1 JEE Main 2021 (Online) 1st September Evening Shift

MCQ (Single Correct Answer)

A student determined Young's Modulus of elasticity using the formula $Y = \frac{MgL^3}{4bd^3\delta}$. The value of g is taken to be 9.8 m/s^2, without any significant error, his observation are as following.

Physical Quantity	**Least count of the Equipment used for measurement**	**Observed value**
Mass (M)	1 g	2 kg
Length of bar (L)	1 mm	1 m
Breadth of bar (b)	0.1 mm	4 cm
Thickness of bar (d)	0.01 mm	0.4 cm
Depression (δ)	0.01 mm	5 mm

Then the fractional error in the measurement of Y is :

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A 0.0083

B 0.0155

C 0.155

D 0.083

Explanation

$$y = \frac{MgL^3}{4bd^3\delta}$$

$$\frac{\Delta y}{y} = \frac{\Delta M}{M} + \frac{3\Delta L}{L} + \frac{\Delta b}{b} + \frac{3\Delta d}{d} + \frac{\Delta \delta}{\delta}$$

$$\frac{\Delta y}{y} = \frac{10^{-3}}{2} + \frac{3\times10^{-3}}{1} + \frac{10^{-2}}{4} + \frac{3\times10^{-2}}{4} + \frac{10^{-2}}{5}$$

$$= 10^{-3}[0.5 + 3 + 2.5 + 7.5 + 2] = 0.0155$$

Option (b)