Question 6)In the determination of Young's modulus Y = ($4MLg/\pi ld^2$) by using Searle's method, a wire of length L = 2m 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 micrometre, 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.

(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.

Answer: (A) due to the errors in the measurements of d and l are the same.

Solution:

Given,

Y = ($4MLg/\pi ld^2$)

l = 0.25 mm

d = 0.5 mm

Since the pitch and the number of divisions on the circular scale is the same,

$\Delta l = \Delta d$

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

$$\frac{\Delta Y}{Y} = \frac{\Delta M}{M} + \frac{\Delta L}{L} + \frac{\Delta l}{0.25} + 2\frac{\Delta d}{0.5}$$

$$\frac{\Delta Y}{Y} = \frac{\Delta M}{M} + \frac{\Delta L}{L} + 4\Delta l + 4\Delta d$$