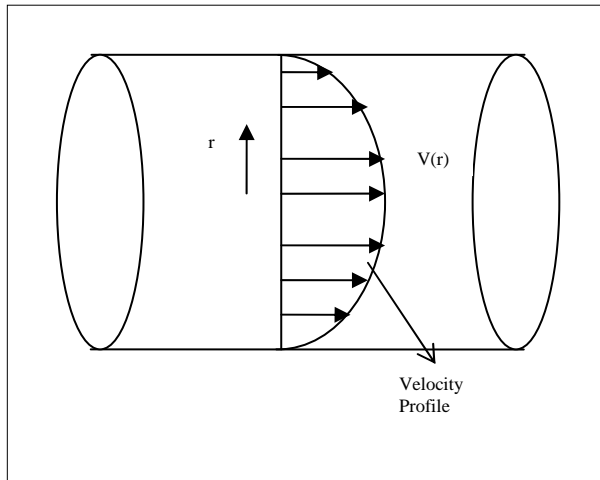


TOPIC

Fluids

QUESTION

The velocity of water out of the pipe of inner radius 0.5 m, varies over the radial location in the pipe and is given below

$$V(r) = 10 \left(1 - \frac{r^2}{0.5^2} \right),$$

where

V is given in m/s, and
r is in m.

The flow rate of the water out of the pipe is most nearly

- (A) 3.333 m/s³
- (B) 3.927 m/s³
- (C) 5.890 m/s³
- (D) 7.854 m/s³

HINT

The velocity is maximum at the center of the pipe, that is, $r=0$, and is zero at the wall, that is $r=0.5$ m.

The flow rate of the water out of the pipe is given by

$$\begin{aligned} Q &= \int_0^a 2\pi r V(r) dr \\ &= \int_0^{0.5} 2\pi r \left[10 \left(1 - \frac{r^2}{0.5^2} \right) \right] dr \end{aligned}$$

$$= 20\pi \int_0^{0.5} \left[r - \frac{r^3}{0.25} \right] dr$$
$$= 3.927 \frac{m^3}{s}$$

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