Answer on Question #37462 - Physics - Other

A water line with an internal radius of 5.70 x 10-3 m is connected to a shower head that has 13 holes. The speed of the water in the line is 1.27 m/s. (a) What is the volume flow rate in the line? (b) At what speed does the water leave one of the holes (effective hole radius = 3.92 x 10-4 m) in the head?

Solution:

The volume flow rate:

$$\Phi = \frac{\Delta V}{\Delta t} = vS = v \cdot \pi \cdot r^2 = 1.27 \frac{m}{s} \cdot \pi \cdot (5.7 \times 10^{-3} m)^2 = 1.3 \times 10^{-4} \frac{m^3}{s}$$

Equation of continuity tells us that the volume flow rate in the holes equals that in the line, so $\Phi = n \cdot v_1 \cdot S_1$, where n is the number of the holes and $S_1 = \pi \cdot (3.92 \times 10^{-4} m)^2 = 4.83 \times 10^{-7} m^2$ the flow area (circle).

So, $v_1 = \frac{1.3 \times 10^{-4} \frac{m^3}{s}}{13 \cdot 4.83 \times 10^{-7} m^2} = 20.7 \frac{m}{s}$.

Answer: volume flow rate in the line Is equal to $20.7 \frac{m}{s}$.