1.80 A 10-kg block slides down a smooth inclined surface as shown in Fig. P1.80. Determine the terminal velocity of the block if the 0.1-mm gap between the block and the surface contains SAE 30 oil at 60 °F. Assume the velocity distribution in the gap is linear, and the area of the block in contact with the oil is 0.1 m².
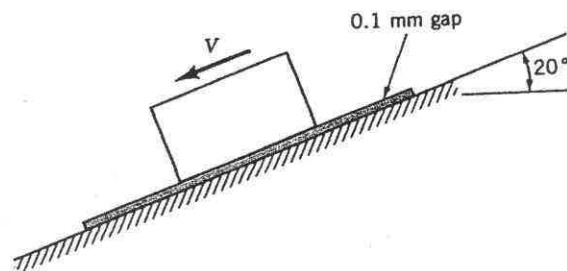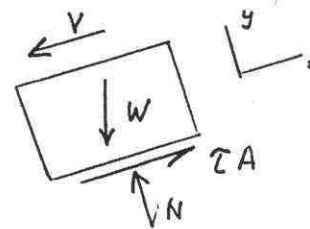

FIGURE P1.80

$$\Sigma F_x = 0$$

Thus,

$$W \sin 20° = \tau A$$

Since

$$\tau = \mu \frac{V}{b} \quad , where \quad b \quad is \quad film \quad thickness,$$

$$W \sin 20° = \mu \frac{V}{b} A$$

Thus, (with $W = mg$)

$$V = \frac{b W \sin 20°}{\mu A} = \frac{(0.0001\,m)(10\,kg)(9.81\,\frac{m}{s^2})(\sin 20°)}{(0.38\,\frac{N \cdot s}{m^2})(0.1\,cm^2)}$$

$$= 0.0883 \frac{m}{s}$$