

Formulae

1	Stress(σ)	$\sigma = \frac{F}{A}$	
2	Strain(ϵ)	Strain = $\frac{\text{change in length}}{\text{original length}}$	
3	Volumetric strain	Volumetric strain = $\frac{\Delta V}{V_0}$	
4	Compressive Strain	$\epsilon = \frac{\text{decrease in length}}{\text{original length}}$	
5	Tensile Strain	$\epsilon = \frac{\text{increase in length}}{\text{original length}}$	
6	Modulus of elasticity (E)	$E = \frac{\text{stress}}{\text{strain}}$	
7	Young's modulus	$Y = \frac{\text{tensile/compressive stress}}{\text{tensile /compressive strain}}$	$Y = \frac{F/A}{\Delta l/l}$
8	Bulk modulus	$K = \frac{\text{volumetric stress}}{\text{volumetric strain}}$	$K = \frac{F/A}{\Delta V/V}$
9	Bulk modulus	$G = \frac{\text{shear stress}}{\text{shear strain}}$	$K = \frac{F}{A \tan \theta}$
10	Strain energy	$E = \frac{1}{2} (F \times \Delta l)$	$E = \frac{1}{2} \left[\frac{EA \times (\Delta l)^2}{L} \right]$

Units

1	Stress	Nm ⁻²	Pa
2	Strain	No unit	

3	Modulus of elasticity	Nm ⁻²	Pa
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Constants

1	Conductivities of good conductors	$10^7 (\Omega m)^{-1}$	
2	Conductivities of insulators (wood, diamond etc) are of the order of	10^{-20} and $10^{-10} (\Omega m)^{-1}$	
3	Conductivities of semiconductors (silicon, germanium etc) are of the order of	10^{-6} and $10^{-4} (\Omega m)^{-1}$	
4	Forbidden energy gap for semiconductor is of the order of	1eV	
5	Forbidden energy gap for insulators is of the order of	5eV or more	
6	Doping ratio	1 to 10^6	
7	Critical Temperature for	4.2K	
8	Critical Temperature for aluminum	1.18 K	
9	Critical Temperature for tin	3.72 K	
1	Critical Temperature for	7.2 K	

Key Points

- ❖ In a crystalline solid, the particles (ion, molecule or atoms) are arranged in definite geometric pattern in the three-dimensional network. This is known as long range order.

Polycrystalline is a material made up of many small single crystals (also called crystallites or grains). Metals are examples of polycrystalline solids.

Amorphous (Non-crystalline) Solid is composed of randomly orientated atoms, ions, or molecules that do not form defined patterns or lattice structures.

Geometrical analysis of crystal structure is made by referring to an imaginary array of points in space. The collection of infinite number of points in a periodic arrangement is called a lattice.

The smallest geometric figure or unit whose periodic repetition in two or three dimensions form a crystal is called cell.

Crystal structure is obtained when a basis is added at each point in the lattice.

The ratio of stress to strain is constant and it is called elastic modulus.

The ratio of the magnitude of external force F to the area of cross-section A is called as tensile stress. Young's modulus is defined as the ratio of tensile stress to tensile strain.

The shear stress is defined as the ratio of tangential deforming force F to the area A of the face being sheared.

- ❖ The bulk modulus is defined as the ratio of volume stress to volume strain.
- ❖ For small deformations the stress and strain are proportional to each other. This is known as Hook's law.
- ❖ Hardness is a measure of how easily a material can be scratched or indented.

❖ A material that has a tendency to break easily is called brittle.

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