1st Law of Motion
If the Net Force is zero in a direction, objects maintain constant speed in that direction.

2nd Law of Motion
If there is a Net Force in a direction, objects will change speed in that direction:

- Speed up = Net Force and motion in the same direction.

- Slow down = Net Force and motion in opposite directions.

How rapidly will the speed change happen?

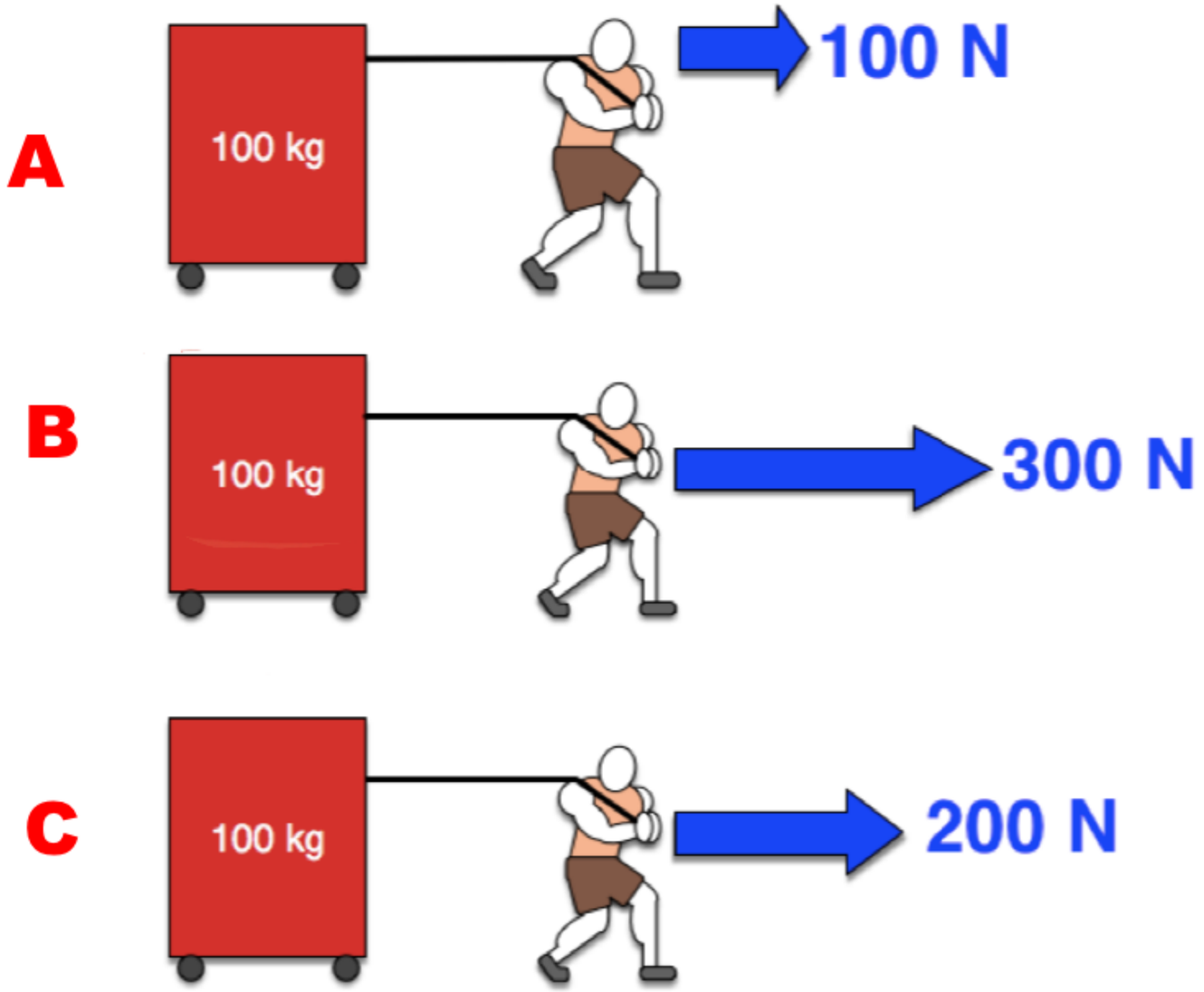
NET FORCE

The larger the net force, the more rapid the speed change.

