

Solutions

2.1 E Area is proportional to radius squared, so the area quarters and speed quadruples.

Compare the rejected options: one quarter; one half; unchanged; twice. Use the stated model and conditions.

2.2 D Poiseuille flow has Q proportional to R^4 under these stated conditions.

Compare the rejected options: twice; four times; eight times; unchanged. Use the stated model and conditions.

2.3 4000. $\rho gh = 800 \cdot 10 \cdot 0.5 = 4000$.

2.4 False. Equal speed and height would predict equal pressure; a viscous loss requires an additional term/model.

3.1 Define resistance $\mathcal{R} = \Delta p/Q = 8\eta L/(\pi R^4)$ for the narrow tube. Wide-tube resistance is $\mathcal{R}/16$. In series Q is common, pressure ratio is 16:1, and total resistance $17\mathcal{R}/16$. In parallel pressure is common, flow ratio narrow:wide is 1:16 and equivalent resistance $\mathcal{R}/17$. Award radius scaling, series ratio, series total, parallel ratio and parallel total.