

Properties of Solids and Liquids Topics

- Elastic behavior
- Stress and strain relationship, Hooke's Law
- Young's modulus, bulk modulus, modulus of rigidity.
- Pressure, Pascal's law, and its applications.
- Viscosity, terminal velocity, Stokes' law
- streamline and turbulent flow, Reynolds number
- Bernoulli's principle and its applications.
- Surface energy and surface tension and its applications, angle of contact, capillary rise.
- Heat and temperature,
- Thermal expansion of solids, liquids
- Specific heat capacity, calorimetry; change of state, change of phase, latent heat.
- Heat transfer and its types like conduction, convection, and radiation, Newton's law of cooling.

Properties of Solids and Liquids Overview

In this chapter,

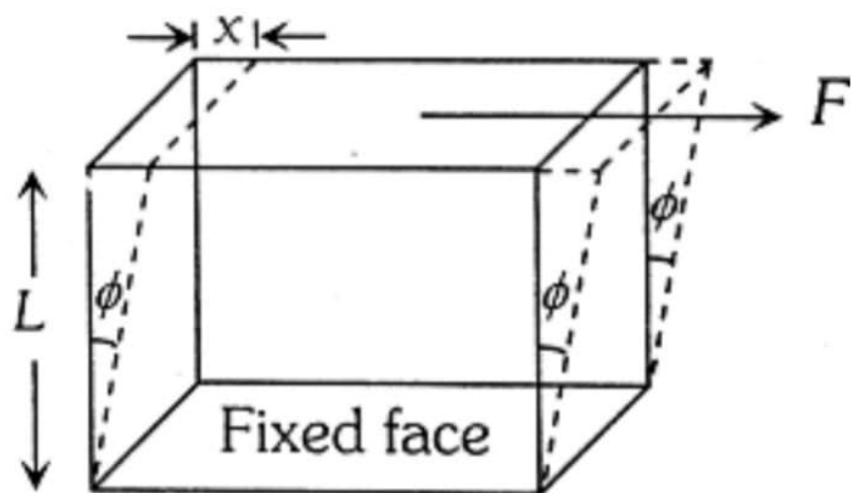
- You will learn two important topics of Mechanical Properties of Solids which are stress and strain. If you understand these topics then it would be easy for you to understand all the modulus of elasticity, comparing the restoring force of wire, etc.
- You will learn about liquids and its important properties like pressure, Viscosity, Surface energy, and surface tension and with the help of concepts like Pascal's Law, Stokes' law, Bernoulli's Principle you will be able to understand these properties easily. Working of Capillary, Venturimeter, Hydraulic Lift are based on applications of these laws.
- Bernoulli's Principle is a very important concept in this chapter. When a spinning ball is thrown it deviates from its usual path in flight, During a tornado or hurricane Blowing off roofs by wind storms, Working of an airplane all can be understood with the help of Bernoulli's application.
- Viscosity is also an important concept from this chapter, which is also known as fluid friction or internal friction.
- After studying mechanical properties you will learn about important thermal properties of Matter like thermal expansion, Thermal Stress, and strain, specific heat capacity, latent heat

along with the importance of these properties.

