P6.91 Heat exchangers often consist of many triangular passages. Typical is Fig. P6.91, with L = 60 cm and an isosceles-triangle cross section of side length a = 2 cm and included angle β = 80°. If the average velocity is V = 2 m/s and the fluid is SAE 10 oil at 20°C, estimate the pressure drop.

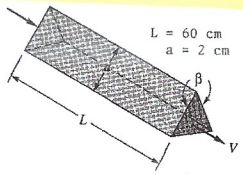

Fig. P6.91

SAE oil: $\rho = 870$ kg/m^3, $\mu = .104$ kg/ms

$Re = \rho V a/\mu = 335$ laminar using characteristic length a

Bottom side isosceles triangle $2 \times (2) \sin 40° = 2.57$ cm

$A = \frac{1}{2} b h = \frac{1}{2}\, 2.57 \times 2 \cos 40° = 1.97$ cm^2

$P = 2.57 + 4 = 6.57$ $\quad D_h = 4A/P = 1.2$ cm

$Re_{D_h} = \rho V D_h/\mu = 201$ Table 6.4 $f Re_{D_h} = 52.9$

$\Theta = 40°$

$f = 52.9/201 = .263$ not 64!

$$\Delta p = f \frac{L}{D_h} \frac{\rho}{2} V^2 = .263 \frac{60}{.012} \frac{870}{2} 2^2$$

$= 23000$ Pa