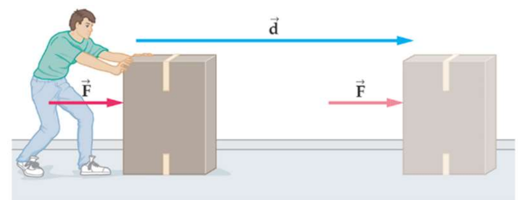
Chapter 13.1 & 13.2 Notes
Work, Power, and Simple Machines

Section: 13.1

Work

- What is work?
    -
- The product of the _____________________________ to an object and the ____________ through which that _____________________________.



- Work is __________ when an ____________ is ______________________
- All or part of the _________must act in the ______________ of the ___________________.
    - When an Olympic weight lifter presses a barbell over his head?
    - When he has to hold it there until the judges say he can put it down?
- Do you do more work when you finish a job quickly?
- Energy is expressed in ________________
    - Energy can be expressed more specifically by using the term ___________

Calculating Work

- Work= ________ x __________
- W = F x d
- Unit for Work: ______

What is the formula when solving for force?

Units of work

Force=
Distance=
Work= ________ x ________ (N·m)
N·m= ______________

What is the formula when solving for distance?

Practice Problem (Work)

1. A crane uses an average force of 5,200 N to lift a girder 25 m. How much work does the crane do on the girder?

2. A bicycle's brakes apply 125 N of frictional force to the wheels as the bike moves 14.0 m. How much work do the brakes do?

3. A mechanic uses a hydraulic life to raise a 1,200 kg car 0.50 m off the ground. How much work does the lift do on the car?

4. A car has run out of gas. Fortunately, there is a gas station nearby. You must exert a force of 715 N on the car in order to move it. By the time you reach the station, you have done 2.72×10^4 J of work. How far have you pushed the car?

Power

- What is Power?
    -
    - How ____________ work is done
- It Running up stairs is harder than walking up stairs
    - Why? ____.
    - Your ____________________ would be greater than if you walked up the stairs.
- If two people mow two lawns of equal size and one does the job in half the time, who did more work?

Calculating Power

- Power is _______ divided by _______
- Power =
- Units for power is ____________

Power =
Work=
Time=

What is the formula when solving for work?

What is the formula when solving for time?

Practice Problem (Power)

1. A student lifts a 12 N textbook 1.5 m of the floor in 1.5 s.

   How much work was done? How much power was used?

2. A 43 N force is exerted through 2.0 m distance for 3.0 s.

   How much work was done? How much power was used?

3. While rowing across the lake during a race, John does 3,960 J of work on the oars in 60.0 s. What is his power output in watts?

4. Anna walks up the stairs on her way to class. She weighs 565 N, and the stairs go up 3.25 vertically.

   a. If Anna climbs the stairs in 12.6 s, what is her power output?

   b. What is her power output if she climbs the stairs in 10.5 s?

Machines

- A device that makes work ___________
- A machine can change the ______, the direction, or the distance over which a _____________.
- They _______________ by using a small force to go a _________________
- Things like _________, levers, etc.

Mechanical Advantage

- Mechanical Advantage:
- How many times a machine multiplies the ______________
- Mechanical advantage ____
- ______________ it multiplies distance, _________________

Forces Involved:

Input Forces	**Output Forces**

Calculating Mechanical Advantage

- Mechanical Advantage = _____________
- Mechanical Advantage = ____________

MA =
Force=
Distance =

Practice Problem (Mechanical Advantage)

1. Find the mechanical advantage of a ramp that is 6.0 m long and 1.5 m tall.

2. Alex pulls on the handle of a claw hammer with a force of 15 N. If the hammer has a mechanical advantage of 5.2, how much force is exerted on the nail in the claw?

3. If an input force of 202 N is applied to the handles of the wheelbarrow with a mechanical advantage of 2.2. How large is the output force that just lifts the load?

4. Suppose you need to remove a nail from a board by using a claw hammer. What is the input distance for a claw hammer if the output distance is 2.0 cm and the mechanical advantage is 5.5?

<u>Section: 13.2 Simple Machines</u>

What is a Simple Machine?

-
- Make ___________________________
- _______ types

<u>Simple Machines</u>

1. Levers
   - A bar that is free to pivot, or move about a fixed point when an input force is applied.
   - ______________ = the pivot point of a lever.
   - <u>3 Classes of Levers</u>

Levers-1st Class

- The fulcrum is in the __________ and the load and effort is on ____________________
- Makes work easier by multiplying the ____________________ AND changing ___________________.
- Ex:

Levers-2nd Class

- The fulcrum is at the _________, with the _________ in the middle
- Makes work easier by multiplying the _____________________ but ________ changing direction.
  - Ex:

Levers-3rd Class

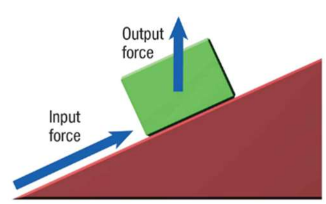
- The fulcrum is again at the _______, but the _________ is in the middle
- Does _______________________ the effort force, only multiplies the ___________________________.
- Ex:

2. Wheel and axles

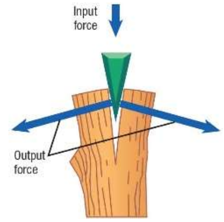
- A lever that ____
- A combination of ______________________________ of different _________
- Smaller wheel is termed ________________
- MA = Radius of _________/Radius of __________

3. Inclined Planes (Ramps)

- An inclined plane is a ____
- Inclined planes make the work of__________________ things easier
- Reduces _______________________

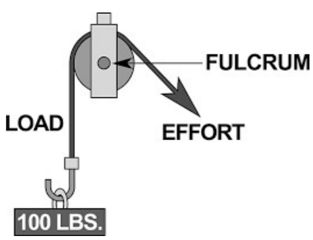
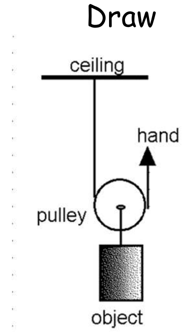


4. **Wedges**
    - ______________________________ joined back to back.
    - Wedges are used to s_________________________.

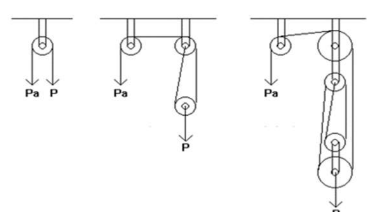


5. **Screws**
    - An ______________________ wrapped around a ______________________.
    - The inclined plane allows the screw to ___________________________________.

6. **Pulleys**
    - Wheels with a ____
    - A pulley needs a _________, chain or belt around the ___________ to make it do work
    - They ______________________________
        - Enables us to use ____________ to help us (it is usually easier to pull down to lift something up)
    - One end of rope has a __________________________
    - Why use pulleys?

Types of Pulleys	
Fixed Pulleys	**Movable Pulleys**
Object __________ Pulley stays in the _____________ Force applied only on ____________ of the rope	Pulley is attached to _________ Pulley and object _____________________ Rope is _____________to something that does not __________ Force applied to other _______________
MA=	MA=
	Draw 

Try this out: What is the mechanical advantage for each of the pulleys in the image?



<u>**Compound Machines**</u>
- Compound machine: a machine that combines ___________________________________
- ______________________ can be put together in different ways to make
_____________________________.