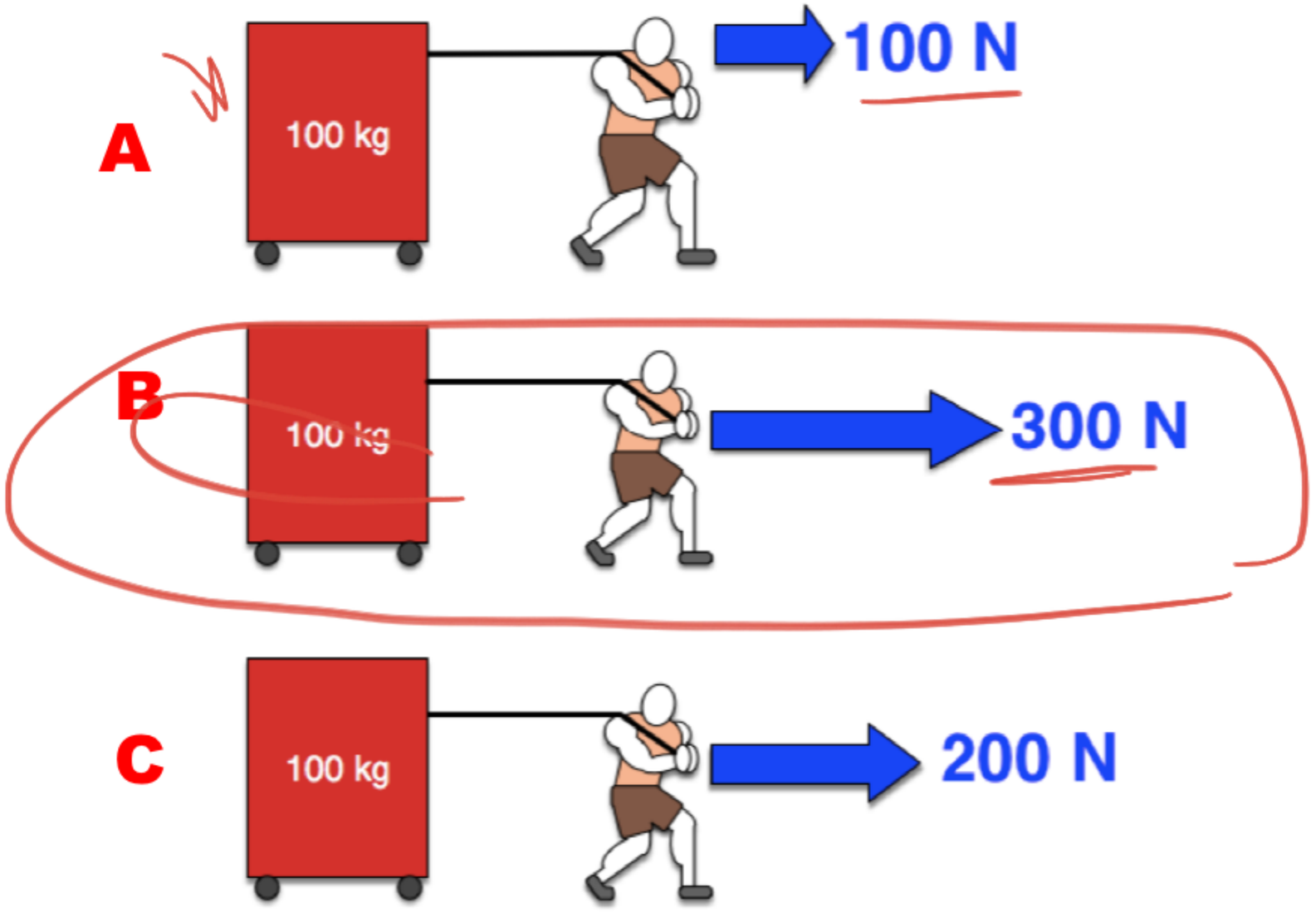
MASS

The larger the mass, the more gradual the speed change.

Assuming no friction, which one will have the most rapid speed up?