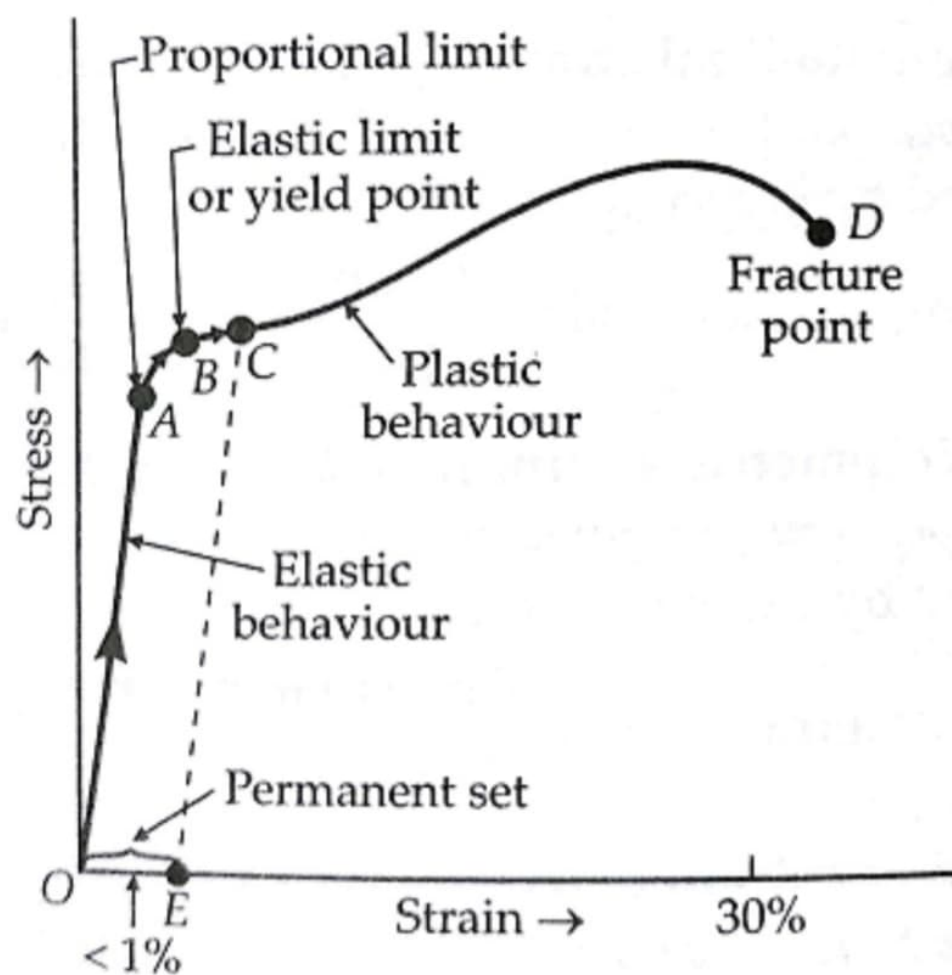
- You will learn about temperature which is the degree of hotness or coldness of a body.
- Then you will learn about Thermal expansion because of which a matter can change its shape, area, and volume when there is a change in temperature. You will also learn the effect of Thermal expansion on a matter like there is Loss of time in a time period of Simple Pendulum due to increase in temperature. Thermal Stress and Thermal Strain are produced in the material due to this Thermal Expansion.
- Then you will learn about heat and different Heat transfer methods like conduction, convection, and radiation. You will also learn about Newton's Law of Cooling, Stefan's Law which will help you to understand the heat transfer.

Properties of Solids and Liquids Formulas

1. $Stress = \frac{force}{Area} = \frac{F}{A}$
2. **Longitudinal strain** = $\frac{\Delta l}{l}$
3. **Volumetric strain** = $\frac{\Delta V}{V}$
4. **Shearing strain** = $\phi = \frac{x}{L}$



5. Stress vs strain curve



6. HOOKE'S LAW = $\frac{\text{stress}}{\text{strain}} = E$

7. Young Modulus = $Y = \frac{\text{Normal stress}}{\text{longitudnal strain}} =$

$$Y = \frac{F/A}{\Delta l/L}$$

8. **Modulus of Rigidity (Shear modulus)=**

$$G = \frac{\text{Tangential stress}}{\text{shearing strain}} = G = \frac{F}{A\phi}$$

9. **Energy Stored per unit Volume=**

$$U_v = \frac{1}{2} \times y \times (\text{strain})^2 = \frac{1}{2y} (\text{stress})^2$$

10. **Pressure=** $P = \frac{F}{A}$

11. **Viscous Force=** $F \propto \frac{Adv}{dx} = F = -\eta A \frac{dv}{dx}$

12. **Terminal Velocity=** $v_t = \frac{2r^2(\rho - \sigma)}{9\eta} g$

13. **Bernoulli's Principle-**

$$P + \rho gh + \frac{1}{2}\rho v^2 = \text{constant}$$

14. **Surface Tension=** $T = \frac{F}{l}$

15. **Ascent Formula=** $\frac{2T \cos \Theta}{\rho gr}$

16. **Coefficient of Linear Expansion=** $\alpha = \frac{\Delta L}{L_0 \Delta T}$

17. **Specific Heat=** $C = \frac{Q}{m \cdot \Delta \theta}$

18. **Heat Current=**

$$I_H = \frac{\theta_1 - \theta_2}{R_{th}}$$

19. **Newton's Law of Cooling=** $\frac{d\theta}{dt} \propto (\theta - \theta_0)$

How to prepare Properties of Solids and Liquids

- First, you should have good command over the concepts of the Properties of Solids and Liquids and you should also know how to apply them well at the time of the entrance exam or while solving questions.
- Please try to understand each concept from this chapter, with the help of theory, questions with solutions and video lectures on each important concept.
- For each concept practice enough problems to have a thorough understanding of the concept. Solve all the questions at home with proper concentration and try to do all calculations by yourself without seeing the solution first.
- Formulae for spring can be used for wire also using spring constant for wire as $K = \frac{YL}{A}$.
- Topics like stress and strain are interrelated so study both the topics.
- Practice lots of questions based on the concept of Bernoulli's Principle. Surface Energy and Surface Tension are also important concepts from this chapter. A lot of questions are asked to find out Excess Pressure or Change in Pressure of bubble in air/liquid.
- Also, Understand the concept of Thermal expansion and its effects on matter. Remember the formulas from this chapter because in certain questions you will get the answer by direct applying these formulas.
- Understand all the laws from this chapter along with their applications. With proper study, you can solve questions from this chapter with ease.