Name: _____

Period: _____

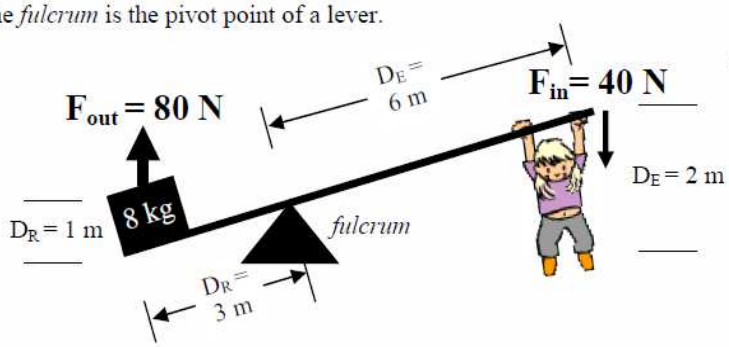
Levers, Pulleys, and Incline Planes

Levers

To increase the Mechanical Advantage of a lever, move the *fulcrum* closer to the object. The *fulcrum* is the pivot point of a lever.

Output—The side that lifts the object. F_{out} is the weight of the object. D_R is the distance the object is lifted up OR the distance from the fulcrum to the object.

The ratios of the vertical distance or those along the lever are the same: 6m/3m = 2 = 2m/1m.

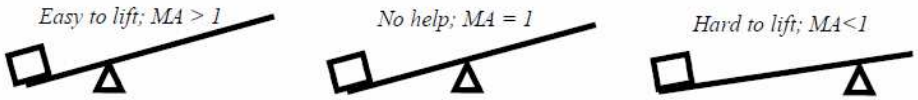


By using 2 times the distance, you only need 1/2 the force. This lever has a MA of 2. This lever multiplies your force by 2.

Input—The side you pull on. F_{in} is how hard you pull down on the lever. D_E is the distance you pull down the lever OR the distance from F_{in} to the fulcrum.

Levers lose energy thru friction of the rubbing of the fulcrum or if the lever bends.

As the fulcrum moves closer to the object, F_{in} decreases as the ratio of D_E/D_R increases.



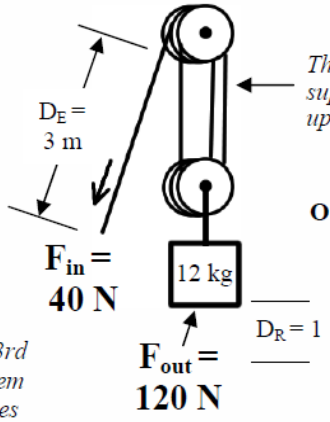
SAMPLE

Pulleys

To increase the Mechanical advantage of a pulley, increase the number of support ropes. The mechanical advantage of a pulley equals the number of support ropes.

Input—Pulling the rope out of the pulley. F_{in} is the force you pull on the rope. D_E is length of rope you pull out of the pulley.

By using 3 times the distance, you only need 1/3rd the force. This pulley system has a MA of 3. It multiplies your force by 3.

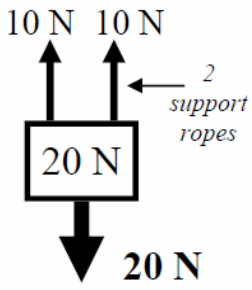


This pulley system has three support ropes, each pulling up with 40 N of force.

Output—Lifting the object. F_{out} is the weight of the object. D_R is the distance the object is lifted.

Pulleys lose energy thru friction (in the wheels) and thru stretching of the ropes.

The weight of the object is shared by the support ropes.