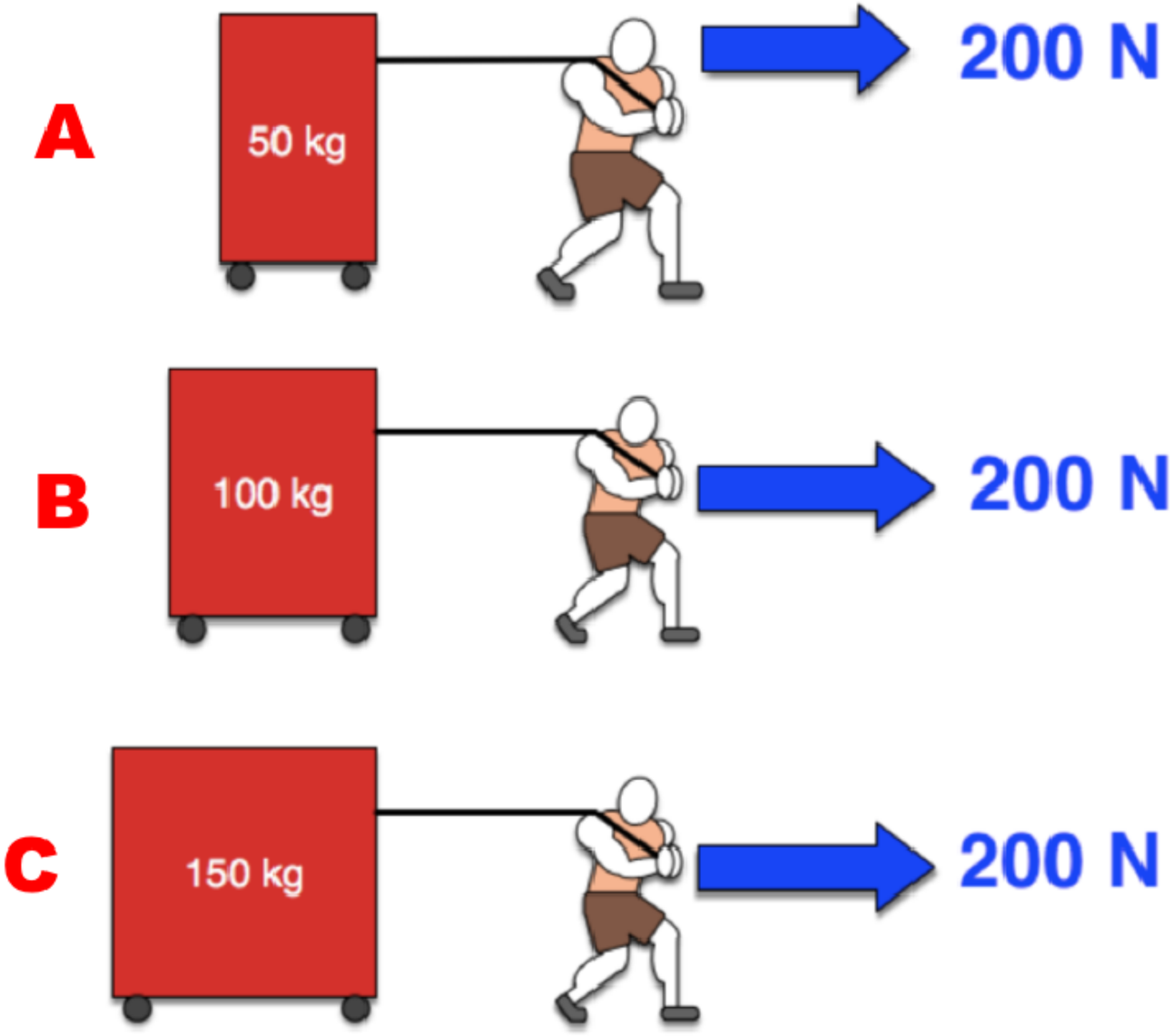


Assuming no friction, which one will have the most rapid speed up?

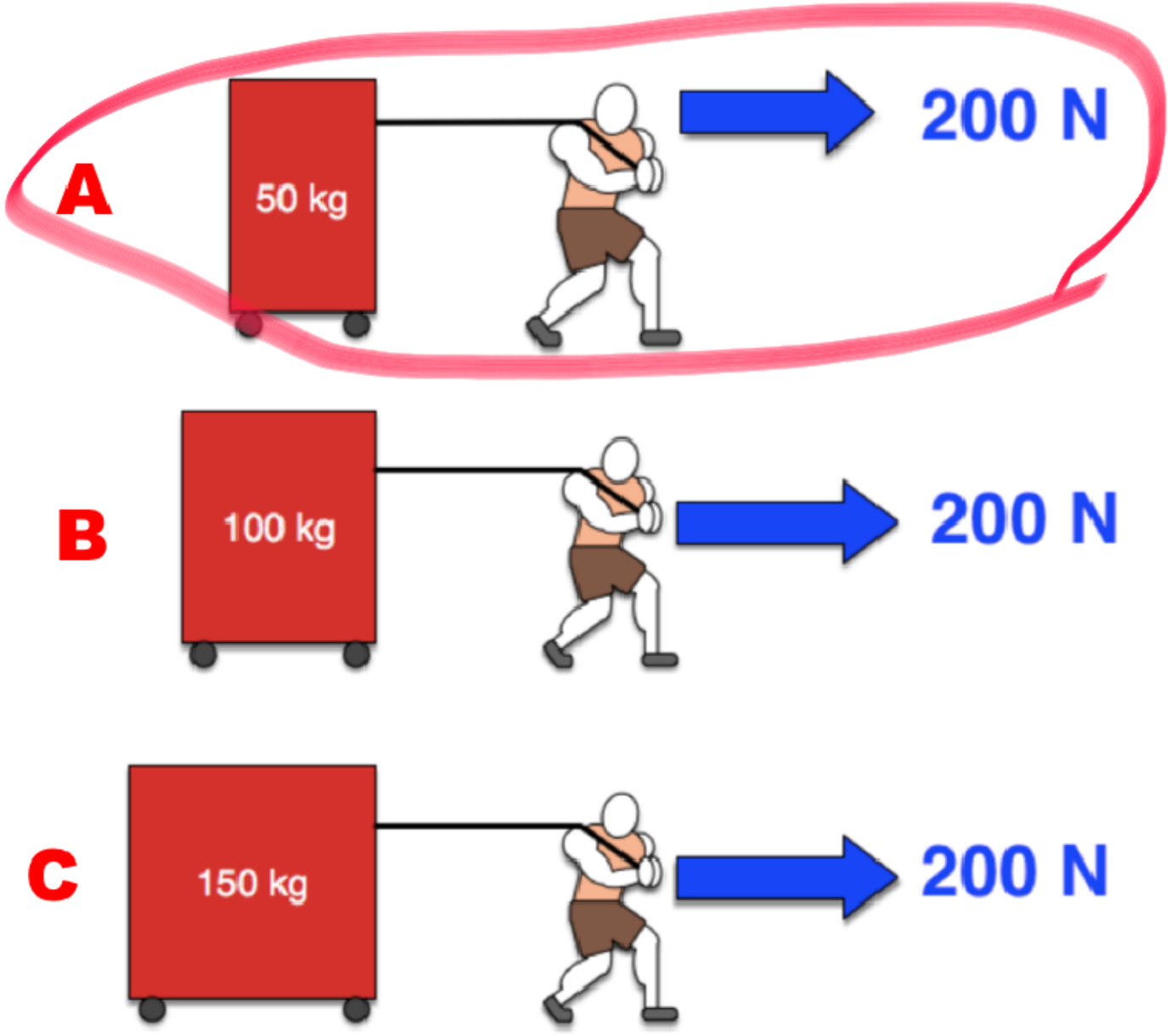


All the same mass, so the biggest force causes the most rapid speed up.

Assuming no friction, which one will have the most rapid speed up?



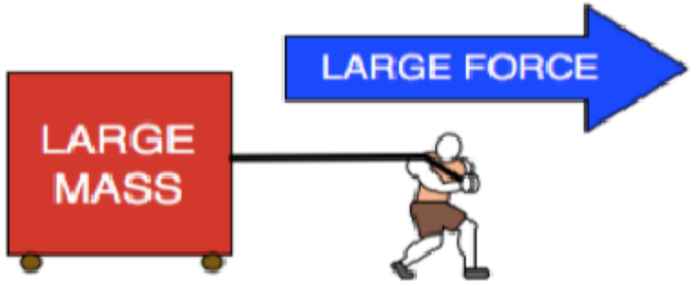
Assuming no friction, which one will have the most rapid speed up?



