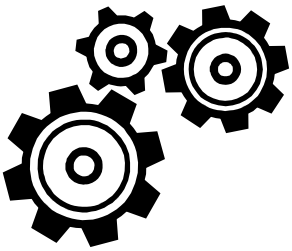
Chapter 10.2 Notes: *Why we use machines*



1. What is ***a machine***?
   - A device that makes work easier

2. How do machines make work easier?
   - By changing the force you exert in size (*multiply*), direction, or both
   - A machine cannot change the amount of work done

3. What is a ***simple machine***?
   - A device that does work with only one movement

4. Six simple machines:
   - Lever
   - Pulley
   - Wheel and axle
   - Incline plane
   - Wedge
   - Screw

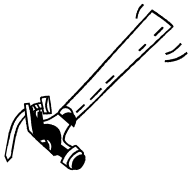
5. ***Work*** is the transfer of energy through motion ($W = F_x \ d$)
   - Depends on
     - magnitude of force exerted
     - distance over which the force is applied

6. ***Ideal Machine*** is…

The ideal or "perfect" machine doesn't exist… ***some energy is lost due to friction, etc.***

$$Work_{IN} = Work_{OUT}$$
$$(F \times d)_{IN} = (F \times d)_{OUT}$$

7. In most cases, a machine multiplies the **input force** or the force applied to it. In order to do this, the input force must travel through a greater distance



$$(F \times \mathbf{d})_{IN} = (\mathbf{F} \times d)_{OUT}$$

8. Can a machine multiply work?
   NO!!! A machine CANNOT create energy or work. It can multiply the FORCE, but only at the expense of DISTANCE!

9. Two forces are involved when a machine is used to do work:
   - The input force or effort force (F_e) *force applied **TO** the machine*
   - The output force or resistance force (F_r) *force applied **BY** the machine*

10. What is ***mechanical advantage*** (MA)?
    - The number of times the machine multiplies the input or effort force (Fe)

$$MA = \frac{\text{output force}}{\text{input force}} = \frac{\text{resistance force}}{\text{effort force}} = \frac{F_r}{F_e}$$

11. ***Ideal Mechanical Advantage*** (IMA)

$$W_i = W_o$$
$$F_e \times d_e = F_r \times d_r$$
$$\frac{d_e}{d_r} = \frac{F_r}{F_e} \qquad IMA = \frac{d_e}{d_r}$$

12. Define **efficiency**:

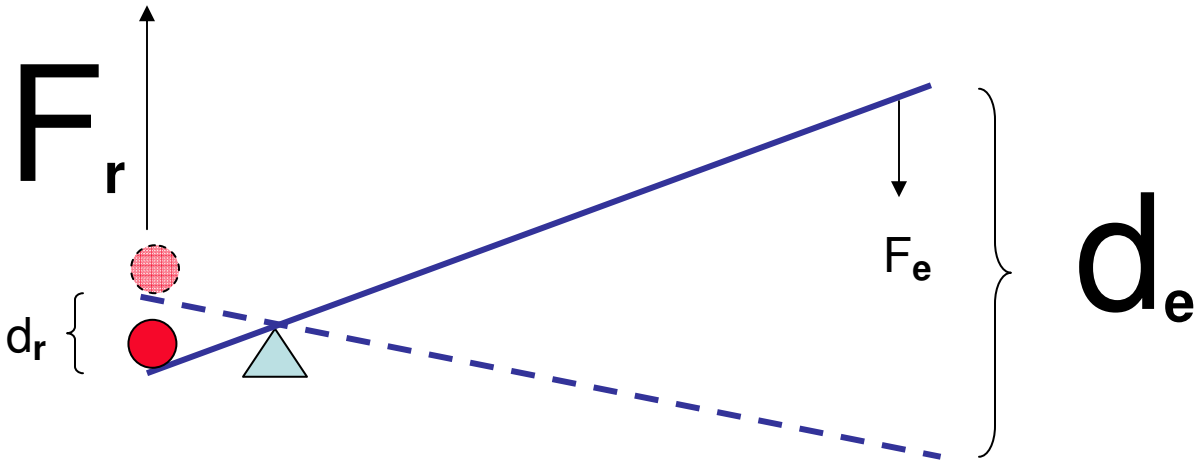
    Efficiency is a measure of how much of the work input is changed to useful work output (expressed as a percentage)

