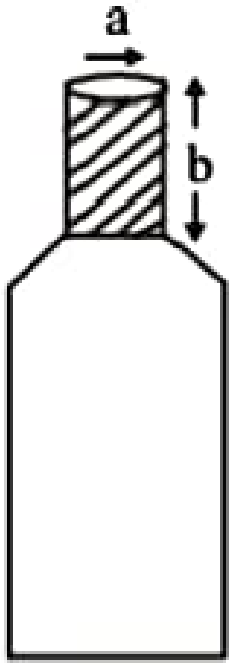
25. A bottle has an opening of radius a and length b. A cork of length b and radius $(a + \Delta a)$ where $(\Delta a << a)$ is compressed to fit into the opening completely (see figure). If the bulk modulus of cork is B and frictional coefficient between the bottle and cork is μ then the force needed to push the cork into the bottle is : **[Online April 10, 2016]**



(a) $(\pi\mu B\, b)\, a$ (b) $(2\pi\mu Bb)\, \Delta a$

(c) $(\pi\mu B\, b)\, \Delta a$ (d) $(4\, \pi\mu B\, b)\, \Delta a$

25. (d) $\text{Stress} = \dfrac{\text{Normal force}}{\text{Area}} = \dfrac{N}{A} = \dfrac{N}{(2\pi a)b}$

$\text{Stress} = B \times \text{strain}$

$$\frac{N}{(2\pi a)b} = B\frac{2\pi a\Delta a \times b}{\pi a^2 b}$$

$$\Rightarrow N = B\frac{(2\pi a)^2 \Delta a b^2}{\pi a^2 b}$$

Force needed to push the cork.

$$f = \mu N = \mu 4\pi b\Delta aB = (4\pi\mu Bb)\Delta a$$