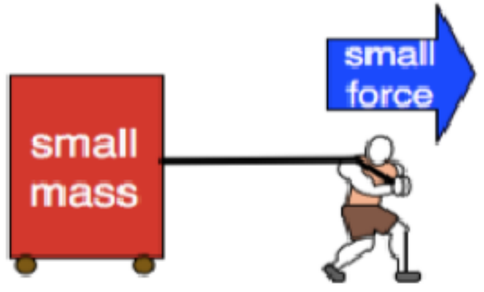
All the same force, so the smallest mass will have the most rapid speed up.

A

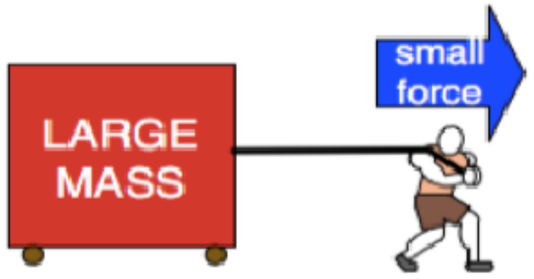
B



C



D



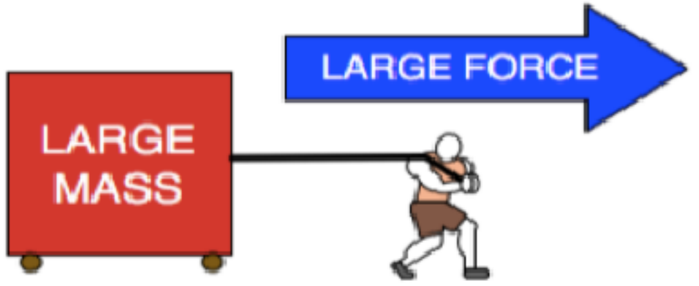
Which one(s) will have a RAPID speed change?

Which one(s) will have a GRADUAL speed change?

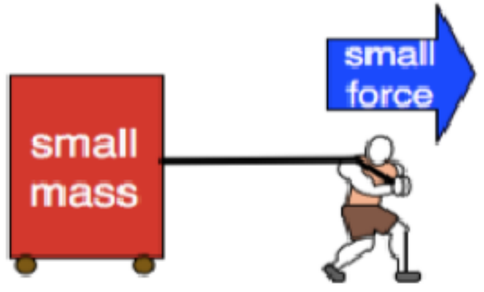
Which one(s) will have a MODERATE speed change?

A

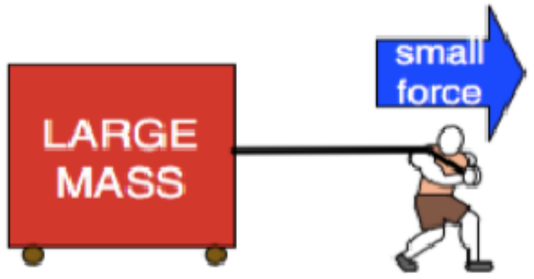
B



C



D



Which one(s) will have a RAPID speed change? A

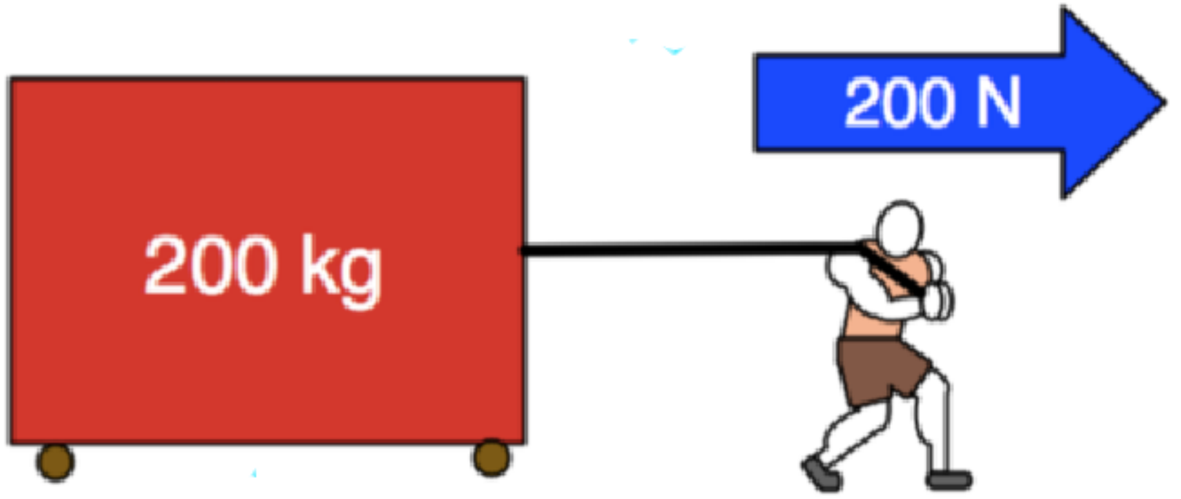
Which one(s) will have a GRADUAL speed change? D

Which one(s) will have a MODERATE speed change?

