Answer on Question #49007-Physics-Other

A water hose 2.50 cm in diameter is used by a gardener to fill a 30.0-liter bucket. (One liter = 1,000 cm3.) The gardener notices that it takes 1.00 min to fill the bucket. A nozzle with an opening of cross-sectional area 0.500 cm2 is then attached to the hose.

The nozzle is replaced with a Y-shaped fitting that split the flow in half. garden hose are connected to each end of the Y, with each hose having a 0.400 cm squared nozzle.

a) how fast does the water come out of one of the nozzle?

b) how far would one of the nozzle squirt water if both were operated simultaneously and held horizontally 1.00m off the ground.

Solution

Volume flow rate is

$$\frac{dV}{dt} = \frac{30.0 \text{ L}}{1 \text{ } min} \cdot \frac{1000 \text{ } cm^3}{1 \text{ } L} \cdot \left(\frac{1m}{100 \text{ } cm}\right)^3 \cdot \frac{1 \text{ } min}{60 \text{ } s} = 5 \cdot 10^{-4} \frac{m^3}{s}.$$

a) Volume flow rate of one of the nozzle is $\frac{1}{2}\frac{dV}{dt}$. So

$$\frac{1}{2}\frac{dV}{dt} = Av_{0x} \rightarrow v_{0x} = \frac{1}{2A}\frac{dV}{dt} = \frac{1}{2 \cdot 0.400 \text{ } cm^2} \cdot 5 \cdot 10^{-4} \frac{m^3}{s} = 6.25 \frac{m}{s}.$$

b) The time for the stream to fall 1.00m, using kinematics:

$$y = \frac{1}{2}gt^2 \rightarrow t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{2 \cdot 1.00 \text{ } m}{9.80 \frac{m}{s^2}}} = 0.452 \text{ } s.$$

The horizontal distance is

$$x = v_{0x}t = 6.25 \frac{m}{s} \cdot 0.452 \text{ } s = 2.83 \text{ } m.$$