Giancoli Friction Problems # 35, 36, 43, 45 (p. 104) SL1 HW#8

(35) $\mu_K = 0.30$ — 20 kg on Floor — $F_N = F_W = mg$

a) F to drag across floor at constant v ($a = 0$) $= F_f$

$F_f = \mu_K \cdot F_N = (0.30)(20\,kg)(9.8\,m/s^2) = \boxed{58.8\,N}$

b) If $\mu_K = 0$, no F is needed to keep crate moving at a constant speed

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(36) F = 400 N to start a 50 kg box moving on a concrete floor

a) $F = F_{f_s} = \mu_S F_N$ $\quad \mu_s = \frac{F_f}{F_N} = \frac{F_f}{mg} = \frac{400\,N}{(50\,kg)(9.8\,m/s^2)} = \boxed{0.8}$

b) Box accelerates with $a = 0.70\,m/s^2$

$\Sigma F_{net} = F - F_{f_k} = ma$ $\quad F_{f_k} = F - ma = 400\,N - (50\,kg)(0.70\,\frac{m}{s^2})$

$F_f = 365\,N = \mu_K \cdot F_N = \mu_K(mg)$ $\quad \mu_K = \frac{365\,N}{(50\,kg)(9.8\,m/s^2)} = \boxed{0.7}$

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(43) Box slides across floor and stops (due to kinetic friction) $\mu_K = 0.$

$F_f = \mu_K F_N$ $\quad u = 3.0\,m/s$ $\quad v = 0$

$F_f = \mu_K mg = ma$ (mass cancels) $\quad$ so $a = \mu_K \cdot g = (0.20)(9.8\,\frac{m}{s^2}) = \boxed{1.96\,m/s^2}$

How far does it slide?

$v^2 = u^2 + 2as$ $\quad s = \frac{v^2 - u^2}{2a} = \frac{0 - (3)^2}{2(1.96)} = \boxed{2.3\,m}$

– over –

(45) a) Show minimum stopping distance for a car moving at speed $v = \frac{v^2}{2\mu_s g}$ → Change v to u to match 1B equations

$a = \frac{F_f}{m}$ $\quad v^2 = u^2 + 2as$ $\quad v^2 = 0$ (Stopped) $\quad u$ = initial speed

$a = \frac{\mu_s F_N}{m} = \frac{\mu_s mg}{m} = \mu_s \cdot g$ $\quad 0 = u^2 + 2\mu_s \cdot g \cdot s$

$$s = \frac{u^2}{2\mu_s g}$$

b) distance = ? for 1200kg car traveling at $90\frac{km}{hr} \times \frac{1000m}{1km} \times \frac{1hr}{3600s} = 25\frac{m}{s}$

$u = 25\frac{m}{s}$ $\quad s = \frac{(25\frac{m}{s})^2}{2(0.85)(9.8)\frac{m}{s^2}} = 37.5m$

$\mu_s = 0.85$

c) On the moon? $g_m = 1.62 m/s^2$

$$s = \frac{(25 m/s)^2}{2(0.85)(1.62\frac{m}{s^2})} = 226.9 m$$