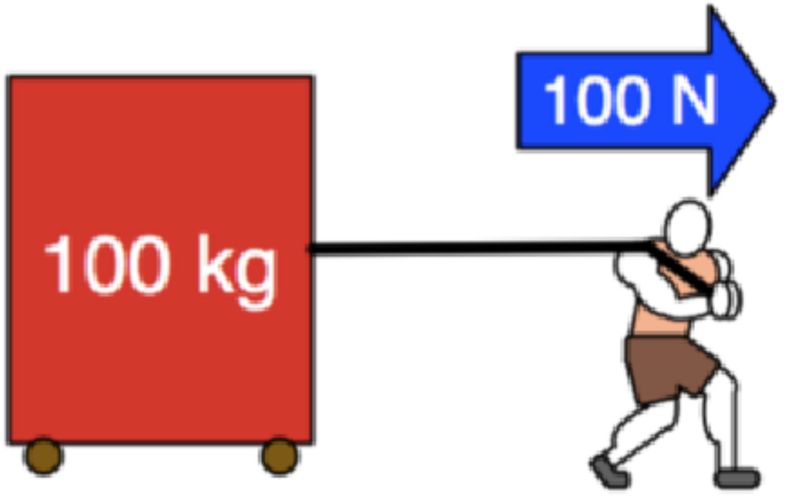
B & C

What would you say about how rapid the speed changes will be? WHY?

A

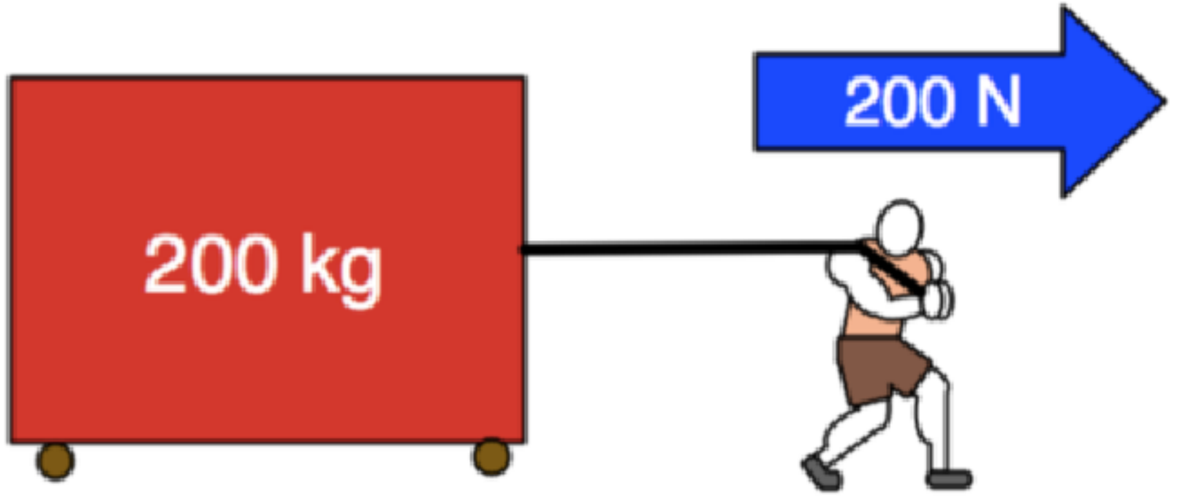


B



What would you say about how rapid the speed changes will be? WHY?

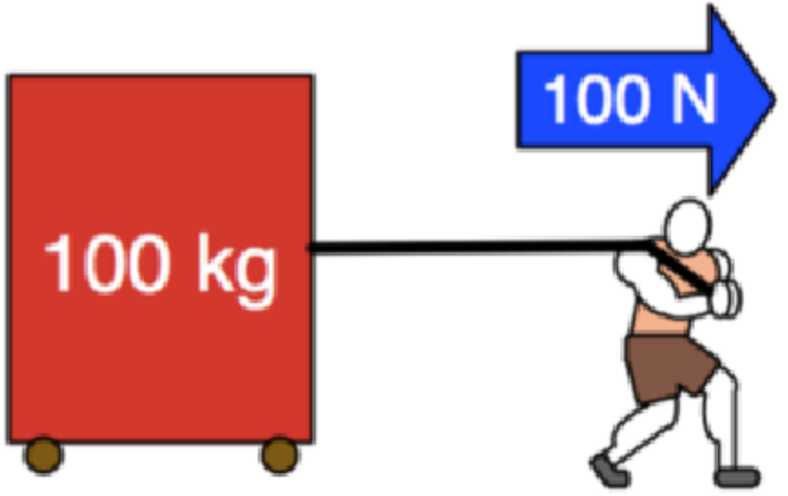
A



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

Same speed change, because same ratio of force to mass.

B



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

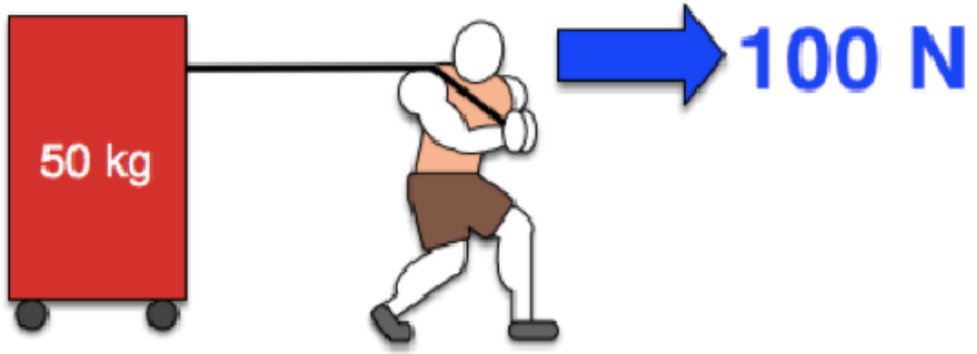
Comparing Force to the Mass:
Is that a big force for that particular mass?
Is that a small force for that particular mass?

