Newton's 3rd Law

For every force there is an equal and opposite force. This is true for contact forces (pushing a box, pulling a toboggan) and for non-contact forces like gravity and magnetic repulsion.

ie: CONTACT FORCES - if I throw a ball against the wall, the ball exerts a force on the wall but the wall exerts an equal force back on the ball! It's this force exerted by the wall that causes the ball to change it 's motion (accelerate) and bounce back!

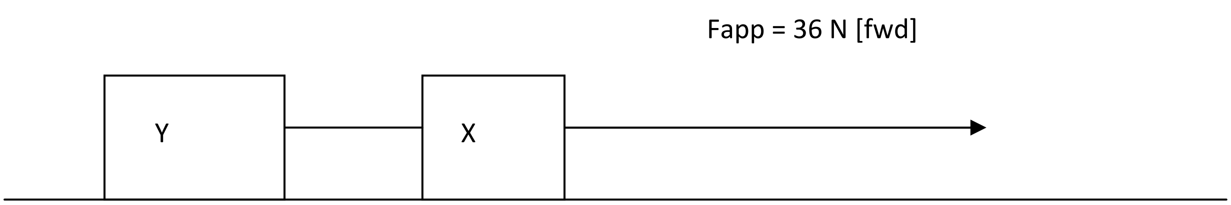
ie: NON-CONTACT FORCES - When I drop a ball from a height, the earth pulls the ball down with Fg AND the ball pulls the earth up with the equal force of Fg. However, the earth is MASSIVE and thus does not move much (a = Fnet/m is very little) and the ball has a small mass and thus changes it's motion a lot(acceleration is huge!).

*for additional detailed explanations, please read the section in your text *

………

Pulling multiple objects – tricky

Given: A winter camper is pulling 2 attached tobaggans loaded with equipment with a force of 36 N [fwd]. Fortunately, the snow is very slippery and so we will consider there to be no friction. (and camper has cleats to get a grip on this slippery snow!)



My = 12 kg   Mx = 6.0 kg

Required: Calculate the force X exerts on Y.

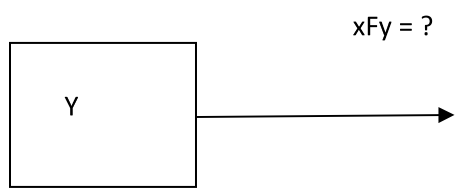
Note: X must pull on Y or box Y wouldn't move! The applied force is only applied directly to box X. Whatever force X exerts on Y [fwd], Y exerts on X [backwards]. The person pulling experiences this as 'drag'. Cut Y off of the system and it's much easier to pull! (less drag,,or backwards force).

Steps: #1 – find the acceleration of the system
Steps: #2 – find the internal tension (force X applies on Y) by analyzing 1 part of the system.

First: system -- mass = 12 kg + 6 kg = 18 kg
Force applied to entire system = 36 N

Fnet = ma
Fapp = ma
36 N = 18 Kg (a)
A = 2.0 m/s^2 [fwd]

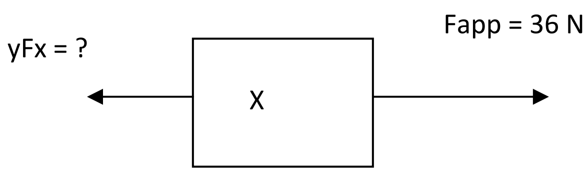
Second: look at 1 part of the system. I choose Box Y – it is easier – end box is usually easier to analyze.



a = 2.0 m/s^2
(both boxes are moving at the same rate assuming the string doesn't snap!)
m = 12 kg

Fnet = ma
xFy = ma
xFy = 12 kg (2 m/s^2)
xFy = 24 N [fwd] This is the force that allows Y to move forward with X.

Proof: Newton's 3rd law says Box Y should pull on X with 24 N [backwards]. Let's see if it is.



$a = 2.0\ m/s^2$ $\quad$ $mx = 6.0$ kg

Fnet = ma
Fapp + yFx = ma
+36 N + yFx = (6) (2)
yFx = 12 – 36
yFx = -24 N [fwd] …..or box Y pulls on box X with 24 N backwards! Same answer as above.

Newton's 3rd Law holds true!