For N_2O, from Table A-4, $k \approx 1.31$, so $B_{N_2O} = 1.31\text{ atm} = \mathbf{1.33E5\ Pa}$ *Ans.* (a)

For water at 20°C, we could just look it up in Table A-3, but we more usefully try to estimate B from the state relation (1-22). Thus, for a liquid, approximately,

$$B \approx \rho\frac{d}{d\rho}[p_o\{(B+1)(\rho/\rho_o)^n - B\}] = n(B+1)p_o(\rho/\rho_o)^n = n(B+1)p_o \quad \text{at 1 atm}$$

For water, $B \approx 3000$ and $n \approx 7$, so our estimate is

$$B_{water} \approx 7(3001)p_o = 21007\text{ atm} \approx \mathbf{2.13E9\ Pa} \quad \textit{Ans.}\text{ (b)}$$

This is 2.7% less than the value B = 2.19E9 Pa listed in Table A-3.

1.37 A near-ideal gas has M = 44 and c_V = 610 J/(kg·K). At 100°C, what are (a) its specific heat ratio, and (b) its speed of sound?

Solution: The gas constant is $R = \Lambda/M = 8314/44 \approx 189$ J/(kg·K). Then

$$c_v = R/(k-1), \quad \text{or:} \quad k = 1 + R/c_v = 1 + 189/610 \approx \mathbf{1.31} \quad \textit{Ans.}\text{ (a)} \quad [\text{It is probably } N_2O]$$

With k and R known, the speed of sound at 100ºC = 373 K is estimated by

$$a = \sqrt{kRT} = \sqrt{1.31[189\ m^2/(s^2\cdot K)](373\ K)} \approx \mathbf{304\ m/s} \quad \textit{Ans.}\text{ (b)}$$

1.38 In Fig. P1.38, if the fluid is glycerin at 20°C and the width between plates is 6 mm, what shear stress (in Pa) is required to move the upper plate at V = 5.5 m/s? What is the flow Reynolds number if "L" is taken to be the distance between plates?

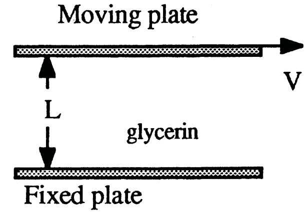

Fig. P1.38

Solution: (a) For glycerin at 20°C, from Table 1.4, $\mu \approx 1.5\ N\cdot s/m^2$. The shear stress is found from Eq. (1) of Ex. 1.8:

$$\tau = \frac{\mu V}{h} = \frac{(1.5\ Pa\cdot s)(5.5\ m/s)}{(0.006\ m)} \approx \mathbf{1380\ Pa} \quad \textit{Ans.}\text{ (a)}$$

The density of glycerin at 20°C is 1264 kg/m^3. Then the Reynolds number is defined by Eq. (1.24), with L = h, and is found to be decidedly laminar, Re < 1500:

$$Re_L = \frac{\rho VL}{\mu} = \frac{(1264\ kg/m^3)(5.5\ m/s)(0.006\ m)}{1.5\ kg/m\cdot s} \approx \mathbf{28} \quad \textit{Ans.}\text{ (b)}$$