Unit 8 · Elasticity

WORKSHEET

Full marks 32

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 32

1 Key words [4]

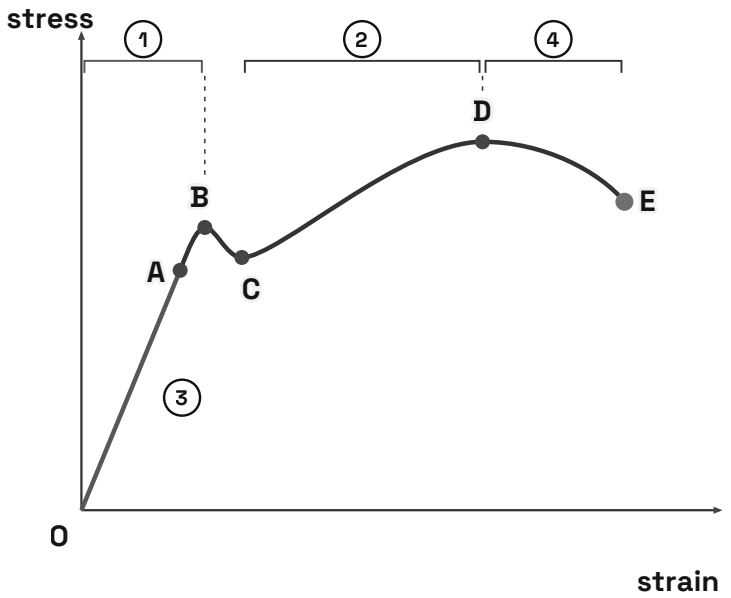
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

bulk modulus	ductile	elasticity	Hooke's law	plasticity	Poisson's ratio	rigidity	strain	stress	viscosity

The property of a body by which it regains its shape and size when the deforming force is removed is _____; a body that keeps its new shape shows _____. The restoring force per unit area inside a deformed body is the _____, and the change in length per unit length is the longitudinal _____. Within the elastic limit stress is proportional to strain: this is _____. The ratio of the lateral strain to the longitudinal strain is _____. The modulus of a material for a change of volume is its _____, and for a change of shape its modulus of _____.

2 Label the diagram [2]

The diagram shows the stress–strain curve of a mild steel wire. Write the name of the region or the law that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. The SI unit of Young's modulus is: [1]

a. N/m **b.** N/m^2

c. N m **d.** it has no unit

ii. Which is more elastic, in the physicist's sense? [1]

a. rubber, because it stretches far **b.** steel, because it is much harder to deform

c. both are equally elastic **d.** neither, both are plastic

iii. A wire is replaced by one of the same material and length but half the diameter. Under the same load, its extension becomes: [1]

a. half as much **b.** twice as much

c. four times as much **d.** the same

iv. A wire stretched by 2 mm by a force of 50 N stores elastic potential energy of: [1]

a. 100 J **b.** 0.1 J

c. 0.05 J **d.** 25 J

v. Only a solid has: [1]

a. a bulk modulus **b.** a modulus of rigidity

c. a compressibility **d.** a density

4 Short answers [7]

Write short answers to the following questions.

a. Distinguish between ductile and brittle materials, with one example of each. [2]

b. Why does a material that has been bent back and forth many times eventually break, even though the stress was always below its breaking stress? [2]

c. A steel wire 2.0 m long and 1.0 mm in diameter hangs from a hook. Find how much it stretches when a 10 kg mass is hung on it. ($Y = 2.0 \times 10^{11}$ N/m^2, $g = 9.8$ m/s^2) [3]

5 Long answer [4]

Write a long answer to the following question.

Describe how the Young's modulus of the material of a wire is found in the laboratory (Searle's method). Give the formula used and two precautions.

6 Numerical problems [7]

Solve the following problems. Show your working. Take $g = 9.8\ m/s^2$.

a. A climbing rope of nylon is 10 m long and 10 mm in diameter. A 600 N climber hangs still on it. Find i. the stress, ii. the strain and the extension, and iii. the elastic potential energy stored. (Y of nylon $= 3 \times 10^9\ N/m^2$) [4]

Answer:

b. 1.0 litre of water in a hydraulic press is put under an extra pressure of 2.2×10^7 Pa. By how much does its volume decrease? (Bulk modulus of water $= 2.2 \times 10^9\ N/m^2$) [3]

Answer:

7 Think [3]

Two wires of the same material carry the same load. Wire Q is twice as long as wire P and has twice its diameter. Which stretches more? Which, if either, is nearer to breaking?

8 Activity: Does a rubber band obey Hooke's law? (not marked)

Hang a rubber band from a nail and hang a small cup from it. Measure its length with a ruler, then add coins of the same kind one at a time, measuring each time. Then take the coins off one at a time and measure again.

Coins	Length while loading (cm)	Extension (cm)	Length while unloading (cm)
0			
2			
4			
6			
8			

Plot extension against the number of coins. Is it a straight line? Do the unloading lengths match the loading ones?