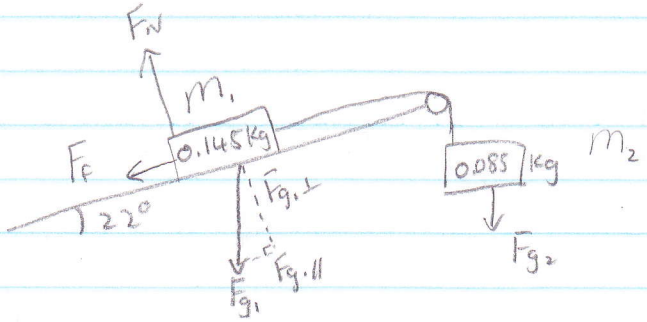
Textbook Solution

Page 489, # 27, 28

27.

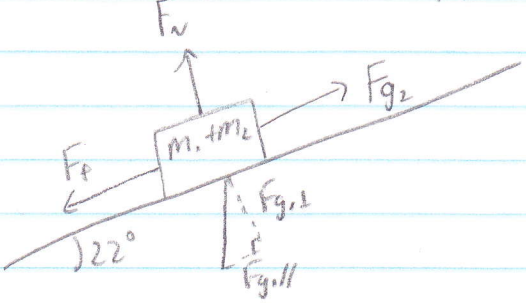


$F_{g_2} = m_2 g$
$F_{g_2} = (0.085\ kg)(9.81\ m/s^2)$
$F_{g_2} = 0.83385\ N$

$F_{g,\perp} = m_1 g \cos 22°$
$F_{g,\perp} = (0.145\ kg)(9.81\ m/s^2)\cos 22$
$F_{g,\perp} = 1.319\ N$

$F_{g,\parallel} = m_1 g \sin 22° = 0.533\ N$

$F_N = F_{g,\perp} = 1.319\ N$, $F_f = \mu F_N$
$F_f = (0.18)(1.319\ N)$
$F_f = 0.23742\ N$

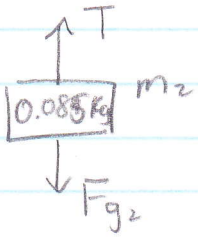


F_N and $F_{g,\perp}$ cancel each other.

(a) $F_{net} = m\vec{a}$
$F_{g_2} - F_f - F_{g,\parallel} = (m_1 + m_2)\vec{a}$
$0.83385\ N - 0.23742\ N - 0.533\ N = (0.23\ kg)\vec{a}$
$0.06343\ N = (0.23\ kg)\vec{a}$
$\vec{a} = 0.2758\ m/s^2$

$V_f = V_i + at$, $V_i = 0\ m/s$
$V_f = 0 + (0.2758\ m/s^2)(2.5\ s) = 0.6894\ m/s = 0.69\ m/s$

(b)



$F_{net} = m\vec{a}$

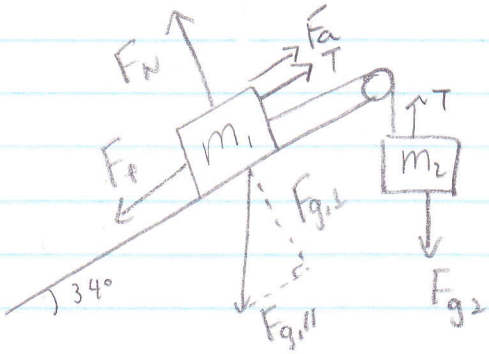
$T - F_{g_2} = m_2 \vec{a}$

$T - 0.83385\ N = (0.085\ kg)(-0.2758\ m/s^2)$

$T = 0.810407\ N$

$T = 0.81\ N$ up

28.

