

# Mechanical Properties of Solids — NEET Physics PYQ (2013-2020)

Class 11 Physics · 7 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2020 · Q161

**1. A wire of length  $L$ , area of cross section  $A$  is hanging from a fixed support. The length of the wire changes to  $L_1$  when mass  $M$  is suspended from its free end. The expression for Young's modulus is :**

- (A)  $MgL_1/(AL)$
- (B)  $Mg(L_1 - L)/(AL)$
- (C)  $MgL/(AL_1)$
- (D)  $MgL/(A(L_1 - L))$

NEET 2019 · Q1

**2. When a block of mass  $M$  is suspended by a long wire of length  $L$ , the length of the wire becomes  $(L + l)$ . The elastic potential energy stored in the extended wire is:**

- (A)  $Mgl$
- (B)  $MgL$
- (C)  $\frac{1}{2} Mgl$
- (D)  $\frac{1}{2} MgL$

NEET 2018 · Q44

**3. Two wires are made of the same material and have the same volume. The first wire has cross-sectional area  $A$  and the second wire has cross-sectional area  $3A$ . If the length of the first wire is increased by  $\Delta l$  on applying a force  $F$ , how much force is needed to stretch the second wire by the same amount?**

- (A)  $4 F$
- (B)  $6 F$
- (C)  $9 F$
- (D)  $F$

NEET 2017 · Q161

**4. The bulk modulus of a spherical object is ' $B$ '. If it is subjected to uniform pressure ' $p$ ', the fractional decrease in radius is:**

- (A)  $p/B$
- (B)  $B/3p$
- (C)  $3p/B$
- (D)  $p/3B$

AIPMT 2015

**5. The approximate depth of an ocean is 2700 m. The compressibility of water is  $45.4 \times 10^{-11} \text{ Pa}^{-1}$  and density of water is  $10^3 \text{ kg/m}^3$ . What fractional compression of water will be obtained at the bottom of the ocean?**

- (A)  $1.4 \times 10^{-2}$
- (B)  $0.8 \times 10^{-2}$
- (C)  $1.0 \times 10^{-2}$
- (D)  $1.2 \times 10^{-2}$

AIPMT 2014

**6. Copper of fixed volume ' $V$ ' is drawn into wire of length ' $l$ '. When this wire is subjected to a constant force ' $F$ ', the extension produced in the wire is ' $\Delta l$ '. Which of the following graphs is a straight line?**

- (A)  $\Delta l$  versus  $l^2$
- (B)  $\Delta l$  versus  $1/l^2$
- (C)  $\Delta l$  versus  $l$
- (D)  $\Delta l$  versus  $1/l$

**7. The following four wires are made of the same material. Which of these will have the largest extension when the same tension is applied ?**

- (A) length = 50 cm, diameter = 0.5 mm
- (B) length = 100 cm, diameter = 1 mm
- (C) length = 200 cm, diameter = 2 mm
- (D) length = 300 cm, diameter = 3 mm

### Answer key and explanations

**1. Answer: (D)  $MgL/(A(L_1 - L))$**

$Y = \text{stress/strain} = (Mg/A)/((L_1 - L)/L) = MgL/(A(L_1 - L))$ . The strain uses the extension  $L_1 - L$ , not the new length  $L_1$ , and the extension goes in the denominator.

**2. Answer: (C)  $\frac{1}{2} Mg l$**

Elastic energy stored =  $\frac{1}{2} \times \text{force} \times \text{extension} = \frac{1}{2} \times Mg \times l$ . Using  $MgL$  confuses the original length with the extension, and  $Mgl$  forgets the factor  $\frac{1}{2}$  (the average force during stretching is half the final force).

**3. Answer: (C)  $9 F$**

$F = YA\Delta l/L$ . Equal volume means the second wire has length  $L/3$ .  $F' = Y(3A)\Delta l/(L/3) = 9 \times YA\Delta l/L = 9F$ . Considering only the area change would give  $3F$ .

**4. Answer: (D)  $p/3B$**

Volumetric strain  $\Delta V/V = p/B$ , and for a sphere  $V \propto r^3$  so  $\Delta V/V = 3\Delta r/r$ . Hence  $\Delta r/r = p/3B$ .  $p/B$  is the fractional change in volume, not radius.

**5. Answer: (D)  $1.2 \times 10^{-2}$**

Pressure at the bottom  $\approx h\rho g = 2700 \times 10^3 \times 10 = 2.7 \times 10^7$  Pa. Fractional compression  $\Delta V/V = \text{compressibility} \times \text{pressure} = 45.4 \times 10^{-11} \times 2.7 \times 10^7 \approx 1.2 \times 10^{-2}$  ( $1.20 \times 10^{-2}$  with  $g = 9.8$ ).

**6. Answer: (A)  $\Delta l$  versus  $l^2$**

$\Delta l = Fl/(AY)$ , and with fixed volume  $A = V/l$ , so  $\Delta l = Fl^2/(VY)$ . Hence  $\Delta l$  is proportional to  $l^2$ , giving a straight line against  $l^2$ , not against  $l$ .

**7. Answer: (A) length = 50 cm, diameter = 0.5 mm**

Extension  $\Delta L = FL/(AY) \propto L/d^2$  for the same material and tension.  $L/d^2 = 50/0.25 = 200$ ,  $100/1 = 100$ ,  $200/4 = 50$  and  $300/9 \approx 33$  (cm/mm<sup>2</sup>), so the 50 cm, 0.5 mm wire stretches most. The longest wire is not the answer because its larger area wins.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.