Question: Water is flowing continuously from a tap having an internal diameter 8 × 10–3 m. The water velocity as it leaves the tap is 0.4 ms–1.The diameter of the water stream at a distance 2 × 10–1 m below the tap is close to :-

(1) 9.6 × 10–3 m
(2) 3.6 × 10–3 m
(3) 5.0 × 10–3 m
(4) 7.5 × 10–3 m

Solution: Let us use Bernoulli equation:

$$v_2^2 = v_1^2 + 2gh$$

And the fact that water flows continuously

$$S_1 v_1 = S_2 v_2$$

$S = \frac{\pi D^2}{4}$, therefore, we conclude that

$$D_1^2 v_1 = D_2^2 v_2$$

After solution of these who equation we obtain

$$D_2 = \frac{D_1}{\left(1 + \frac{2gh}{v_1^2}\right)^{\frac{1}{4}}} = \frac{8 \cdot 10^{-3}}{\left(1 + \frac{2 \cdot 10 \cdot 0.2}{0.16}\right)^{\frac{1}{4}}} \approx 3.6 \cdot 10^{-3} \text{ m}$$

Answer:

$$(2)\ 3.6 \cdot 10^{-3} \text{ m}$$