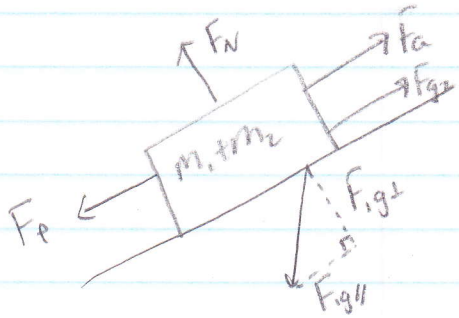


$m_1 = 0.725\ kg$

$m_2 = 0.595\ kg$

$\mu_s = 0.47$

$\mu_K = 0.12$



(a) Find F_a when $F_{net} = 0\ N$

$F_{1g\perp} = m_1 g \cos 34°$

$F_{1g\perp} = (0.725\ kg)(9.81\ m/s^2)\cos 34°$

$F_{1g\perp} = 5.896\ N$

$F_{1g\parallel} = m_1 g \sin 34° = 3.977\ N$

$F_{2g} = m_2 g = (0.595\ kg)(9.81\ m/s^2) = 5.837\ N$

$F_N = F_{g,\perp} = 5.896\ N$

$F_f = \mu_s F_N = (0.47)(5.896\ N) = 2.771\ N$

$F_{net} = 0\ N \Rightarrow -F_f - F_{g,\parallel} + F_{2g} + F_a = 0\ N$

$-3.977\ N - 2.771\ N + 5.837\ N + F_a = 0\ N$

$F_a = 0.911\ N$

$F_a = 0.91\ N$

(b) Now assume $F_a = 0\ N$

$F_{net} = m\vec{a}$ for all parallel forces

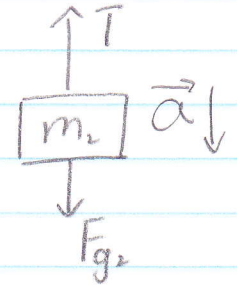
$F_f = \mu_K F_N = 0.70752\ N$

$F_{2g} - F_f - F_{g,\parallel} = (m_1 + m_2)\vec{a}$

$5.837\ N - 0.70752\ N - 3.977\ N = (1.32\ kg)\vec{a}$

$\vec{a} = 0.87\ m/s^2$

(c)



$F_{net} = m\vec{a}$

$T - F_{g_2} = m_2(\vec{a})$

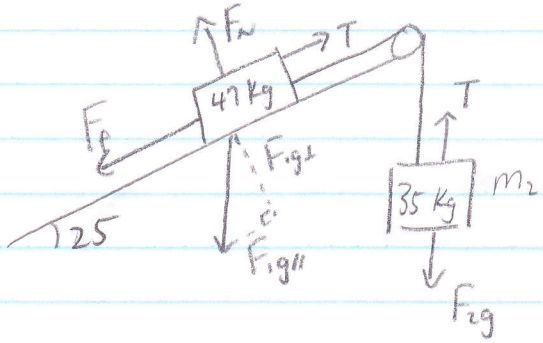
$T - 5.837\ N = (0.595\ kg)(-0.87\ m/s^2)$

$T = 5.32\ N$

$T = 5.3\ N$

Page 529, # 26

26.



$F_{2g} = m_2 g$

$F_{2g} = (35\ kg)(9.81\ m/s^2)$

$F_{2g} = 343.35\ N$

$F_{g\perp} = m_1 g \cos 25 = (47\ kg)(9.81\ m/s^2)\cos 25$

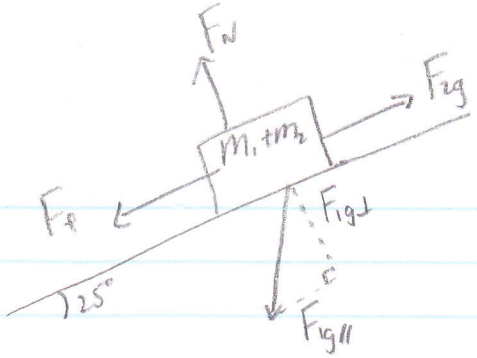
$F_{g\perp} = 417.9\ N$

$F_{g\parallel} = m_1 g \sin 25 = 194.9\ N$

$F_N = F_{g\perp} = 417.9\ N$

$F_f = \mu_S F_N = (0.42)(417.9\ N) = 175.5\ N$

(a)



If F_{2g} is less than $F_f + F_{1g\parallel}$, then it won't move.

$F_f + F_{1g\parallel} = 175.5\ N + 194.9\ N = 370.4\ N > F_{2g}$
So this will not move.

(b) System will not move.

(c) We need $F_{2g} = F_f + F_{1g\parallel} = 370.4\ N$
$m_2 g = 370.4\ N$
$m_2 = 37.76\ Kg$

Original mass is 35 Kg, so we need 2.76 kg more.

(d) Once the system moves, F_f now uses μ_K rather than μ_S.

$F_f = \mu_K F_N = (0.19)(417.9\ N)$
$F_f = 79.401\ N$

$F_{net} = m\vec{a}$
$F_{2g} - F_f - F_{1g} = (m_1 + m_2)\vec{a}$
$370.4\ N - 79.401\ N - 194.9\ N = (47\ kg + 37.76\ kg)\vec{a}$
$96.099\ N = (84.76\ kg)\vec{a}$
$\vec{a} = 1.1\ m/s^2$