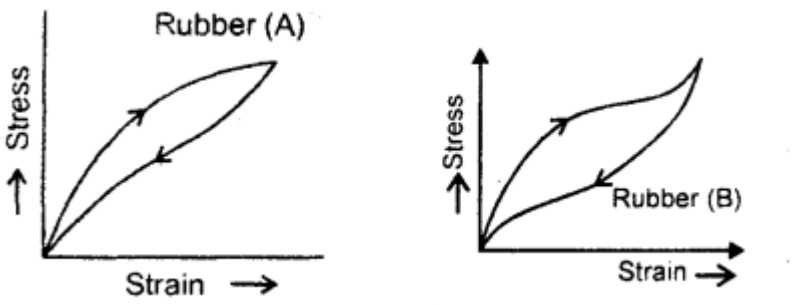
Board – CBSE	Class – 11	Topic – Mechanical Properties of Matter

1 marks Questions

1. What is the value of modulus of rigidity of a liquid?
2. Why does spring balance show wrong readings after they have been used for a long time?
3. Name three physical properties which can have different values in different directions.
4. What are ductile and brittle materials?
5. Define hydrostatic stress.

2 marks Questions

6. What is an Elastomer?
7. A wire of length L and cross-sectional area A is made of a material of Young's modulus Y. If the wire is stretched by an amount x, then what is the work done?
8. When we stretch a wire, we have to perform work. Why? What happens to the energy given to the wire in this process?
9. The length of a Wire is increased by 16 cm when a weight of 5 kg is hung. If all conditions are the same, what will be the increase in its length when the diameter is doubled?
10. Elasticity is said to be the internal property of matter. Explain.
11. A heavy machine is to be installed in a factory. To absorb vibrations of the machine, a block of rubber is placed between the machinery and the floor. Which of the two rubbers (A) and (B) of Figure would you prefer to use for this purpose? Why?



12. A copper wire of negligible mass, 1 m length and cross-sectional area 10^{-6} m^2 is kept on a smooth horizontal table with one end fixed. A ball of mass 1 kg is attached to the other end.

The wire and the ball are rotating with an angular velocity of 20rad/s. If the elongation in the wire is 10^{-3} m. If for the same wire as stated above, the angular velocity is increased to 100rad/s and the wire breaks down, find the breaking stress (in terms of 10^{10} N/m^2).

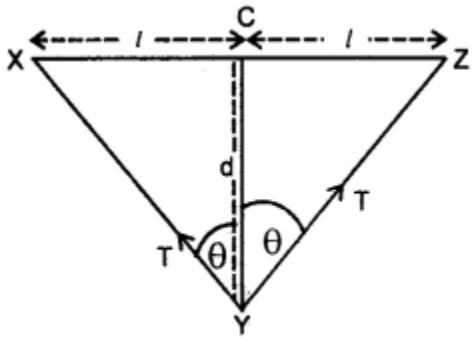
3 marks Questions

13. The length of a metallic wire is L_1 when tension is T_1 and L_2 when tension is T_2. Find the original length of the wire.
14. A mass of 5 kg is hung from a copper wire of 1 mm diameter and 2 m in length. Calculate the extension produced. What should be the minimum diameter of the wire so that its elastic limit is not exceeded? Elastic limit for copper $= 1.5 \times 10^9$ dyne cm^{-2}, Y for copper $= 1.1 \times 10^{12}$ dyne cm^{-2}.
15. Calculate the % increase in the length of a wire of diameter 2.5mm stretched by a force of 100 kg wt.? Y for the wire $= 12.5 \times 10^{11}$ dyne cm^{-2}.
16. Estimate the maximum height of a mountain.
    Given that the elastic limit of a typical rock is 3×10^8 N/m^{-2} and the density of its rock is 3×10^3 kg/m^{-3} .
17. A copper wire of negligible mass, area of cross-section 10^{-6} m^2, and length 1 m are kept on a smooth horizontal table with one end fixed. A ball of mass 1 kg is attached to the other end. The wire and ball are rotating with an angular velocity of 20 rad s^{-1}. If the elongation in the wire is 10^{-3} m, then find Young's modulus.
18. Two rods of different materials having coefficients of linear expansion α_1 and α_2 and Young's modulus Y_1 and Y_2 respectively are fixed between two massive points and are heated such that they undergo the same increase in temperature. There is no bending in rods of $\alpha_1 : \alpha_2 = 2 : 3$ and thermal stresses produced in two rods are equal. Calculate the ratio $Y_1 : Y_2$.

5 marks questions

19. A wire of density 9 g cm^{-3} is stretched between two clamps 100 cm apart, while subjected to an extension of 0.05 cm. What is the lowest frequency of transverse vibrations in the wire, assuming $Y = 9 \times 10^{11}$ dyne/cm^2?

20. A wire loaded by the weight of density 7.6 g cm^{-3} is found to measure 90 cm. On immersing the weight in water, the length decreases by 0.18 cm. Find the original length of the wire.
21. The rubber cord catapult has a cross-sectional area of 1 mm^2 and a total unstretched length of 10 cm. It is stretched to 12 cm and then released through a projectile of the mass of 2 gm. Taking Y =5×10^8 Nm^{-2}, find tension in the cord and velocity of projection.
22. A steel wire with a cross-sectional area of 0.5 mm^2 is held between two fixed supports. If the tension in the wire is negligible and it is just taut at a temperature of 20°C. Determine the tension when the temperature falls to 0°C. Y = 21×10^{11} dyne/cm^2 and coefficient of linear expansion is 12×10^{-6} per degree centigrade. Assume distance between two supports remains same.
23. A wire of radius r stretched without tension along a straight line is tightly fixed at points A and B as shown in the figure. What is the tension in the wire when it is pulled into the shape XYZ?



Answers:

1. Zero
2. Because of elastic fatigue.
3. Thermal conductivity, compressibility, and electrical conductivity.
4. Ductile materials are those materials which show large plastic range beyond elastic limit. eg:- copper, Iron

   Brittle materials are those materials which show very small plastic range beyond elastic limit. eg:- Cast Iron, Glass.
5. When a body is subjected to a uniform and equal force from all sides, then the corresponding stress is called hydrostatic stress.
6. An elastomer is a polymer with viscoelasticity (having both viscosity and elasticity) and very weak inter-molecular forces, generally having low Young's modulus and high failure strain compared with other materials.
7. $W = \frac{YAx^2}{2L}$
8. In a normal situation, the atoms of a solid are at the locations of minimum potential energy. When we stretch a wire, the work has to be done against interatomic forces. This work is stored in the wire in the form of elastic potential energy.
9. 4 cm.
10. When a deforming force acts on a body, the atoms of the substances get displaced from their original positions. Due to this the configuration of the matter (substance) changes. The moment, the deforming force is removed, the atoms return to their original positions and hence the substance or matter regains its original configuration. Hence elasticity is said to be the internal property of matter.
11. B is preferred.
12. 10^{10} Nm^{-2}
13. $L = \frac{T_2L_1 - T_1L_2}{T_2 - T_1}$
14. d= 0.0645 cm
15. 0.16%
16. h ≈ 10 km
17. 4×10^{11} N/m^{-2}

18. 3:2
19. 35.33Hz
20. 88.632 cm
21. $100\text{N}, 10\sqrt{10}\ \text{ms}^{-1}$
22. 25.2N
23. $\text{T} = \frac{\text{Y}\pi\text{r}^2\ \text{d}^2}{2\text{l}^2}$