Name: _____

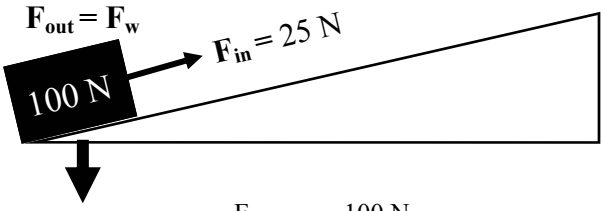
Period: _____

Incline Planes

Using Forces to find MA

F_{out} — the weight of the object (measured vertically) .

F_{in} — force it takes to pull the object up the ramp (measured parallel to the ramp).



$$MA = \frac{F_{out}}{F_{in}} = \frac{100\text{ N}}{25\text{ N}} = 4$$

This incline plane multiplies force by 4 OR it takes 1/4 of the force to pull the object up this incline plane !

Ex. A 400 N box is dragged up an incline plane with 50 N of force. Find the MA of the ramp.

$F_{out} = 400$ N
$F_{in} = 50$ N
MA = ?

$$MA = \frac{F_{out}}{F_{in}} = \frac{400\text{ N}}{50\text{ N}}$$

MA = 8

Ex. An incline plane has an MA of 10. If you have a 200 N object, how much input force do you need?

MA = 10
F_{in} = ?
F_{out} = 200 N

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

then $F_{out} = (MA)(F_{in})$ AND

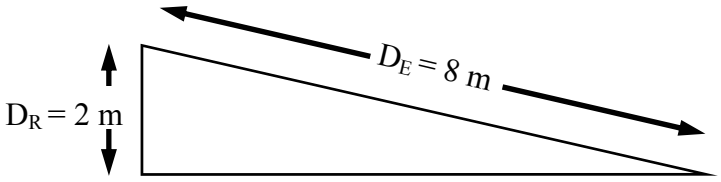
$$F_{in} = \frac{F_{out}}{MA} = \frac{200\text{ N}}{10}$$

$F_{in} = 20$ N

Using Distances to find MA

$D_{Resistance}$ - how far it goes up vertically (how far gravity acts on it).

D_{Effort} - how far you pull the object up the incline plane.



$$MA = \frac{D_E}{D_R} = \frac{8\text{ m}}{2\text{ m}} = 4$$

The longer the ramp, the more MA you get —the easier it is to pull the object up.

Stairs are incline planes you use everyday. Steep stairs are harder to climb — small D_E.

Ex. You need to move a car up 2 m. You use a 10 m ramp. What is the MA of your simple machine?

$D_E = 10$ m
$D_R = 2$ m
MA = ?

$$MA = \frac{D_E}{D_R} = \frac{10\text{ m}}{2\text{ m}}$$

MA = 5

Ex. You have an object that you need to raise 3 m. If you need an MA of 4, find the length of the ramp.

$D_R = 3$ m
MA = 4
D_E = ?

$MA = \frac{D_E}{D_R}$ so $D_R(MA) = D_E$

$D_E = (3\text{ m})(4) = 12$ m long ramp

Combining Equations

In algebra you can combine equations that have a common variable:

$$a = \frac{\Delta S}{\Delta T} \qquad F = ma$$

$$F = (m)\frac{\Delta S}{\Delta T} = \frac{m(\Delta S)}{\Delta T}$$

You then have a NEW formula to work with.

Likewise, we can combine the two formulas for MA.

$$\frac{F_{out}}{F_{in}} = MA = \frac{D_E}{D_R}$$

$$\frac{F_{out}}{F_{in}} = \frac{D_E}{D_R}$$

If you know three of the variables, you can find the fourth.

Ex. You have to move a 2000 N block up 4 meters, but your machine can only pull with 100 N. You decide to use an incline plane. How long would it have to be?

$F_{out} = 2000$ N
$F_{in} = 100$ N
$D_R = 4$ m
D_E = ?

$\frac{F_{out}}{F_{in}} = \frac{D_E}{D_R}$

$$\frac{2000\text{N}}{100\text{N}} = \frac{D_E}{4\text{ m}}$$

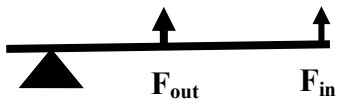
$$20 = \frac{D_E}{4\text{ m}}$$

$D_E = (4\text{m})(20) = 80$ m

A VERY long ramp makes the job easy!

Name: _____

Period: _____



Type of Lever: _____

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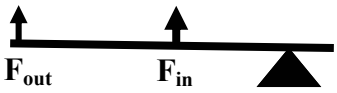

Type of Lever: _____

1. $F_w = mg$	A. Equation for conservation of momentum.
2. $F = ma$	B. Equation for weight.
3. $MA = D_E/D_R$	C. Equation for Mechanical Advantage using distances.
4. $MA = F_{in}/F_{out}$	D. Equation for momentum.
5. $p = mv$	E. Equation for Newton's second law.
6. $m_L v_L = m_R v_R$	F. Equation for Mechanical Advantage using forces.

Give the question for determining which has more inertia:

Give the question for determining which has more momentum:

Input Force (F_{in}) or Output Force (F_{out})?	Distance of Effort (D_E) or Distance of Resistance (D_R)?
____ Pulling a block up a ramp. ____ The weight of the block. ____ You pull a 45 N object up an incline plane. ____ It takes 15 N to pull an object up an incline plane.	_____ How high you have to lift the object. _____ The length of the ramp. _____ You use 7 N to pull an object up an incline plane. _____ You lift a 35 N object up 5 meters.
You pull a 100 N object up a ramp with only 20 N of force. Find MA.	Which of Newton's Three Laws Applies? ___ A jet moves forward by pushing air backwards. ___ To change direction a spacecraft has to use thrusters. ___ When you push harder on a bike's pedals it moves faster.
You use a 36 m incline plane to lift a rock up 6 m. Find MA.	You are pulling an object up 1 m with a 5 m ramp. You pull with 20 N of force. How much does the object weigh?
A ramp has an MA of 5. You are lifting an object up 3 meters. How long is the ramp?	Then, find the mass of the object.
You pull a bock up an incline plane with 7 N of force. If MA is 4, how heavy an object can be lifted?	A young hockey player on frictionless ice shoots a 1 kg hockey puck 150 m/sec toward the goal. If the hockey player slides backward at 3 m/sec what is his mass.