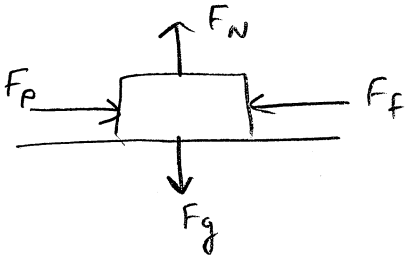
P101 37, 39, 40, 41, 42, 44, 45, 47, 50, 51, 54, 55, 58, 70, 76, 83

(37) (a) $F_f = \mu F_N$



$\mu = \frac{F_f}{F_N}$

$= \frac{F_p}{mg}$

$F_f = F_p$

$F_N = F_g = mg$

$= \frac{48.0\,N}{(5.0\,kg)(9.81\,ms^{-2})} = \underline{0.98}$

(b) $F_{net} = ma$

$F_p - F_f = ma$

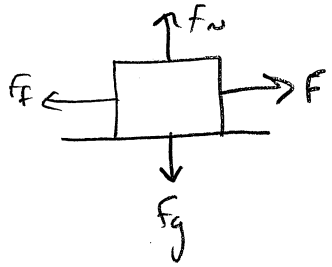
$F_f = F_p - ma = 48N - (5\,kg)(0.7\,ms^{-2})$

$F_f = 44.5\,N$

$F_f = \mu F_N$

$\mu = \frac{F_f}{F_N} = \frac{F_f}{mg} = \frac{44.5\,N}{(5\,kg)(9.81\,ms^{-2})} = \underline{0.91}$

(39)



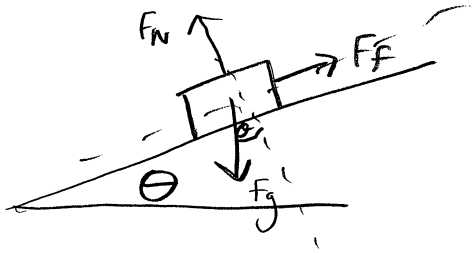
$f_f = \mu F_N = \mu mg$

$f_f = F = ma$

$\mu mg = ma$

$a = (.8)(9.81\,ms^{-2}) = \underline{7.8\,ms^{-2}}$

(40)



$F_f - F_g \sin\theta = 0$ $\qquad$ $F_N - F_g \cos\theta = 0$

$f_f = mg\sin\theta$ $\qquad$ $F_N = mg\cos\theta$

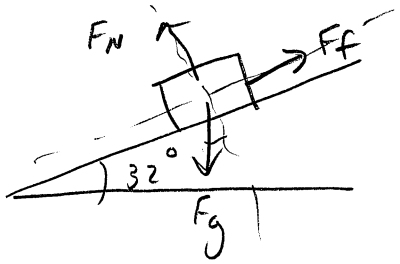
$F_f = \mu F_N$

$mg\sin\theta = \mu\, mg\cos\theta$

$\theta = \tan^{-1}(\mu) = \tan^{-1}(.8)$

$\underline{\theta = 40^\circ}$

(41)



$-F_f + F_g \sin 32 = ma$

$F_f = mg\sin 32 - ma$

$= (15\,kg)(9.81\,ms^{-2})\sin 32 - (15\,kg)(0.3\,ms^{-2})$

$= 73.48\,N$

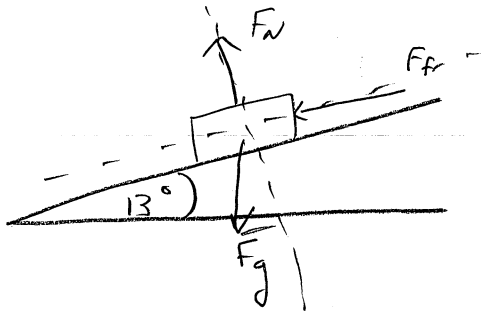
$\underline{f_f = 73\,N}$

$F_N = F_g\cos 32 = (15\,kg)(9.81\,ms^{-2})\cos 32 = 124.79\,N$

$F_f = \mu F_N$

$\mu = \dfrac{F_f}{F_N} = \dfrac{73.48\,N}{124.79\,N} = \underline{0.59}$

(42)



