Answer on Question#37585, Physics, Other

Question:

A pipe contains a gradually tapering section in which its diameter decreases from 400 mm to 250 mm. The pipe contains an incompressible fluid of density 1000 kgm−3 and runs full. If the flow velocity is 2 ms−1 in the smaller diameter, determine the velocity in the larger diameter, the volume flow rate and the mass flow rate.

Answer:

Conservation of flow:

$$vA = const$$

$$v_s A_s = v_l A_l$$

$$v_l = \frac{v_s A_s}{A_l} = 2\frac{m}{s}\frac{250^2}{400^2} = 0.78\ \frac{m}{s}$$

Volume equals:

$$V = A * v * t$$

Therefore volume flow rate equals:

$$\frac{\Delta V}{\Delta t} = Av = (v_s A_s = v_l A_l) = \frac{2m}{s} * \pi\left(\frac{250mm}{2}\right)^2 = 0.098\frac{m^3}{s}$$

Mass flow rate equals:

$$\frac{\Delta m}{\Delta t} = \frac{\Delta V}{\Delta t}\ \rho = 0.098\frac{m^3}{s} * 1000\frac{kg}{m^3} = 98\frac{kg}{s}$$