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Answer | **2** | **4** | **3** | **2** | **3** | **2** | **3** |

**SOLUTIONS DPP-08**

**1.** **(2)**

η and Y are properties of material.

These coefficients are independent of geometry of body.

**2.** **(4)**

Modulus of rigidity is the property of material.

**3.** **(3)**

Fact

**4.** **(2)**

$\eta = \frac{FL}{A\Delta L} = \frac{FL}{L^2\Delta L}$ or $\Delta L \propto \frac{1}{L}$

If L is halved, then $\Delta L$ is doubled.

**5.** **(3)**

Fact

**6.** **(2)**

Fact

**7.** **(3)**

Fact

DPP
DAILY PRACTICE PROBLEM

## Elastic Potential Energy, Work done DPP-09

**1. If x longitudinal strain is produced in a wire of Young's modulus y then energy stored in the material of the wire per unit volume is**

(1) $yx^2$
(2) $2yx^2$
(3) $\frac{1}{2}y^2x$
(4) $\frac{1}{2}yx^2$

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

(1) Stress $\times$ Strain
(2) $\frac{1}{2}\times$Stress $\times$Strain
(3) 2 × strain × stress
(4) Stress/Strain

**3. Calculate the work done, if a wire is loaded by 'Mg' weight and the increase in length is 'l'**

(1) Mgl
(2) Zero
(3) Mgl/2
(4) 2Mgl

**4. If the force constant of a wire is K, the work done in increasing the length of the wire by L is**

(1) KL/2
(2) KL
(3) $KL^2/2$
(4) $KL^2$

**5. The elastic energy stored in a wire of Young's modulus Y is**

(1) $\mathbf{Y} \times \frac{\text{Strain}^2}{\text{Volume}}$
(2) Stress × Strain × Volume
(3) $\frac{\text{Stress}^2 \times \text{Volume}}{2\mathbf{Y}}$
(4) $\frac{1}{2}\mathbf{Y}$ × Stress × Strain × Volume

**6. An elastic material of Young's modulus Y is subjected to a stress S. The elastic energy stored per unit volume of the material is**

(1) $\frac{2Y}{S^2}$

(2) $\frac{S^2}{2Y}$

(3) $\frac{S}{2Y}$

(4) $\frac{S^2}{Y}$

**9. A mass of 0.5 kg is suspended from wire then length of wire increases by 3 mm then find out work done :**

(1) $4.5 \times 10^{-3}$ J

(2) $7.3 \times 10^{-3}$ J

(3) $9.3 \times 10^{-2}$ J

(4) $2.5 \times 10^{-2}$ J

**Answer key**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Answer | 4 | 2 | 3 | 3 | 3 | 2 | 2 |

## SOLUTIONS DPP-09

**1.** **(4)**

Energy stored per unit volume $= \frac{1}{2} \times$ Stress $\times$ Strain

$$= \frac{1}{2} \times \text{Young's modulus } \times (\text{Strain})^2 = \frac{1}{2} \times \mathbf{y} \times \mathbf{x}^2$$

**2.** **(2)**

Fact

**3.** **(3)**

Work done $= \frac{1}{2}\mathbf{Fl} = \frac{\mathbf{Mgl}}{2}$

**4.** **(3)**

Fact

**5.** **(3)**

Fact

**6.** **(2)**

Fact

**7.** **(2)**

$W_{ext} = \vec{\mathbf{F}}.\vec{\mathbf{d}}$ using COM

$= \frac{F\Delta L}{2}$

$= \frac{mg\Delta L}{2} = \frac{0.5 \times 9.8 \times 3 \times 10^{-3}}{2}$

$= 7.3 \times 10^{-3}$ Joule

DAILY PRACTICE PROBLEM

**Poisson's Ratio DPP-10**

1. **Liquids have no Poisson's ratio, because**
(1) It has no definite shape
(2) It has greater volume
(3) It has lesser density than solid
(4) None of the above

2. **The possible value of Poisson's ratio is**
(1) 1
(2) 0.9
(3) 0.8
(4) 0.4

3. **The value of Poisson's ratio lies between**
(1) $-1$ to $\frac{1}{2}$
(2) $-\frac{3}{4}$ to $-\frac{1}{2}$
(3) $-\frac{1}{2}$ to 1
(4) 1 to 2

4. **The Poisson's ratio cannot have the value**
(1) 0.7
(2) 0.2
(3) 0.1
(4) 0.5

5. **For a given material, the Young's modulus is 2.4 times that of rigidity modulus. Its Poisson's ratio is :**
(1) 2.4
(2) 1.2
(3) 0.4
(4) 0.2

6. **The mean distance between the atoms of iron is $3 \times 10^{-10}$ m and inter atomic force constant for iron is 7 N/m. The young's modulus of elasticity for iron is :**
(1) $2.33 \times 10^{5}$ N/m$^2$
(2) $23.3 \times 10^{10}$ N/m$^2$
(3) $233 \times 10^{10}$ N/m$^2$
(4) $2.33 \times 10^{10}$ N/m$^2$

**7. Which statement is true for a metal**

(1) $Y < \eta$

(2) $Y = \eta$

(3) $Y > \eta$

(4) $Y < 1/\eta$

**8. Which of the following relations is true**

(1) $3Y = K(1 - \sigma)$

(2) $K = \frac{9\eta Y}{Y+\eta}$

(3) $\sigma = (6K + \eta)Y$

(4) $\sigma = \frac{0.5Y-\eta}{\eta}$

**9. The Young's modulus of the material of a wire is $6\times10^{12}\,N/m^2$ and there is no lateral strain in it, then its modulus of rigidity will be**

