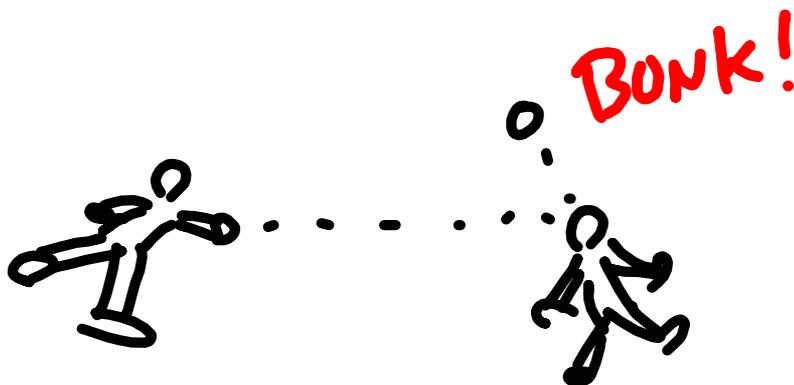
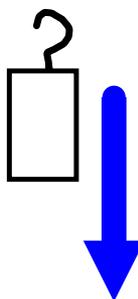


**Does it hurt to get hit with a baseball
(or anything else) in zero-g?**



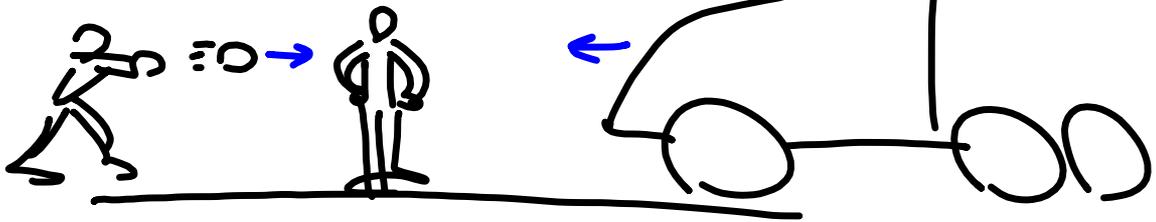
1 kg weighs 10 N
of stuff pull of gravity

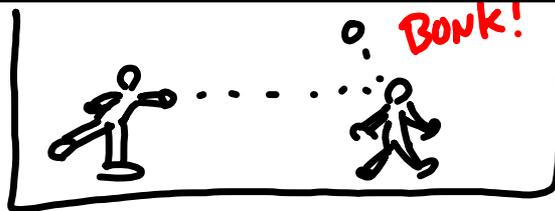


| Mass | Weight |
|--|---|
| amount of matter | pull of gravity on the matter |
| the stuff | the heaviness of the stuff |
| kilograms | Newtons |
|  <p>The same wherever you are Makes things tough to speed up, slow down or turn</p> |  <p>Depends on where you are (Earth, Moon, zero-g, etc.)</p> |

Is it Mass or Weight

**That makes things hard to speed up,
slow down or turn?**





Is it

WEIGHT (the pull of gravity)

or

MASS (the stuff)

that makes things hurt when they hit you?

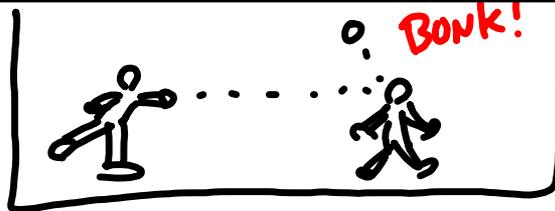
(tough to speed up/slow down)

1. When you hold the weight in place what are you fighting? (mass or weight?)

2. When you shake it side to side, what are you fighting? (mass or weight?)

3. When weight is canceled out, can the mass still hurt you?

4. Does NASA worry about moving bits of space junk hitting satellites in zero-g?



Is it

WEIGHT (the pull of gravity)

or

MASS (the stuff)

that makes things hurt when they hit you?

(tough to speed up/slow down)

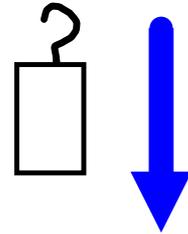
1 kg weighs 10 N

of stuff

pull of gravity



It's



Mass
The Stuff

MASS

The Amount of Stuff.

Makes things tough to speed up, slow down or turn.

(Which is why things can hurt when they hit you.)

Weight makes things hard to lift and causes them to fall when you drop them.

