Physics 160

Extra Credit #11

4.19

on Io $g = 1.81 m/s^2$

on Earth $g = 9.81 m/s^2$

$W = 56N$ on Earth

$W = mg \Rightarrow m = \frac{W}{g} = \frac{56N}{9.81 m/s^2} = 5.71 kg$

b) Mass on Io? → MASS the SAME everywhere!

$m = 5.71 kg$

c) Weight on Io? $W = (5.71 kg)(1.81 m/s^2) = 10.3N$

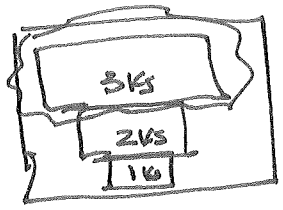
Space Walk

a) you can't swim or walk in space Because there's nothing to push Against. Throwing a tool ~~away~~ from shuttle will cause A force towards shuttle on Astronaut.

b) She should throw largest tool. That way her MASS will be SMALLER After the throw, so she'll have the largest Acceleration

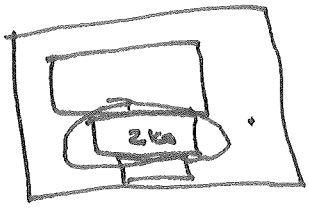
c) Throws w/ $F = 16N \Rightarrow$ 16N on her. In outerspace this would be the only force on her. $\Rightarrow \Sigma F = 16N$, $\Sigma F = ma \Rightarrow a = \frac{\Sigma F}{m} = \frac{16N}{80kg} = 0.2 m/s^2$

Blocks in an Elevator



Forces on 3Kg: Upwards force from 2Kg $\Rightarrow \vec{F}_{2\text{ON}3,\text{up}}$ (only 2Kg Box At Boundary)

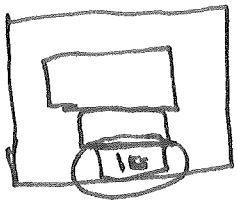
Weight of 3Kg down: $w_3 = (3\text{Kg})(9.8\text{m/s}^2)$
$= 29.4\text{N}$



Forces on 2Kg: Downards force from 3Kg $\Rightarrow \vec{F}_{3\text{ON}2}$ By 3rd law $F_{3\text{ON}2} = F_{2\text{ON}3}$

Upwards force from 1Kg $\Rightarrow \vec{F}_{1\text{ON}2}$

Weight of 2Kg, down: $w_2 = (2\text{Kg})(9.8\text{m/s}^2)$
$= 19.6\text{N}$



Forces on 1Kg: Downwards force from 2Kg $\Rightarrow \vec{F}_{2\text{ON}1}$. 3rd law $\Rightarrow F_{2\text{ON}1} = F_{1\text{ON}2}$

Upwards force from floor: $\vec{F}_{\text{floor ON}1}$

Weight of 1Kg, down, $w_1 = (1\text{Kg})(9.8\text{m/s}^2)$
$= 9.8\text{N}$

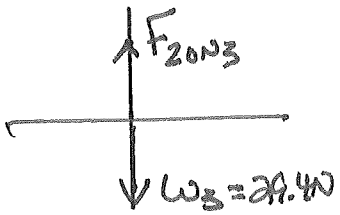
Finally, 3rd law $\Rightarrow F_{1\text{ON floor}} = F_{\text{floor ON}1}$.

Notice how 3Kg exerts no force on 1Kg since they don't touch
$\Rightarrow F_{3\text{ON}1} = F_{1\text{ON}3} = 0$

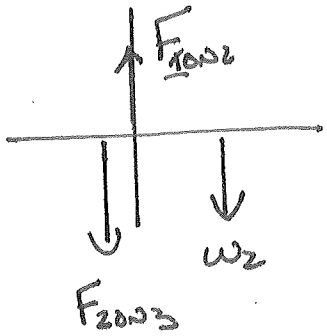
(cont.)

fbd's:

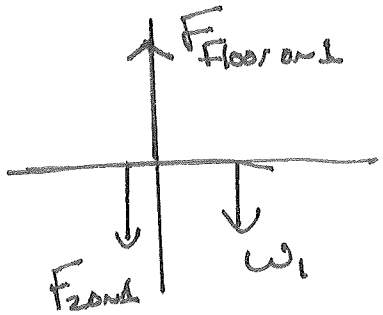
M_3



M_2



M_1



Elevator at rest $\Rightarrow \sum \vec{F} = 0$ on All Boxes

So from M_3 we get $F_{2ON3} = w_3 = 29.4N$

From M_2 and 3rd Law, we get $F_{1ON2} = F_{2ON3} + w_2 = 29.4N + 19.6N = 49N$

From M_1 and 3rd Law: $F_{Floor\ on\ 1} = F_{2ON1} + w_1 = 49N + 9.8N = 58.8N$

Largest

$F_{Floor\ on\ 1}$, F_{1ON2}

$F_{1\ on\ Floor}$, F_{2ON1}

F_{2ON3}, F_{3ON2}

Smallest

F_{3ON1}, F_{1ON3}

When Accelerating up, the results are the same. Now,

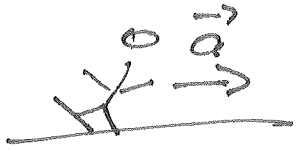
$F_{2ON3} = w_3 + m_3a$

$F_{1ON2} = F_{2ON3} + w_2 + m_2a$

$F_{Floor\ on\ 1} = F_{2ON1} + w_1 + m_1a$

So each are bigger than before but the ranking stays the same.

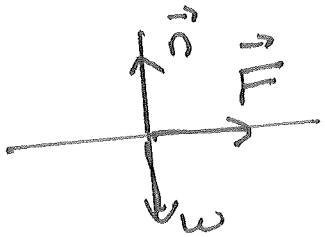
World-Class Sprinter



$a = 15 m/s^2$, $m = 63 kg$

What Horizontal force?

Forces on Sprinter: $\vec{w}$ down, $\vec{n}$ up, Horizontal $\vec{F}$



$\Sigma F_x = ma_x$, & $\Sigma F_y = ma_y$

Acceleration is Horizontal $\Rightarrow a_x = 15 m/s^2$; $a_y = 0$

$\therefore \Sigma F_x = ma_x \Rightarrow F = ma_x$

$\Rightarrow F = (63kg)(15 m/s^2) = 945 N$

to be complete

3

$\Sigma F_y = ma_y \Rightarrow n - w = 0 \Rightarrow n = w = (63kg)(9.8 m/s^2)$

$\Rightarrow n = 617.4 N$

b) Sprinter pushes BACK on blocks, so Blocks push Sprinter forward