(1) $3 \times 10^{12} N/m^2$

(2) $2 \times 10^{12} N/m^2$

(3) $10^{12} N/m^2$

(4) None of the above

**Answer key**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| **Answer** | **1** | **4** | **1** | **1** | **4** | **4** | **3** | **4** | **1** |

## SOLUTIONS DPP-10

**1.** **(1)**

Fact

**2.** **(4)**

Fact

**3.** **(1)**

Fact

**4.** **(1)**

Fact

**5.** **(4)**

$Y = 2\eta(1 + \sigma)$

$2.4\eta = 2\eta(1 + \sigma) \Rightarrow 1.2 = 1 + \sigma \Rightarrow \sigma = 0.2$

**6.** **(4)**

Force constant = 7 N/m

k or $k_a = Yr_0$

$Y = \frac{k}{r_0}$

$Y = \frac{7}{3\times10^{-10}}$

$= 2.33 \times 10^{10}$ N/m$^2$

$Y = 2.33 \times 10^{10}$ N/m$^2$

**7.** **(3)**

$Y = 2\eta(1 + \sigma)$

**8.** **(4)**

$Y = 2\eta(1 + \sigma) \Rightarrow \sigma = \frac{0.5Y-\eta}{\eta}$

**9.** **(1)**

$Y = 2\eta(1 + \sigma)$

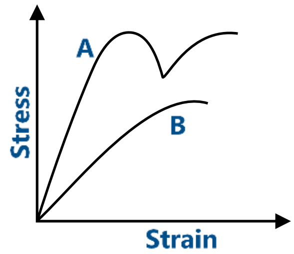
For no lateral strain ($\sigma = 0$)

$Y = 2\eta \Rightarrow \eta = \frac{Y}{2} = 3 \times 10^{12} \mathrm{N/m^2}$

DPP
DAILY PRACTICE PROBLEM

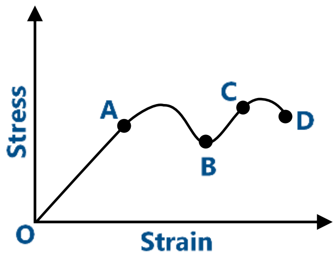
## Stress Strain relationship and Graphical analysis DPP-11

**1. The diagram shows stress v/s strain curve for the materials A and B. From the curves we infer that**




(1) A is brittle but B is ductile
(2) A is ductile but B is brittle
(3) Both A and B are ductile
(4) Both A and B are brittle

**2. A graph is shown between stress and strain for a metal. The part in which Hooke's law holds good is**

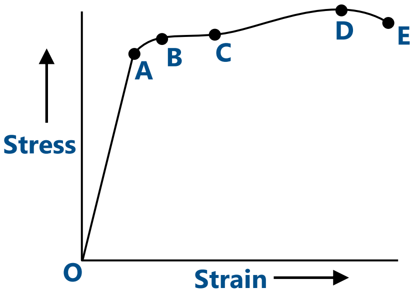



(1) OA
(2) AB
(3) BC
(4) CD

**3. In the above graph, point B indicates**
(1) Breaking point
(2) Limiting point
(3) Yield point
(4) None of the above

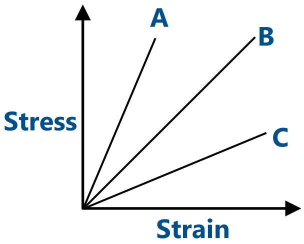
**4. In the above graph, point D indicates**
(1) Limiting point
(2) Yield point
(3) Breaking point
(4) None of the above

**5.** **The stress-strain graph for a metal wire is as shown in the figure. In the graph, the region in which Hooke's law is obeyed, the ultimate strength and fracture points are represented by –**




(1) OA, C, D
(2) OB, D, E
(3) OA, D, E
(4) OB, C, D

**6.** **The stress-strain curves for brass, steel and rubber are shown in the figure. The lines A, B and C are for**




(1) Rubber, Brass and steel respectively
(2) Brass, steel and rubber respectively
(3) Steel, brass and rubber respectively
(4) Steel, rubber and brass respectively

**Answer key**

| Question | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Answer | 2 | 1 | 3 | 3 | 3 | 3 |

## SOLUTIONS DPP-11

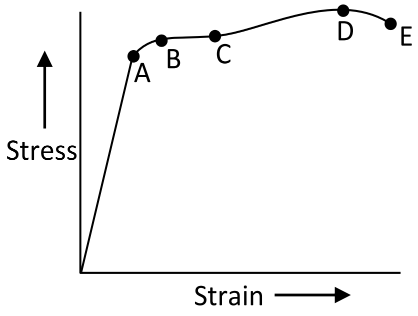
**1.** **(2)**
Fact

**2.** **(1)**
Fact

**3.** **(3)**
Fact

**4.** **(3)**
Fact

**5.** **(3)**
In the region OA, the graph is linear showing the stress is proportional to the strain. Thus, in this region Hooke's law is obeyed. The point D on the graph is known as ultimate tensile strength.




The point E on the graph is known as fracture point.

**6.** **(3)**
$Y = \tan\theta$. According to figure $\theta_A > \theta_B > \theta_C$
i.e., $\tan\theta_A > \tan\theta_B > \tan\theta_C$
or $Y_A > Y_B > Y_C$
$\therefore$ A, B and C graph are for steel, brass and rubber respectively.