Mathematically, comparisons of different things (like force and mass) is best done by dividing.

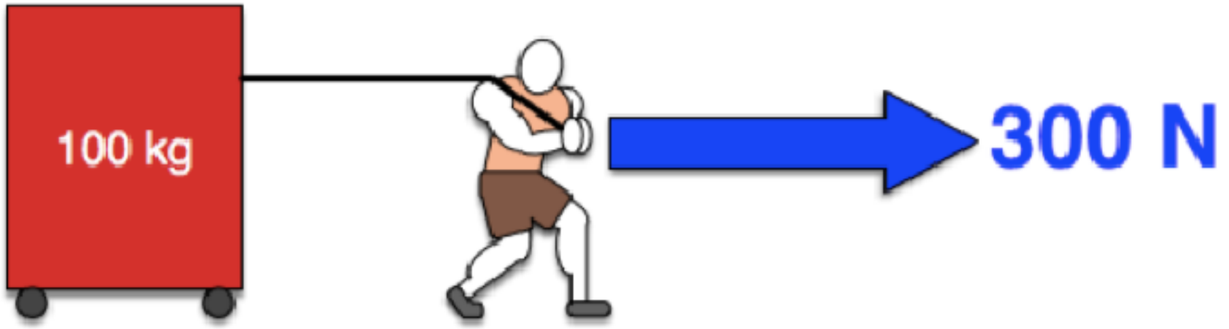
Look at the ratio!

Calculate the ratio of force to mass for each.
Make a prediction about how rapid the speed changes will be.

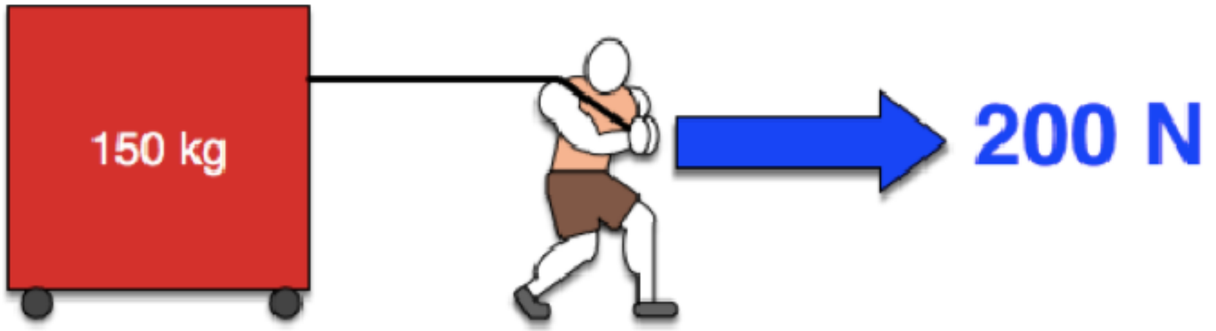
A



B

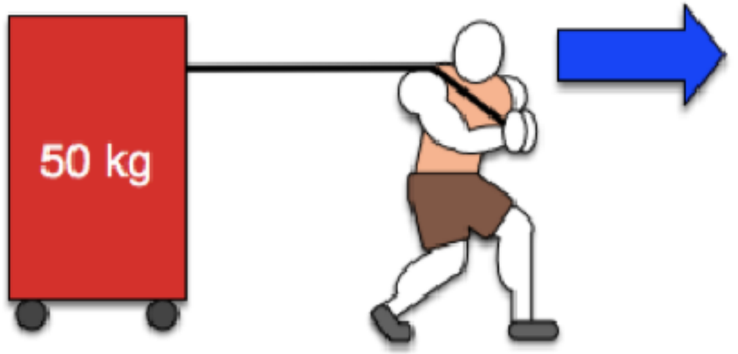


C



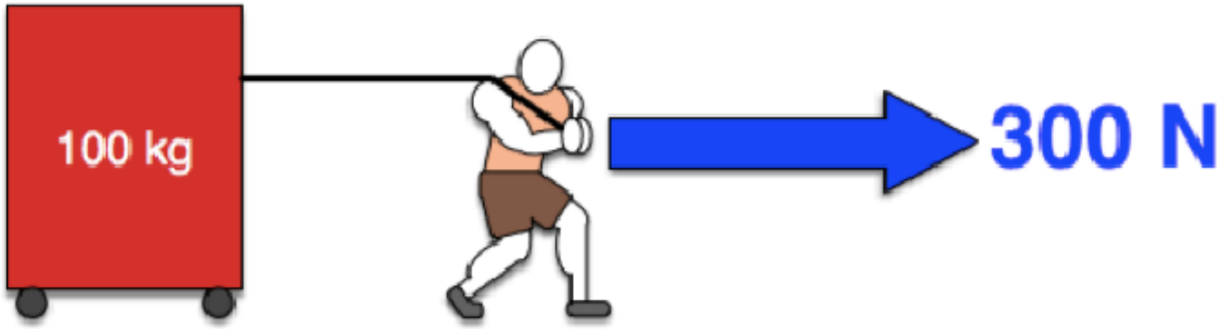
Calculate the ratio of force to mass for each.
Make a prediction about how rapid the speed changes will be.