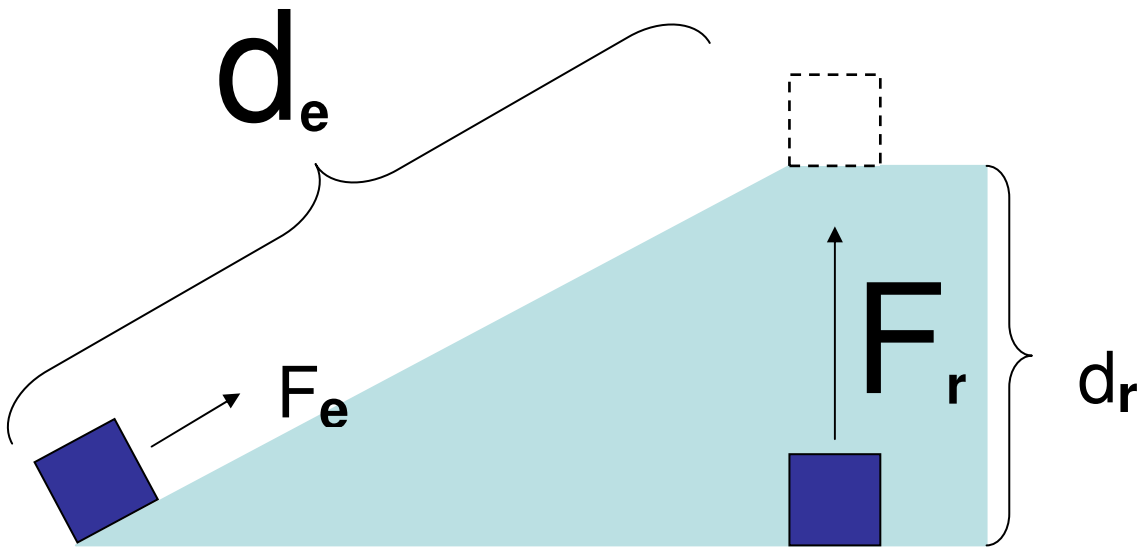
$$\text{efficiency} = \frac{W_o}{W_i} \times 100\% \qquad \text{or} = \frac{F_r \times d_r}{F_e \times d_e} \times 100\%$$

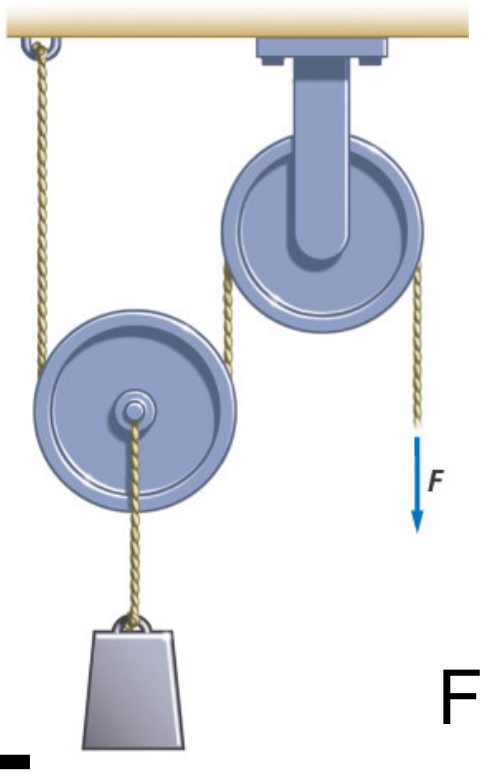
13. Why must the efficiency of a machine always be less than 100%

    Work out is always less than work in because some mechanical energy is converted to thermal energy (friction)

Examples:







F_e d_e

F_r d_r