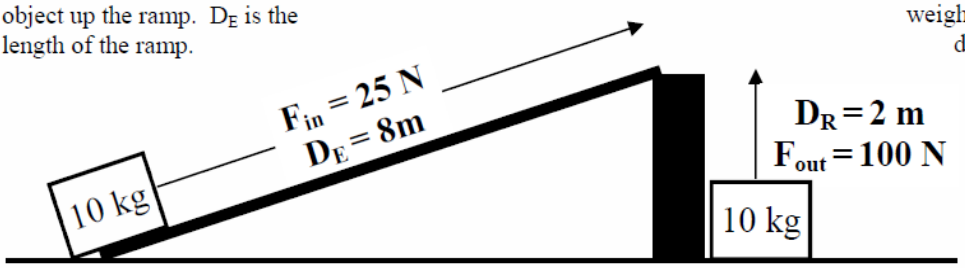
MA = 2. This pulley will double your force.

Incline Planes

You increase the mechanical advantage of an incline plane by increasing its length. This allows you to move the object against gravity more slowly.

Input—Up the ramp. F_{in} is how much force you need to push the object up the ramp. D_E is the length of the ramp.

Output—Moving the object vertically against gravity . F_{out} is the weight of the object. D_R is vertical distance you move the object.



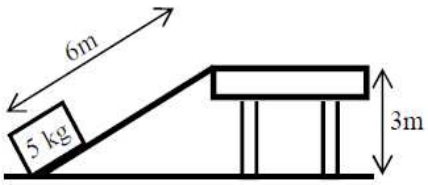
By using 4 times the distance, you only need 1/4th the force to lift the object. This ramp has a MA of 4. It multiplies your force by 4.

Ramps lose energy thru friction. The work seems easier, because you use less force, but you use more energy due to friction.

1. Support rope 2. Friction 3. Fulcrum 4. Bending 5. Pulley	A. How most simple machines lose energy. B. The number of ropes pulling up between the pulleys of the pulley system. C. The "wheels" that allow the rope in a pulley system to move. D. The point a lever pivots on. E. How a lever loses Mechanical Advantage.	How do pulleys lose energy? How do incline planes lose energy? How do levers lose energy?

Input Force (F_{in}) or Output Force (F_{out})?	Distance of Effort (D_E) or Distance of Resistance (D_R)?
_____How much force you push up a ramp. _____How heavy the object is. _____How hard you pull on the rope coming out of the pulley system. _____How much force the lever pushes up on the object. _____The resistance of gravity pulling on the object. _____You pulling down on the lever.	____ How far the pulley lifts the object. ____ How far you apply your force from the fulcrum. ____ How high you lift the object. ____ The length of the incline plane. ____ How far you push down on the lever. ____ The distance from the fulcrum to the object.

Label D_E, D_R, F_{in}, F_{out} and the type of simple machine for each of the following.



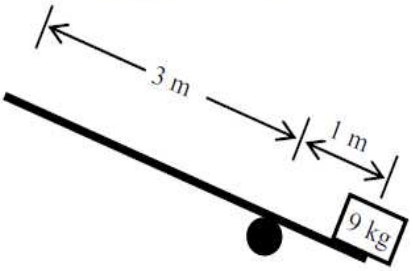
Calculate F_{out}.

Estimate F_{in}.

Which is greater: F_{in} or F_{out}?

Which is greater: D_E or D_R?

Which takes more energy, pulling it up the ramp or lifting it straight up?

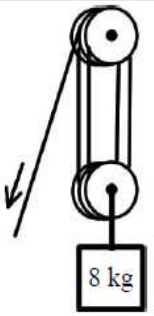


Calculate F_{out}.

Label the fulcrum.

Which is bigger: how far you push down or how far the object lifts up?

Estimate F_{in}.

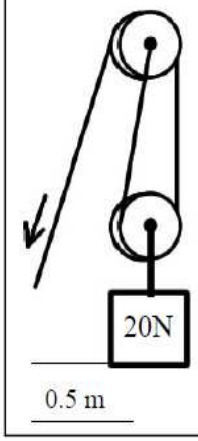


Calculate F_{out}.

How many support ropes?

How much force will you need to lift it?

If the object lifts 2 m, how much rope do you pull out?



How many support ropes?

How much rope do you pull out to lift the object?

What is the MA of this pulley system?

What is F_{in}?

Draw two levers.

Lever 1: hard to lift.

Lever 2: easy to lift.