1st Law of Motion

When forces cancel or are zero, objects maintain constant speed and direction

2nd Law of Motion

When forces act and don't cancel, objects speed up, slow down, or turn

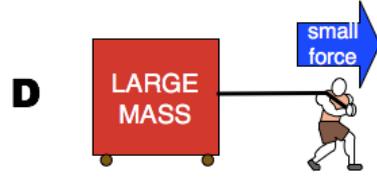
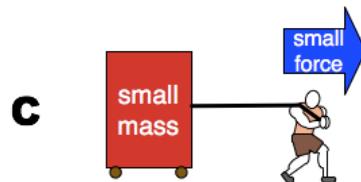
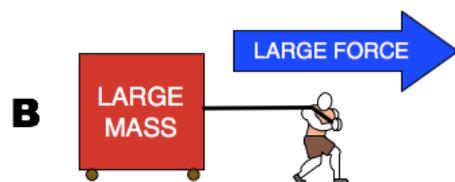
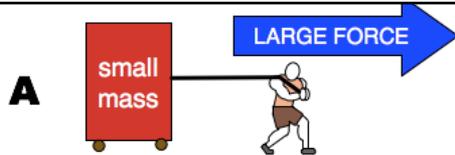
How quickly??

FORCES cause objects to change speed.

(More force means more rapid speed change.)

**MASS (The stuff) makes objects tough to
speed up or slow down or turn.**

(More mass means tougher to change speed.)



Compare Force to mass.
Which situation will ...

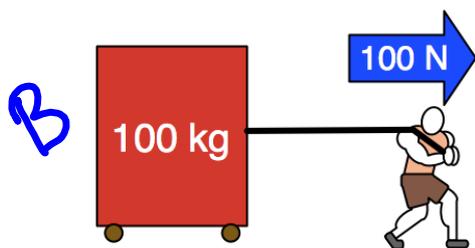
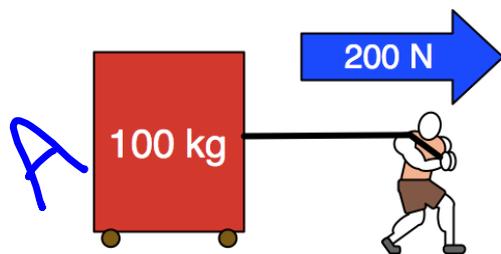
Have a rapid change
in speed?

Have a moderate
(medium) change in
speed?

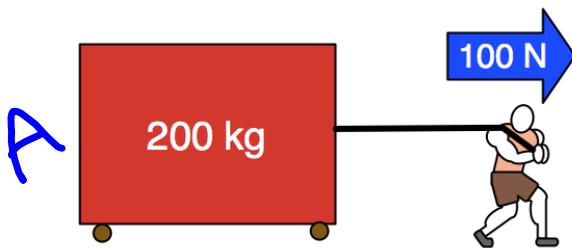
Have a gradual
change in speed?

Winner
:
loser

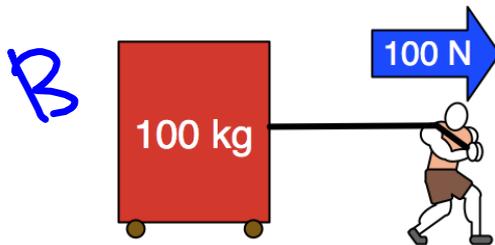
Who changes speed more rapidly?



Who changes speed more rapidly?

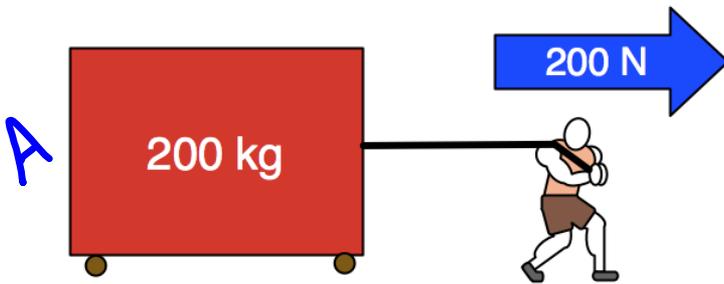


$$\frac{100 \text{ N}}{200 \text{ kg}} = 0.5$$

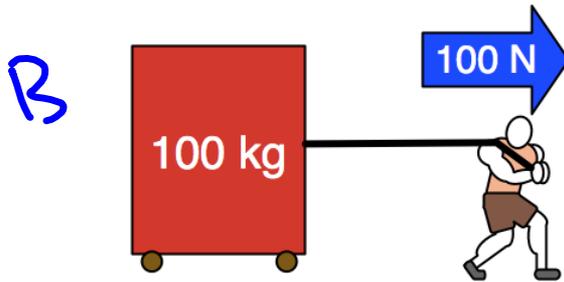


$$\frac{100 \text{ N}}{100 \text{ kg}} = 1$$

Who changes speed more rapidly?



$$\frac{200 \text{ N}}{200 \text{ kg}} = 1$$



$$\frac{100 \text{ N}}{100 \text{ kg}} = 1$$

Who changes speed more rapidly?

Look at the ratio of force to mass:

FORCE (N)



mass (kg)

What is the speed change?