A



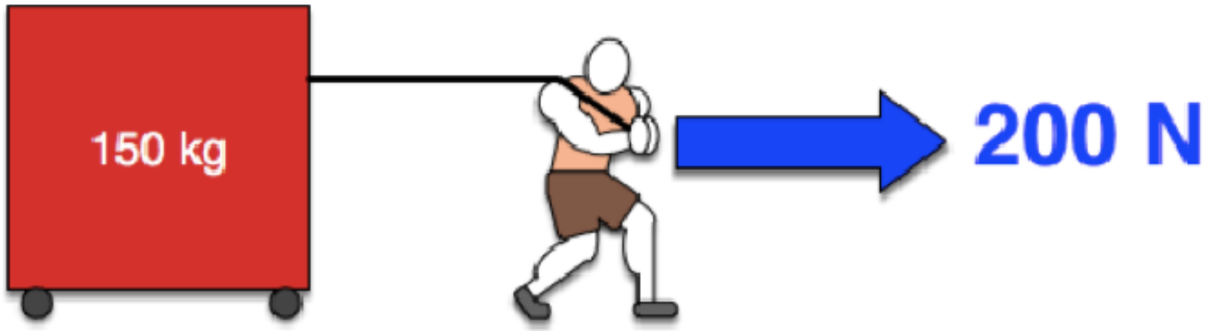
$$\frac{100\ \text{N}}{50\ \text{kg}} = 2$$

B



$$\frac{300\ \text{N}}{100\ \text{kg}} = 3$$

C

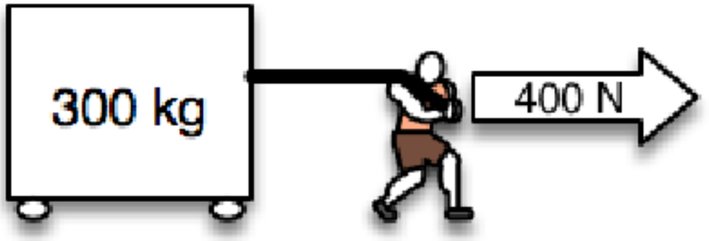


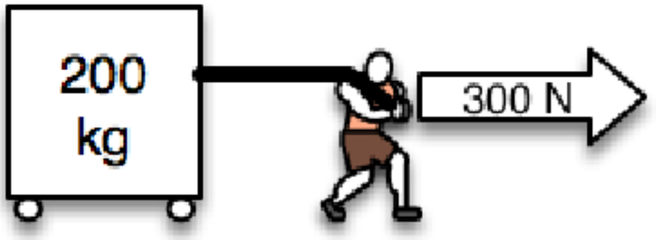
$$\frac{200\ \text{N}}{150\ \text{kg}} = 1.33$$

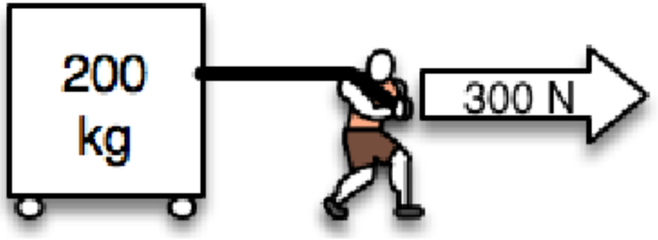
Let's call this ratio the speed change factor.
It indicates how rapid the change in speed will be.

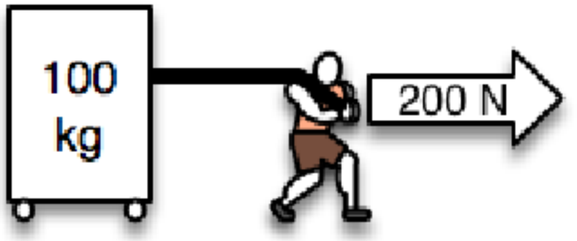
$$\frac{\text{FORCE (N)}}{\text{MASS (kg)}} = \text{speed change factor}$$

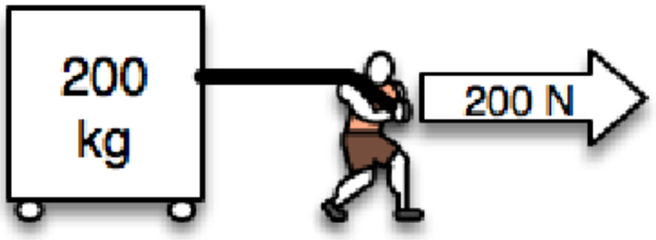
PRACTICE: Calculate the speed change factors for each situation.