$F_f - F_g \sin\theta = ma$

$F_N = F_g \cos\theta$

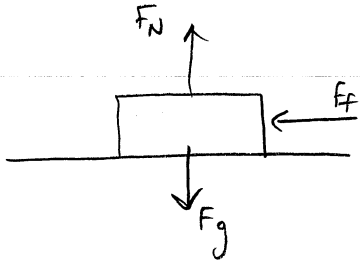
$F_f = \mu F_N$

$a = \dfrac{\mu m g \cos\theta + m g \sin\theta}{m}$

$= (0.489)(9.81 ms^{-2}) \cos 13 - (9.81 ms^{-2}) \sin 13$

$a = 2.47 ms^{-2}$

The deceleration of the car is $2.47 ms^{-2}$



$F_f = ma$

$F_N = F_g$

$F_f = \mu F_N$

$\mu = \dfrac{F_f}{F_N}$

$= \dfrac{ma}{mg}$

$= \dfrac{4.8 ms^{-2}}{9.81 ms^{-2}}$

$\mu = 0.489$

(44)

$s = 1000 m$

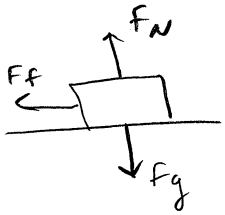
$t = 12 s$

$u = 0$

$a = ?$

$s = ut + \frac{1}{2}at^2$

$a = \dfrac{2s}{t^2} = \dfrac{2(1000 m)}{(12 s)^2} = 13.89 ms^{-2}$



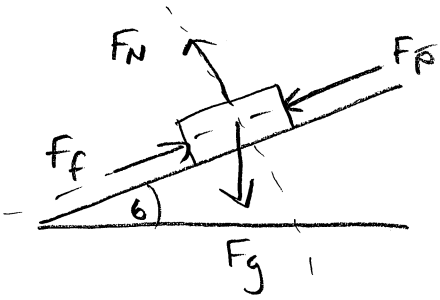
$F_f = ma$

$F_N = F_g = mg$

$F_f = \mu F_N$

$\mu = \dfrac{F_f}{F_N} = \dfrac{ma}{mg} = \dfrac{13.89 ms^{-2}}{9.81 ms^{-2}} = 1.4$

(45)



$u = 0$

$v = 60\ km h^{-1} = 16.67\ ms^{-1}$

$s = 75\ m$

$a = ?$

$F_p - F_f + F_g \sin\theta = ma$

$F_N = F_g \cos\theta$

$F_f = \mu F_N$

$v^2 = u^2 + 2as$

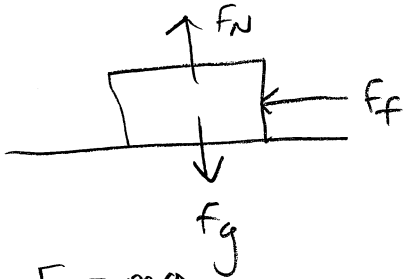
$a = \frac{v^2}{2s} = \frac{(16.67\ ms^{-1})^2}{2(75\ m)} = 1.85\ ms^{-2}$

$F_p = ma + \mu mg\cos\theta - mg\sin\theta$

$= 22kg\left(1.85\ ms^{-2} + .1(9.81\ ms^{-2})\cos 6 - (9.81\ ms^{-2})\sin 6\right)$

$\underline{F_p = 40\ N}$

(47)



$F_f = ma$

$F_f = \mu F_N$

$F_N = F_g$

$ma = \mu mg$

$u = 4.0\ ms^{-1}$

$v = 0$

$a = \mu g$

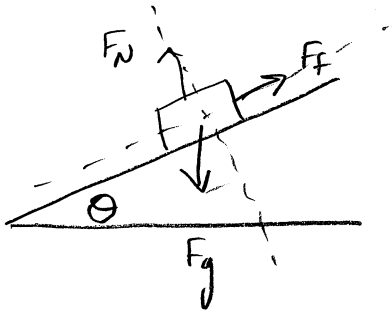
$s = ?$

$v^2 = u^2 + 2as$

$s = \frac{u^2}{2a} = \frac{u^2}{2\mu g} = \frac{(4.0\ ms^{-1})^2}{2(.2)(9.81\ ms^{-2})}$

