In the determination of Young's modulus $\left(Y = \frac{4MLg}{\pi l d^2}\right)$ by using Searle's method, a wire of length $L = 2$ m and diameter $d = 0.5$ mm is used. For a load $M = 2.5$ kg, an extension $l = 0.25$ mm in the length of the wire is observed. Quantities d and l are measured using a screw gauge and a micrometer, respectively. They have the same pitch of 0.5 mm. The number of divisions on their circular scale is 100. The contributions to the maximum probable error of the Y measurement **[2012]**

(a) due to the errors in the measurements of d and l are the same.

(b) due to the error in the measurement of d is twice that due to the error in the measurement of l.

(c) due to the error in the measurement of l is twice that due to the error in the measurement of d.

(d) due to the error in the measurement of d is four times that due to the error in the measurement of l.

(a) The maximum possible error in Y due to l and d

$$\frac{\Delta Y}{Y} = \frac{\Delta l}{l} + \frac{2\Delta d}{d}$$

$$\text{Least count} = \frac{\text{Pitch}}{\text{No. of division on circular scale}}$$

$$= \frac{0.5}{100}\text{ mm} = 0.005\text{ mm}$$

Here, $\Delta d = \Delta l = 0.005$ mm

$$\text{Error contribution of } l = \frac{\Delta l}{l} = \frac{0.005\text{ mm}}{0.25\text{ mm}} = \frac{1}{50}$$

$$\text{Error contribution of } d = \frac{2\Delta d}{d} = \frac{2 \times 0.005\text{ mm}}{0.5\text{ mm}} = \frac{1}{50}$$

Hence contribution to the maximum possible error in the measurement of y due to l and d is the same.