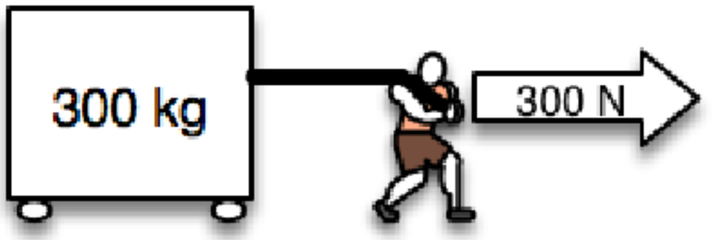


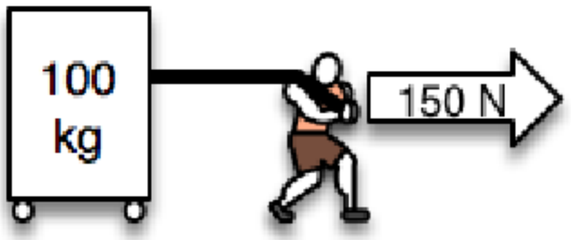


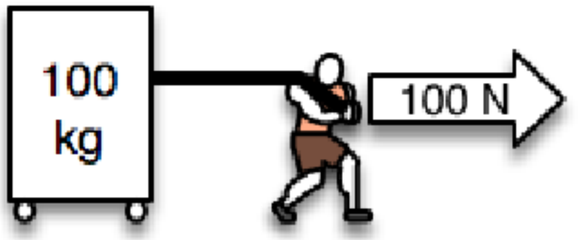




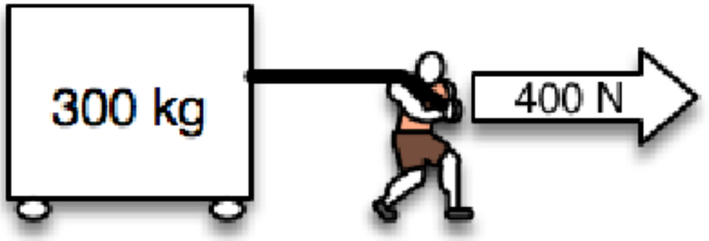




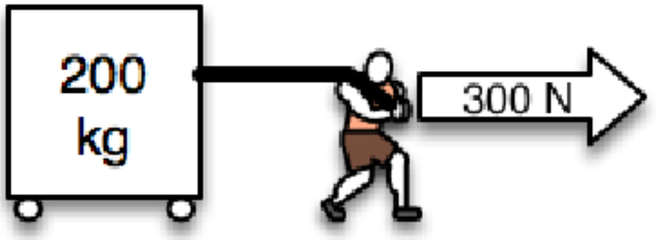




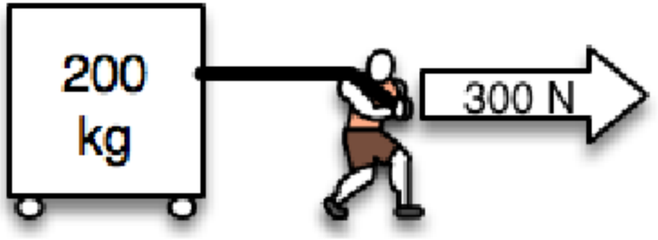
PRACTICE: Calculate the speed change factors for each situation.



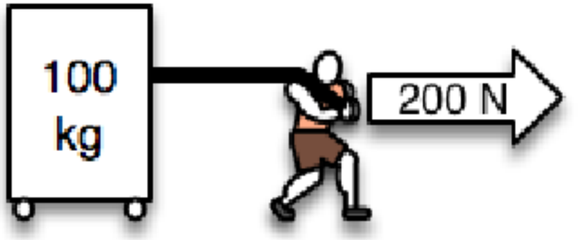
$$\frac{400\ \text{N}}{300\ \text{kg}} = 1.33$$



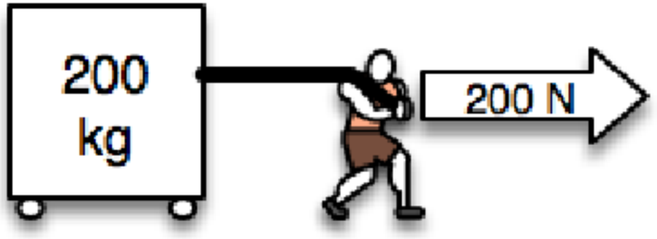
$$\frac{300\ \text{N}}{200\ \text{kg}} = 1.5$$



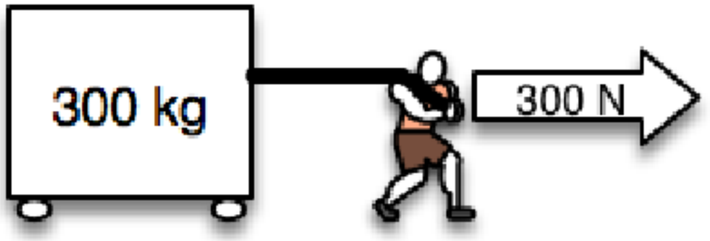
$$\frac{300\ \text{N}}{200\ \text{kg}} = 1.5$$



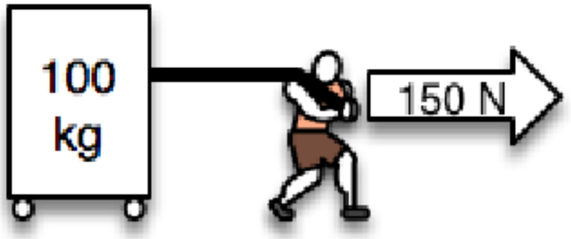
$$\frac{200\ \text{N}}{100\ \text{kg}} = 2$$



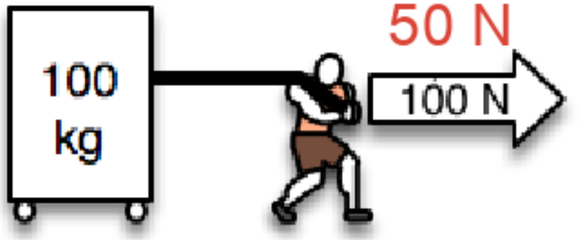
$$\frac{200\ \text{N}}{200\ \text{kg}} = 1$$



$$\frac{300\ \text{N}}{300\ \text{kg}} = 1$$



$$\frac{150\ \text{N}}{100\ \text{kg}} = 1.5$$



$$\frac{50\ \text{N}}{100\ \text{kg}} = 0.5$$