55. (a) The continuity equation yields $Av = aV$, and Bernoulli's equation yields $\Delta p + \frac{1}{2}\rho v^2 = \frac{1}{2}\rho V^2$, where $\Delta p = p_1 - p_2$. The first equation gives $V = (A/a)v$. We use this to substitute for V in the second equation, and obtain $\Delta p + \frac{1}{2}\rho v^2 = \frac{1}{2}\rho (A/a)^2 v^2$. We solve for v. The result is

$$v = \sqrt{\frac{2\,\Delta p}{\rho\left(\frac{A^2}{a^2} - 1\right)}} = \sqrt{\frac{2a^2\,\Delta p}{\rho(A^2 - a^2)}}\ .$$

(b) We substitute values to obtain

$$v = \sqrt{\frac{2(32 \times 10^{-4}\,\mathrm{m}^2)^2(55 \times 10^3\,\mathrm{Pa} - 41 \times 10^3\,\mathrm{Pa})}{(1000\,\mathrm{kg/m}^3)\left((64 \times 10^{-4}\,\mathrm{m}^2)^2 - (32 \times 10^{-4}\,\mathrm{m}^2)^2\right)}} = 3.06\ \mathrm{m/s}\ .$$

Consequently, the flow rate is

$$Av = \left(64 \times 10^{-4}\,\mathrm{m}^2\right)(3.06\,\mathrm{m/s}) = 2.0 \times 10^{-2}\ \mathrm{m}^3/\mathrm{s}\ .$$