Mechanical Properties of Solids

Q.No.1: The pressure that has to be applied at the ends of a steel wire of length 10 cm to keep its length constant when its temperature is raised by 100°C is
(For steel, Young's modulus is 2×10^{11} Nm^{-2} and coefficient of thermal expansion is 1.1×10^{-5} K^{-1}.)

A. 2.2×10^{7} Pa

B. 2.2×10^{6} Pa

C. 2.2×10^{8} Pa

D. 2.2×10^{9} Pa

Q.No.2: A pendulum made of a uniform wire of cross sectional area *A* has time period *T*. When an additional mass *M* is added to its bob, the time period changes to T_M. If the Young's modulus of the material of the wire is *Y* then $\frac{1}{Y}$ is equal to:
(*g* = gravitational acceleration) **JEE 2015**

A. $\left[\left(\frac{T_M}{T}\right)^2 - 1\right]\frac{A}{Mg}$

B. $\left[\left(\frac{T_M}{T}\right)^2 - 1\right]\frac{Mg}{A}$

C. $\left[1 - \left(\frac{T_M}{T}\right)^2\right]\frac{A}{Mg}$

D. $\left[1 - \left(\frac{T}{T_M}\right)^2\right]\frac{A}{Mg}$

Q.No.3: A pendulum clock loses 12 s a day if the temperature is 40 °C and gains 4 s a day if the temperature is 20 °C. The temperature at which the clock will show correct time, and the co-efficient of linear expansion (*a*) of the metal of the pendulum shaft are respectively: **JEE 2016**

A. $60°C$; $\alpha = 1.85 \times 10^{-4}/°C$

B. $30°C$; $\alpha = 1.85 \times 10^{-3}/°C$

C. $55°C$; $\alpha = 1.85 \times 10^{-2}/°C$

D. $25°C$; $\alpha = 1.85 \times 10^{-5}/°C$

Q.No.4: A man grows into a giant such that his linear dimensions increase by a factor of 9. Assuming that his density remains same, the stress in the leg will change by factor of: **JEE 2017**

A. $\frac{1}{81}$

B. 9

C. $\frac{1}{9}$

D. 81

Q.No.5: A solid sphere of radius r made of a soft material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless piston of area a floats on the surface of the liquid, covering entire cross section of cylindrical container. When a mass m is placed on the surface of the piston to compress the liquid, the fractional decrement in the radius of the sphere, $\left(\frac{dr}{r}\right)$, is;

JEE 2018

A. $\frac{mg}{3Ka}$

B. $\frac{mg}{Ka}$

C. $\frac{Ka}{mg}$

D. $\frac{Ka}{3mg}$

Q.No.6: If speed (V), acceleration (A) and force (F) are considered as fundamental units, the dimension of Young's modulus will be : **JEE 2019**

A. $V^{-2} A^2 F^{-2}$

B. $V^{-2} A^2 F^2$

C. $V^{-4} A^{-2} F$

D. $V^{-4} A^2 F$

Q.No.7: A uniform metallic wire is elongated by 0.04 m when subjected to a

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linear force F. The elongation, if its length and diameter is doubled and subjected to the same force will be _____cm. **JEE 2021**

Q.No.8: If Y, K and η are the values of Young's modulus, bulk modulus and modulus of rigidity of any material respectively. Choose the correct relation for these parameters. **JEE 2021**

A. $\mathrm{Y}=\frac{9 \mathrm{K} \eta}{3 \mathrm{K}-\eta} \mathrm{N} / \mathrm{m}^2$

B. $\mathrm{Y}=\frac{9 \mathrm{K} \eta}{2 \eta+3 \mathrm{K}} \mathrm{N} / \mathrm{m}^2$

C. $\mathrm{K}=\frac{\mathrm{Y} \eta}{9 \eta-3 \mathrm{Y}} \mathrm{N} / \mathrm{m}^2$

D. $\eta=\frac{3 \mathrm{YK}}{9 \mathrm{K}+\mathrm{Y}} \mathrm{N} / \mathrm{m}^2$

Q.No.9: The normal density of a material is ρ and its bulk modulus of elasticity is K. The magnitude of increase in density of material, when a pressure P is applied uniformly on all sides, will be : **JEE 2021**

A. $\frac{\rho P}{K}$

B. $\frac{\rho K}{P}$

C. $\frac{K}{\rho P}$

D. $\frac{P K}{\rho}$

Q.No.10: The length of metallic wire is l_1 when tension in it is T_1. It is l_2 when the tension is T_2. The original length of the wire will be **JEE 2021**

A. $\frac{T_1 l_1-T_2 l_2}{T_2-T_1}$

B. $\frac{l_1+l_2}{2}$

C. $\frac{T_2 l_1+T_1 l_2}{T_2+T_1}$

D. $\frac{T_2 l_1-T_1 l_2}{T_2-T_1}$

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