DRY FRICTION (pp. 71-2)

$$F_{static} = \mu_{static} F_{normal}$$
$$F_{kinetic} = \mu_{kinetic} F_{normal}$$

1.

$\Sigma F_n = 0: \quad F_{normal} - mg = 0$

$F_{normal} = mg = 50 \times 9.81 = 490.5$

$F_{static} = \mu_{static} F_{normal} = 0.95 \times 490.5 = 466 \text{ N}$

$F_{kinetic} = \mu_{kinetic} F_{normal} = 0.90 \times 490.5 = 441 \text{ N}$

3.

$\Sigma F_n = 0: \quad F_{normal} - mg = 0$

$F_{normal} = mg = 35 \times 9.81 = 343.4$

Since object is in motion :

$F_{kinetic} = \mu_{kinetic} F_{normal} = 0.90 \times 343.4 = 188.8 \text{ N}$ in negative direction

5.

Since there are only three forces and they must add to zero for statics you can apply the triangle rule :

$\Sigma F = 0: \quad \underline{F}_{friction} + \underline{F}_{normal} + \underline{W} = 0$

be constructing the triangle we see that :

$F_{friction} = W \sin 15 = 50 \times 9.81 \times 0.25882 = 127.0 \text{ N}$ up the incline

7.

$\Sigma F_n = 0:$

$F_{normal} - mg \cos 12^\circ + F_{applied} \sin 45^\circ = 0$

$F_{normal} = 30 \times 9.81 \times \cos 12^\circ - 200 \sin 45^\circ = 146.4$

$F_{static} = \mu_{static} F_{normal} = 0.80 \times 146.4 = 117.2$

Assume $\Sigma F_t = 0:$

$F_{equilbrium} - mg \sin 12^\circ + F_{applied} \cos 45^\circ = 0$

$F_{equilbrium} = 30 \times 9.81 \times \sin 12^\circ - 200 \cos 45^\circ = -80.2$

since this absulute value is smaller than F_{static} friction is 80.2 N down the incline.

9.

$\Sigma F_n = 0: \quad F_{normal} - mg - F_{applied} \sin 13^\circ = 0$

$F_{normal} = 50 \times 9.81 + 500 \sin 13^\circ = 603.0$

$F_{static} = \mu_{static} F_{normal} = 0.80 \times 603 = 482.4 \text{ N}$

Assume $\Sigma F_t = 0: \quad F_{equilbrium} + F_{applied} \cos 13^\circ = 0$

$F_{equilbrium} = -500 \cos 13^\circ = -487.2$

since absolute value is greater than F_{static} the body is moving (friction = $F_{kinetic}$).

11.

$$\Sigma F_n = 0: \quad F_{normal} - W\cos 10^\circ = 0$$

$$F_{normal} = 250\cos 10^\circ = 246.2$$

$$F_{static} = \mu_{static} F_{normal} = 0.500 \times 246.2 = 123.10 \text{ N}$$

To get the box moving the friction must equal F_{static}.

$$\Sigma F_t = 0: \quad -F_{static} - W\cos 10^\circ + F_{applied} = 0$$

$$F_{applied} = F_{static} + 250\sin 10^\circ = 123.10 + 43.41 = 166.5 \text{ N}$$

13.

$$F_{static} = \mu_{static} F_{normal} = 0.950(150.0 \times 9.81) = 1398 \text{ N}$$

$$F_{kinetic} = \mu_{kinetic} F_{normal} = 0.900(150.0 \times 9.81) = 1324 \text{ N}$$

15.

$$F_{normal} = 10.00 \times 9.81 = 98.1 \text{ N}$$

$$\mu_{static} = \frac{F_{static}}{F_{normal}} = \frac{25.0}{98.1} = 0.255$$

$$\mu_{kinetic} = \frac{F_{kinetic}}{F_{normal}} = \frac{20.0}{98.1} = 0.204$$

17.

$$F_{normal} = 30.0 \times 9.81 = 294.3 \text{ N}$$

$$\mu_{static} = \frac{F_{static}}{F_{normal}} = \frac{225}{294.3} = 0.765$$

$$\mu_{kinetic} = \frac{F_{kinetic}}{F_{normal}} = \frac{215}{294.3} = 0.731$$