Name: _____

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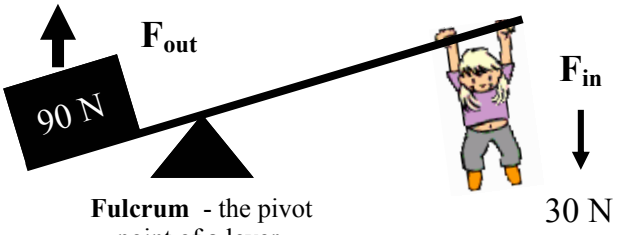
Ch. 4:2

Levers

Using Forces to find MA

F_{out} — what you are lifting with the lever.

F_{in} — force you put into the lever.



Fulcrum - the pivot point of a lever.

$$MA = \frac{F_{out}}{F_{in}} = \frac{90\ N}{30\ N} = 3$$

This lever multiplies force by 3!

Ex. A 250 N crate is picked up by pushing on a lever with 50 N of force. Find the MA of the lever.

$F_{out} = 250$ N
$F_{in} = 50$ N
MA = ?

$$MA = \frac{F_{out}}{F_{in}} = \frac{250\ N}{50\ N}$$

MA = 5

Ex. A lever has an MA of 6. If you weigh 50 N, how much can you lift with the lever?

MA = 6
$F_{in} = 50$ N
F_{out} = ?

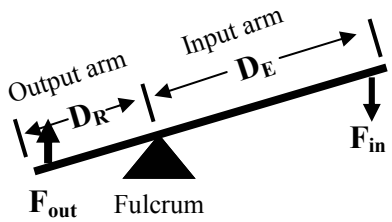
If $MA = \frac{F_{out}}{F_{in}}$

then $F_{out} = (MA)(F_{in}) = 6\ (50\ N)$

$F_{out} = 300$N

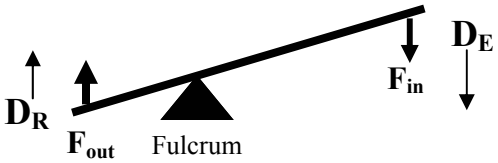
Using Distances to find MA - 2 ways

Using distances from the fulcrum



D_{Effort} - fulcrum to F_{in} (Called "input arm")
$D_{Resistance}$ - fulcrum to F_{out} (Called "output arm")

Using how far the ends move



D_E - how far you push the lever down.
D_R - how far the object goes up.

Either way, the MA comes out the same!

Ex. A lever has an input arm of 6 m and an output arm of 2 meters. Find the MA of the lever.

$Arm_{in} = D_E = 6$ m
$Arm_{out} = D_R = 2$ m
MA = ?

$$MA = \frac{D_E}{D_R} = \frac{6\ m}{2\ m}$$

MA = 3

Ex. To lift a box, you pull down 40 cm. The box moves up only 5 cm. Find the MA of the lever.

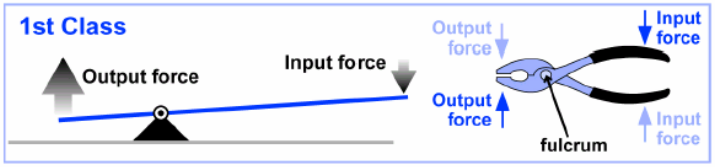
$D_E = 40$ cm
$D_R = 5$ cm
MA = ?

$$MA = \frac{D_E}{D_R} = \frac{40\ cm}{5\ cm}$$

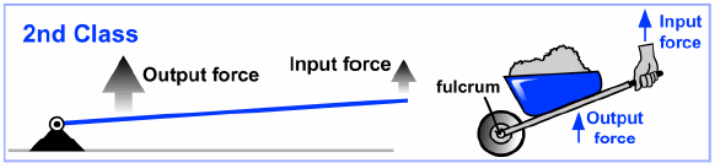
MA = 8

Types of Levers

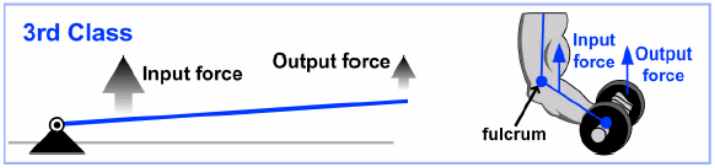
First Class Levers have the fulcrum in the middle. Examples are seesaws, scissors, and pliers.



Second Class Levers have the output force in the middle. Examples are wheelbarrows and nutcrackers.



Third Class Levers have the input force in the middle. Most body parts are good examples (arms and legs), as are most sports equipment (bats, rackets, and clubs).



Name: _____

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Draw an arrow to the fulcrum of each lever.

Identify these levers as first, second, or third class:

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

A. Shovel — handle is fulcrum.

B. Scissors

C. Nutcracker—output is cracking the nuts.

D. Wheelbarrow

E. Hammer (when pulling nails)

F. Stapler—you push in the middle.

Input or Output Force?	Distance of Effort or Distance of Resistance?
_____ You use a lever to lift a 45 N rock.	_____ The part of the lever that lifts the object.
_____ You stand on the end of a lever.	_____ The part of the lever you pull on.
_____ A lever lifts a 38 N crate.	_____ How much you pull down the lever.
_____ A lever applies 78 N of force to a car.	_____ A block is lifted up 4 cm with a lever.
_____ To lift an object you have to apply 8 N of force.	_____ You have to pull down 50 cm to lift a rock.

A lever has a 36 cm input arm and a 6 cm output arm. Find MA.

A lever takes 150 N to lift a 75 N object. Find MA.

You have to pull down 15 cm to lift a box 5 cm. Find MA.

The MA of a lever is 4. If you have to lift the object up 20 cm, how far will you have to pull down?

Which of Newton's Three Laws Applies?

___ To make a skateboard go forward, you push backward.

___ You need good tires to help a car go around curves.

___ If you want to throw a ball faster, you will need to throw it harder.

___ After you hit a hockey puck it glides straight across the ice.

A 25 N and 5 N force pull to the right. Friction is 10 N. If the object is 5 kg, find the net force and acceleration.

An 60 kg astronaut throws a 3 kg wrench to the left. The wrench ends up going 10 m/s to the right. Find the velocity of the astronaut.