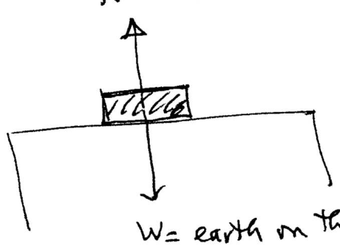
Homework Solutions

ch. 4 part 2

(50)



a) earth on the book
b) table on the book
c) book on the table
d) book on the earth

(a) and (d) → They are interacting Pairs

(b) and (c) → They are interacting Pairs

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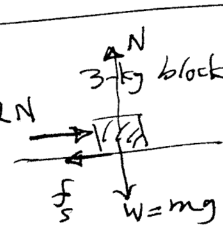
(54)



a) At the Point, where the block just starts to move, $a = 0 \Rightarrow \sum F_x = 0 \Rightarrow 12 - f_s = 0$

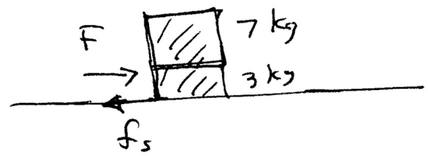
or $\boxed{f_s = 12N}$ but $f_s = \mu_s N$ We need N.

We use $N - W = 0 \Rightarrow N = W = mg = (3)(9.8) = 29.4\ N$

Thus $f_s = \mu_s N \rightarrow \mu_s = \frac{f_s}{N} = \frac{12}{29.4} = \boxed{0.41}$

54 - continues

b)

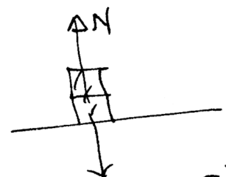


This time we know $\mu_s = 0.41$ from Part (a). But

f_s is different.

$f_s = \mu_s N$

but $N = ?$



$(3+7)(9.8) = 98N$

$\Rightarrow N = 98N$ upward

$f_s = (0.41)(98) = 40\ N$

Thus applying Newton's 2nd law:

$F - f_s = 0$ (a = 0 again in this case)

$\boxed{F = f_s = 40\ N}$

(55)

a) $T - f_k = 0$ or $T = f_k$ → The net force $= 0$

b) but $f_k = \mu_k N = \mu_k mg$ =>

$$\boxed{T = f_k = \mu_k mg}$$

$$\mu_k = \frac{T}{mg}$$

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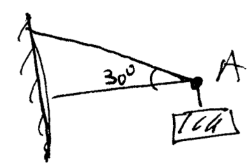
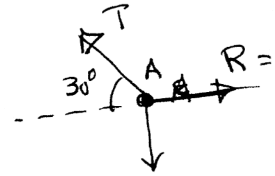
(63)



free body diagram

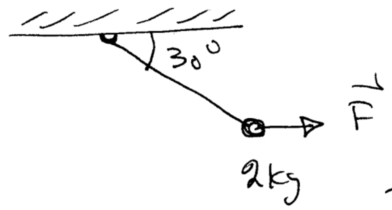


$$\begin{cases} \sum F_x = 0 \Rightarrow R - T\cos 30^\circ = 0 \\ \sum F_y = 0 \rightarrow T\sin 30^\circ - 20 = 0 \end{cases}$$

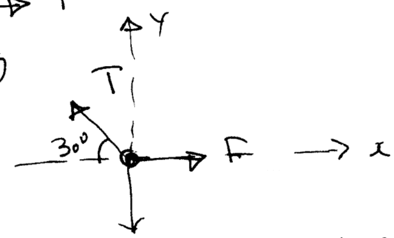
$$\Rightarrow T = \frac{20}{\sin 30^\circ} = \boxed{40\ N}$$

and $R = T\cos 30^\circ = 40\cos 30^\circ = \boxed{35\ N}$

(72)



Free body diagram



$mg = (2 \times 9.8) = 19.6\,N$

$\sum F_x = 0 \rightarrow F - T\cos 30^\circ = 0$

$\sum F_y = 0 \rightarrow T\sin 30^\circ - 19.6 = 0 \Rightarrow T = \dfrac{19.6}{\sin 30^\circ} = \boxed{39.2\ N}$

Then $F = T\cos 30^\circ = (39.2)(\cos 30^\circ) = \boxed{34\ N}$

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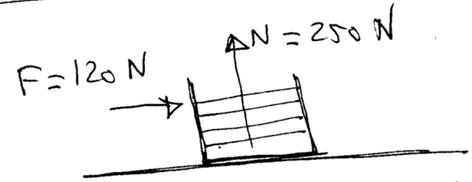
(77)



a) Since the box does not move, we conclude that the friction is at least $f_s = 120\,N$. But this is not the $(f_s)_{max}$. Thus we cannot determine μ_s.