$\underline{s = 4.1\ m}$

(50)



$F_f = F_g \sin\theta$

$F_N = F_g \cos\theta$

$F_f = \mu F_N$

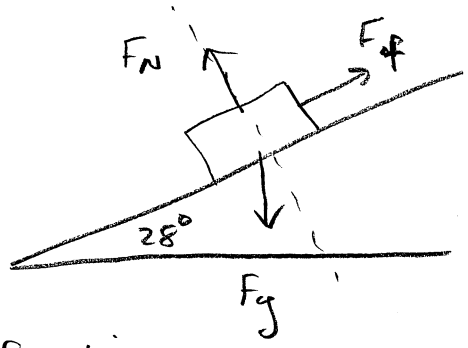
$F_g \sin\theta = \mu F_g \cos\theta$

$\theta = \tan^{-1}(\mu) = \tan^{-1}(.15) = 8.5^\circ$

driveway will be safe if angle is $\leq 8.5^\circ$

so only the 6° driveway is safe.

(51)



no friction

$F_g \sin\theta = ma$

$a = g\sin\theta$

$u = 0$

$s = s$

$v = ?$

$v^2 = u^2 + 2as$

$v = \sqrt{2gs\sin\theta s}$

with friction

$v = \frac{1}{2}\sqrt{2gs\sin\theta s}$

$u = 0$

$s = s$

$a = ?$

$v^2 = u^2 + 2as$

$a = \frac{v^2}{2s} = \frac{\left(\frac{1}{2}\sqrt{2gs\sin\theta s}\right)^2}{2s} = \frac{\frac{1}{4}2gs\sin\theta s}{8s}$

$a = \frac{g\sin\theta}{4}$

continued next page

51 continued.

with friction

$$-F_f + F_g \sin\theta = ma$$

$$F_N = F_g \cos\theta$$

$$F_f = \mu F_N$$

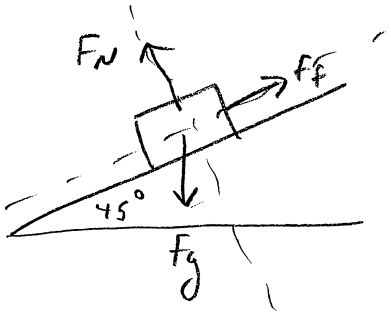
$$\mu = \frac{F_f}{F_N} = \frac{mg\sin\theta - ma}{mg\cos\theta}$$

$$= \frac{g\sin\theta - \frac{g\sin\theta}{4}}{g\cos\theta}$$

$$= \frac{3g\sin\theta}{4g\cos\theta}$$

$$= \frac{3\tan\theta}{4} = \frac{3\tan 28}{4} = \underline{0.40}$$

(54)



$$-F_f + F_g \sin\theta = ma$$

$$F_N = F_g \cos\theta$$

$$F_f = \mu F_N$$

$$a = -\mu g\cos\theta + g\sin\theta$$

$$= 9.81\,ms^{-2}(-.18\cos 45 + \sin 45)$$

$$= 5.688\,ms^{-2}$$

$u = 6.0\,kmh^{-1} = 1.67\,ms^{-1}$

$a = 5.688\,ms^{-2}$

$s = 45.0\,m$

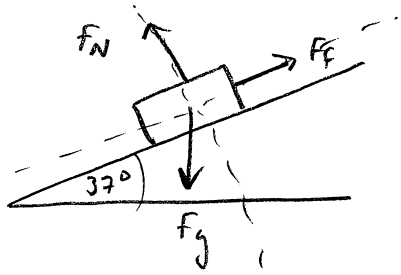
$v = ?$

$$v^2 = u^2 + 2as$$

$$v = \sqrt{(1.67\,ms^{-1})^2 + 2(5.688\,ms^{-2})(45\,m)}$$

$$\underline{v = 23\,ms^{-1}}$$

(55)



