

1.64

1.64 A 10-kg block slides down a smooth inclined surface as shown in Fig. P1.64. 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.

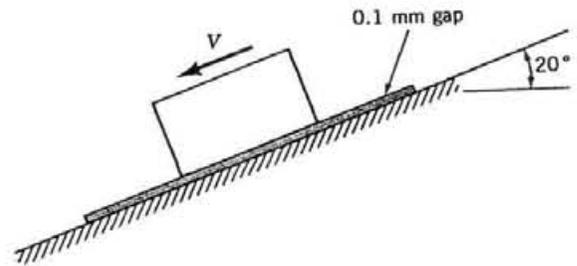
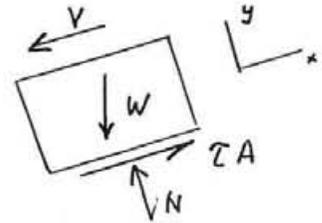


FIGURE P1.64



$$\sum F_x = 0$$

Thus,

$$W \sin 20^\circ = \tau A$$

Since

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

$$W \sin 20^\circ = \mu \frac{V}{b} A$$

Thus, (with $W = mg$)

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

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