b) For $F = 150\,N \rightarrow (f_s)_{max} = 150\,N$

but $(f_s)_{max} = \mu_s N \rightarrow \mu_s = \dfrac{150}{250} = 0.6$

77 - Continues

c) Now we have $F - f_k = m\cancel{a}$ ($a = 0$)

Thus $F = f_k \Rightarrow \boxed{120 = f_k}$

but $f_k = \mu_k N$

$$\mu_k = \frac{120}{250} = 0.48$$

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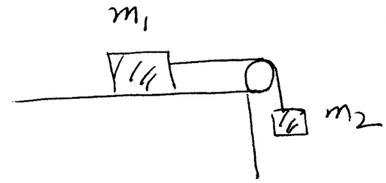
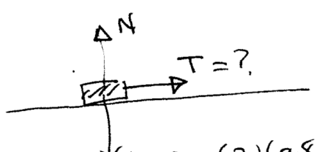
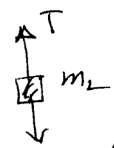
(79) $m_1 = 3\,kg$
$m_2 = 2\,kg$



a) Free body diagrams



$m_1 g = (3)(9.8) = 29.4\,N$



$m_2 g = (2)(9.8) = 19.6\,N$

Apply Newton's law:

$T = m_1 a \quad (1)$

$m_2 g - T = m_2 a \quad (2)$

Combining (1) and (2) $\Rightarrow$

$m_2 g - \underbrace{m_1 a}_{T} = m_2 a \Rightarrow a = \frac{m_2 g}{m_1 + m_2} = \frac{19.6}{5}$

$\boxed{a = 3.9\ m/s^2}$

79 - Continues

b) $V_f = V_i + a\,\Delta t$

$V_f = 0 + (3.9)(1.2) = 4.7\ m/s$

c) $\Delta x = V_i\,\Delta t + \frac{1}{2} a\,\Delta t^2$

$\Delta x = 0 + \frac{1}{2}(3.9)(1.2)^2 = \boxed{2.8\ m}$

d) $(\Delta x)_{block\,1} = \frac{1}{2}(3.9)(.4)^2 = 0.31\ m$ to the right

$(\Delta x)_{block\,2}$ = same toward the floor

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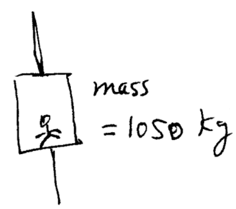
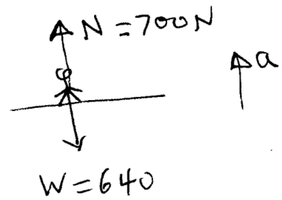
(90) $W_{ground} = 640\ N$ $W_{elevator} = 700\ N$



Free body diagram for Ian :



$\Sigma F = ma \Rightarrow N - W = ma$

$700 - 640 = \left(\frac{640}{9.8}\right) a \rightarrow \boxed{a = .92\ m/s^2}$

90 – continues

Notice that g used Ian's mass, which is

$$m = \frac{640}{9.8} \quad \begin{matrix} \rightarrow \text{weight} \\ \rightarrow g \end{matrix}$$

Now that we have Ian's acceleration, we conclude that the elevator is also moving with the same acceleration of $0.92\ m/s^2$.

$m = 1050$ kg  $\uparrow a = 0.92$

$$\sum F = F_{net} = ma$$

$$= (1050)(0.92) = \boxed{965\ N}$$

(101)

$m = 120\ kg$

$F_d = bv^2 \qquad b = 0.14$

a) $v = 64\ m/s \Rightarrow F_d = bv^2 =$

$= (0.14)(64)^2 = \boxed{573.4\,N}$

b)

$F_d = 573.4\ N$

$mg = (120)(9.8) = 1176\,N$

$\Sigma F = ma \rightarrow 1176 - 573.4 = (120)a$

$\boxed{a = 5\ m/s^2}$

c) At terminal speed: $\Sigma F = 0 \Rightarrow$

$W = F_d$

$1176 = b\,V_{Terminal}^2 \rightarrow V_{Terminal} = \sqrt{\dfrac{1176}{0.14}}$

$\boxed{V_{Terminal} = 91.6\ m/s}$