Case Study - 5

The ratio of shearing stress to the corresponding shearing strain is called the shear modulus of
the material and is represented by G. It is also called the modulus of rigidity.

G = shearing stress (σs)/shearing strain
G = (F/A)/(Δx/L)
= (F · L)/(A · Δx)

Similarly,
G = (F/A)/θ
= F/(A · θ)

The shearing stress σs can also be expressed as σs = G · θ SI unit of shear modulus is N m^{-2} or Pa. It can be seen that shear modulus (or modulus of rigidity) is generally less than Young's modulus for most Materials **G ≈ Y/3**.
we have seen that when a body is submerged in a fluid, it undergoes a hydraulic stress (equal in magnitude to the hydraulic pressure). This leads to the decrease in the volume of the body thus producing a strain called volume strain. The ratio of hydraulic stress to the corresponding hydraulic strain is called bulk modulus. It is denoted by symbol B.

B = – p/(ΔV/V)

The negative sign indicates the fact that with an increase in pressure, a decrease in volume occurs. That is, if p is positive ΔV is negative. Thus for a system in equilibrium, the value of
Bulk modulus B is always positive. SI unit of bulk modulus is the same as that of pressure i.e.,   N m–2 or Pa.
The reciprocal of the bulk modulus is called compressibility and is denoted by k.

1. Compressibility is reciprocal of
   a. Young's modulus
   b. Share modulus
   c. Bulk modulus
   d. None of these

2. In case of bulk modulus if pressure is positive then change in volume(ΔV) is
   a. Positive
   b. Negative
   c. zero
   d. None of these

3. Define compressibility

4. Write note on modulus of rigidity

5. Write note on bulk modulus

Answer key - 5

1. C

2. B

3. The reciprocal of the bulk modulus is called compressibility and is denoted by k.

4. The ratio of shearing stress to the corresponding shearing strain is called the shear modulus of the material and is represented by G. It is also called the modulus of rigidity.

$$G = \text{shearing stress } (\sigma s)/\text{shearing strain}$$
$$G = (F/A)/(\Delta x/L)$$
$$= (F \cdot L)/(A \cdot \Delta x)$$
Similarly,
$$G = (F/A)/\theta$$
$$= F/(A \cdot \theta)$$

The shearing stress σs can also be expressed as $\sigma s = G \cdot \theta$ SI unit of shear modulus is N m^{-2} or Pa.

5. The ratio of hydraulic stress to the corresponding hydraulic strain is called bulk modulus. It is denoted by symbol B.

$$B = -p/(\Delta V/V)$$

The negative sign indicates the fact that with an increase in pressure, a decrease In b   volume occurs. SI unit of bulk modulus is N-m^{-2} or Pa.