

## Inclined Planes

A landscaper finishes mowing a lawn, and is ready to pack up and go. What would be easier, to pick up the lawn mower and place it in the cab of the truck, or to slide it up a ramp? Like other machines, an inclined plane or ramp makes work easier. This is because the incline helps to support the weight of the object as it is raised and because the work is done over a greater distance when an object is pushed up an incline rather than lifted. As a result, a smaller force can be used. That doesn't mean you get to do less work using an incline. In fact, you may have to do more, because of friction. The equations for calculating the work output ( $W_{out}$ ), the work input ( $W_{in}$ ), the work overcoming friction ( $W_f$ ), the actual mechanical advantage (AMA), the ideal mechanical advantage (IMA), and the efficiency (Eff) of an incline are shown below.



Using the equations at the right, solve the problems below. Show your work. Use the proper units in your answers.

1. A 1,125 N crate is pushed up a 8.0 m incline to a shelf 3.2 m high with a force of 600 N. Find (a)  $W_{out}$ , (b)  $W_{in}$ , (c)  $W_f$ , (d) AMA, (e) IMA, and (f) Eff.

$$W_{out} = F_{out} \times d_{out}$$

$$W_{in} = F_{in} \times D_{in}$$

$$W_f = W_{in} - W_{out}$$

$$AMA = F_{out}/F_{in}$$

$$IMA = d_{in}/d_{out}$$

$$Eff = (W_{out}/W_{in}) \times 100$$

$$Eff = (AMA/IMA) \times 100$$

2. A 3,500 N box is pushed up a 14 m incline to a shelf 2 m high with a force of 1,000 N. Find (a)  $W_{out}$ , (b)  $W_{in}$ , (c)  $W_f$ , (d) AMA, (e) IMA, and (f) Eff.