Answer on Question #61165, Physics / Mechanics | Relativity

Write the expressions for the work done for (i) paramagnetic substance, and (ii) stretched wire. Calculate the work done on the steel wire of length 2.5 m and area of cross-section 2.5×10^{-6} m² is suspended from torsion head when a 5 kg weight is suspended at its free end. Take Y = 2 × 10^{11} Nm⁻².

Solution:

(i) The work for paramagnetic substance is

W = -B dmwhere B is magnetic field and dm is change of magnetization.

(ii) The work for stretched wire is

$$W = -Fdl$$

where F is force and dl is displacement.

We know that

$$Y = \frac{Stress}{Strain}$$
$$Strain = \frac{\Delta L}{L} = \frac{Stress}{Y}$$
$$Stress = \frac{Mg}{A}$$

$$\Delta L = \frac{LMg}{YA}$$

Thus, we get

$$\Delta L = \frac{2.5 \cdot 5 \cdot 9.8}{2 \cdot 10^{11} \cdot 2.5 \cdot 10^{-6}} = 0.000245 \text{ m}$$

Work is

 $W = F \cdot \Delta L = Mg \cdot \Delta L = 5 \cdot 9.8 \cdot 0.000245 = 0.012005 = 12.0 \cdot 10^{-3} \text{ J}$

Answer: $12.0 \cdot 10^{-3}$ J

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