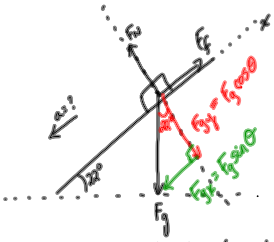
mp|471

$m = 84\,kg$
$\theta = 22^\circ$
$\mu_s = 0.47$
$\mu_k = 0.25$

a) slide down?
b) $a = ?$
c) $F_a = ?$ (to start uphill)
d) $a = ?$ (uphill)



a) The crate will slide down the hill if $F_{gx} = F_f$ (static)

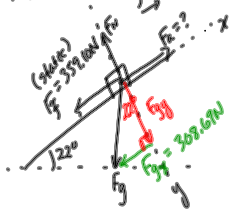
$F_{gx} = F_g \sin\theta$
$F_{gx} = mg\sin\theta$
$F_{gx} = (84\,kg)(9.81\,m/s^2)\sin 22^\circ$
$F_{gx} \doteq 308.69\,N$

$F_f = \mu_s F_N$
$F_f = \mu_s F_{gy}$
$F_f = \mu_s mg\cos\theta$
$F_f = (0.47)(84\,kg)(9.81\,m/s^2)(\cos 22^\circ)$
$F_f \doteq 359.10\,N$ ← maximum static frictional force

Since $F_{gx} < F_f$ (static) the crate does not slide down the hill.

b) N/A

c) What force is needed to just start the crate moving uphill?



At the instant the crate starts moving, $\vec{F}_{net} = 0$

$F_a = F_f(\text{static}) + F_{gx}$
$F_a = 359.10\,N + 308.69\,N$
$F_a = 667.79\,N$
$F_a \doteq 6.7 \times 10^2\,N$

d) $a = ?$ once the crate is moving and $F_a = 667.79\,N$

$\vec{F}_{net} = m\vec{a}$
$F_a - (F_f + F_{gx}) = ma$
$667.79\,N - (191.01\,N + 308.69\,N) = (84\,kg)a$
$168.09\,N = (84\,kg)a$
$a = 2.0\,m/s^2$
$\vec{a} = 2.0\,m/s$ [uphill]

$F_f(\text{kinetic}) = \mu_k F_N$ ($F_N = F_{gy}$)
$= 0.25(84\,kg)(9.81\,m/s^2)\cos 22^\circ$
$= 191.01\,N$

PP|474 – 475

Review: p528/23-25 & p626/33,34 & 36

Review: p117/19-29, p209/24-26,36, p212/34 & 35