L09 – Newton's Third Law

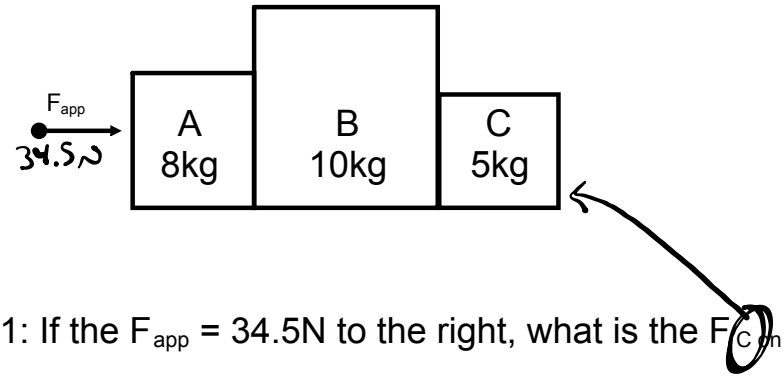
aka "Blocks pushing Blocks"

If object A exerts a force on object B, then B exerts a force on A that is equal in magnitude and opposite in direction.

$$F_{A \text{ on } B} = -F_{B \text{ on } A}$$

my **broken hand**.....
don't **punch** metal objects!

Applying Newton's Third Law to Frictionless Systems



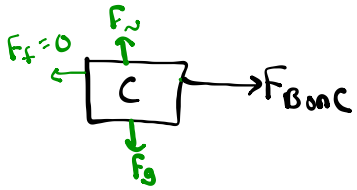
Q1: If the F_{app} = 34.5N to the right, what is the $F_{C\ on\ B}$?

Step #1: What is the acceleration of the system?

$\vec{F}_{net} = \vec{F}_{app} + \vec{F}_f$
$= (+34.5) + (-0)$
$= 34.5N$

$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{34.5}{23} = 1.5 m/s^2 [R]$

Step #2: Free-Body Diagram on C



Step #3: F_{net}=ma

$F_{net} = ma$
$= (5)(1.5)$
$= 7.5N$

$\vec{F}_{net} = \vec{F}_{B on C} + \vec{F}_f$
$+7.5 = \vec{F}_{B on C} + (-0)$

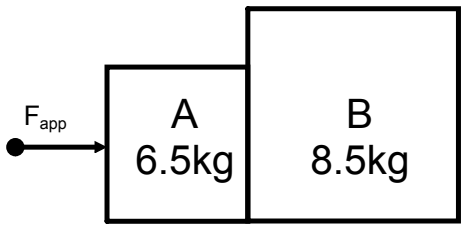
$\vec{F}_{B on C} = 7.5N [R]$
$\vec{F}_{C on B} = 7.5N [L]$

Practice: Pg 164 #1

Discussion:

What is the magnitude of the force applied to Box A?

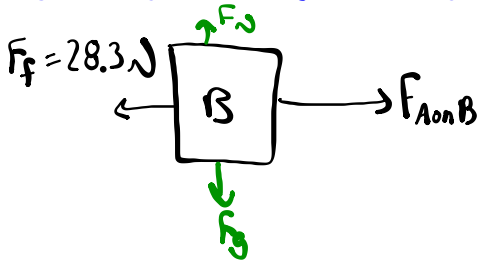
Applying Newton's Third Law to Systems with Friction



Given: $F_{f\ on\ B} = 28.3N$
$a_{system} = 2.6m/s^2$ [Right]

Find: $F_{B\ on\ A}$

Step #1: Free-Body Diagram on B



Step #2: $\mathcal{F}_{net} = ma$

$a = 2.6\ m/s^2$ [R]

$F_{net} = ma$
$= (8.5)(2.6)$
$= 22.1N$ [R]

$\vec{F}_{net} = \vec{F}_{A on B} + \vec{F}_f$

$+22.1 = F_{A on B} + (-28.3)$

$+28.3 \qquad +28.3$

$50.4 = F_{A on B}$

$\vec{F}_{A on B} = 50.4N$ [R]

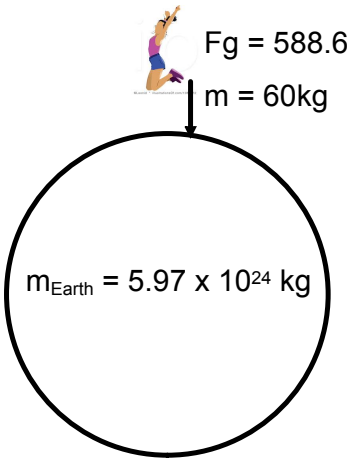
$\vec{F}_{B on A} = 50.4N$ [L]

Practice

Pg 168 #7-9

Newton's Third Law and Gravity

What is the acceleration of the Earth?
What is the acceleration of the girl?



$a = \frac{F_{net}}{m} = \frac{588.6}{60} = 9.81\ m/s^2$

$a = \frac{F_{net}}{m} = \frac{588.6}{5.97 \times 10^{24}} = 9.86 \times 10^{-23}\ m/s^2$

$0.00000000000000000000986\ m/s^2$