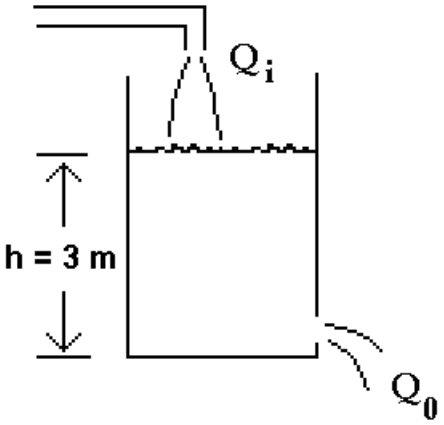
TOPIC

Fluids – Section X – Question 5

QUESTION

Consider the water storage tank shown below. Q_i and Q_0 are the volumetric flow rates at the inlet and outlet, respectively and h is the liquid level height in the tank. The orifice at the bottom of the tank is sharp edged and has a diameter of 2 cm. The inlet flow rate Q_i required to maintain a constant liquid level of 3 m is (in m^3/s) most nearly is

(A) 0.0015
(B) 0.0024
(C) 0.0058
(D) 0.0096



HINTS

- To maintain a constant liquid level, Q_i must equal Q_0.
- Q_0 can be related to the liquid level height h.

SOLUTION

Since the liquid level height is to be constant, the inlet flow rate must equal the outlet flow rate (Q_i=Q_0). The outlet flow rate is found from

$$Q_o = A_0 C\sqrt{2gh}$$

where A_0 is the orifice area and C is the coefficient of discharge = $C_v C_c$.
The orifice area is

$$A_0 = \frac{\pi d^2}{4}$$
$$= \frac{\pi(2)^2}{4}$$
$$= 3.14\text{cm}^2$$

$$= 0.000314m^2$$

The coefficient of discharge is

$$C = C_v C_c$$
$$= 0.98 \times 0.62$$
$$= 0.61$$

The volumetric flow out, and hence the required flow in, is then

$$Q_o = (0.000314)(0.61)\sqrt{2(9.8)(3)}$$
$$= 0.0015m^3/\text{s}$$

ANSWER

(A)

CONTRIBUTOR

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