$$-F_f + F_g \sin\theta = ma$$

$$F_f = mg\sin\theta - ma$$

$$= (18\,kg)(9.81\,ms^{-2})\sin 37 - (18\,kg)(0.27\,ms^{-2})$$

$$= 101.4\,N$$

$$\underline{F_f = 101\,N}$$

$$F_f = \mu F_N \qquad F_N = F_g \sin\theta$$

$$\mu = \frac{F_f}{F_N} = \frac{F_f}{mg\sin\theta} = \frac{101.4\,N}{(18\,kg)(9.81\,ms^{-2})\sin 37}$$

$$\underline{\mu = 0.95}$$

(58) (a) $F_f = ma \qquad F_f = \mu F_N = \mu mg$

$$ma = \mu mg$$

$u = v$

$v = 0$

$a = -\mu g$

$s = ?$

$$v^2 = u^2 + 2as$$

$$s = \frac{-u^2}{2a} = \frac{-v^2}{2(-\mu g)} = \frac{v^2}{2\mu g}$$

Continued next page

58 (b) $u = 95\ \text{km h}^{-1} = 26.39\ \text{m s}^{-1}$

$m = 1200\ \text{kg}$

$\mu = 0.75$

$$s = \frac{v^2}{2\mu g} = \frac{(26.39\ \text{m s}^{-1})^2}{2(.75)(9.81\ \text{m s}^{-2})} = \underline{47\ \text{m}}$$

(70) $F_f = \mu F_N = \mu m g = ma$

$a = -\mu g$

$u = ?$

$s = 72\ \text{m}$

$v = 0$

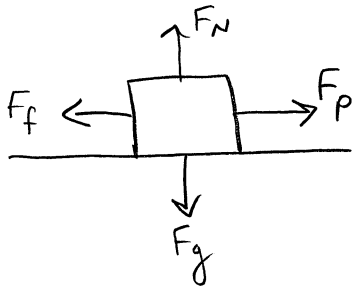
$v^2 = u^2 + 2as$

$u = \sqrt{-2as}$

$= \sqrt{-2(-\mu g)s} = \sqrt{+2(+.8)(9.81\ \text{m s}^{-2})72\ \text{m}}$

$\underline{u = 34\ \text{m s}^{-1}}$

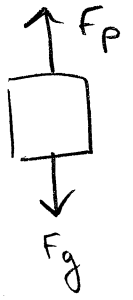
(76) (a)



max F_p occurs when $F_p = F_f = \mu F_N$

$F_p = \mu m_{block} g$

but F_p is a result of sand in the bucket



$F_p = F_g = (m_{bucket} + m_{sand}) g$

$\therefore (m_{bucket} + m_{sand}) g = \mu m_{block} g$

$m_{sand} = \mu m_{block} - m_{bucket}$

$= (0.45)(28\,kg) - 1.35\,kg$

$m_{sand} = 11.25\,kg$

(b) $F_p - F_f = ma$

$(m_{bucket} + m_{sand}) g - \mu m_{block} g = (m_{block} + m_{bucket} + m_{sand}) a$

$a = \dfrac{(m_{bucket} + m_{sand}) g - \mu m_{block} g}{(m_{block} + m_{bucket} + m_{sand})}$

$= \dfrac{(1.35\,kg + 11.25\,kg)(9.81\,ms^{-2}) - (0.32)(28\,kg)(9.81\,ms^{-2})}{(28\,kg + 1.35\,kg + 11.25\,kg)}$

$a = 0.880\,ms^{-2}$

(83) $F_f = ma = \mu F_N = \mu mg$

$a = -\mu g$

$v = 0$

$s = 75\,m$

$u = ?$

$v^2 = u^2 + 2as$

$u = \sqrt{-2as} = \sqrt{+2(+\mu g)s}$

$= \sqrt{2(.1)(9.81\,ms^{-2})(75m)}$

$u = 12\,ms^{-1}$