# Efficiency
# pg 37-38



# Right Side – Teacher Input

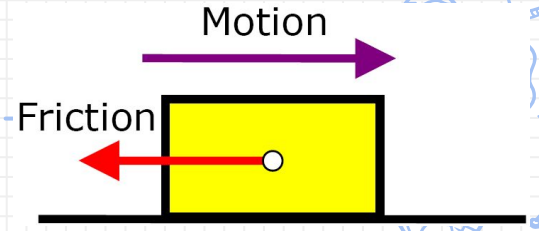
*Remember that all notes must be on the right side and this ENTIRE lesson must be on this page only

# Real vs Actual MA and SR

- Looking back at our pulley example for calculating MA and SR we got an answer of 4 for each. Will they always be the same?
- **Theoretical** values differ from real or **actual** values – this is likely a result of **FRICTION!**
- Do you think the real MA would be greater than or less than the theoretical MA?
- The difference between MA and SR helps us see how well a machines uses energy



# Friction




- **Friction** is a force that opposes motion.
- Friction is caused by the roughness of materials that create uneven surfaces
- Even surfaces that seem and look smooth are not when looked at under a microscope!
- Friction creates heat – this is important to consider when building a machine because heat needs to be released somehow!

# Effects of Friction

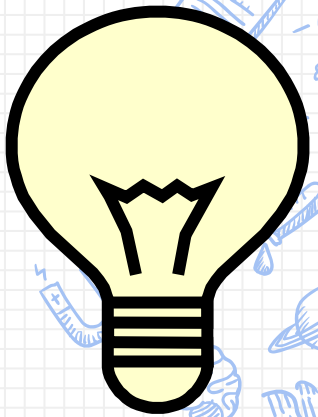
- Since friction opposes motion, machines are required to use extra forces to overcome that friction – therefore your actual MA is less than the theoretical
- SO! MA is affected by friction but SR is NOT. The distance an object is moved is not affected by friction



# Efficiency



- Since friction affects the mechanical advantage of a machine, it also affects the efficiency.
- **Efficiency** is a measurement of how well a machine or device uses energy
- Any machine, loses some energy as it operates. A "loss" of energy is when energy isn't being directly used by the machine to complete the task. We say that no machine is 100% efficient.
- **Efficiency is calculated as a percent



# Efficiency

- The more energy that is lost, the less efficient a machine is.
- Energy can be lost in many ways, but the most common is lost through heat by friction
- We can improve this loss by decreasing friction...how can we do that?



# Calculating Efficiency

- By knowing the mechanical advantage and the speed ratio, you can determine the efficiency. The greater the difference, the less efficient

$$Efficiency = \frac{Mechanical\ Advantage}{Speed\ Ratio} \times 100\%$$



# Friction and Work

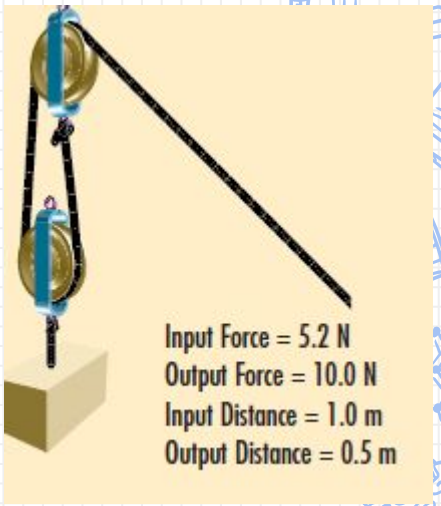
- The reason that work input and work output are not the same is due to friction – similar to the way that friction affects MA and SR
- Because of this, you can also use work input and output to calculate efficiency!

$$Efficiency = \frac{Work_{output}}{Work_{input}} x\ 100\%$$



# Examples

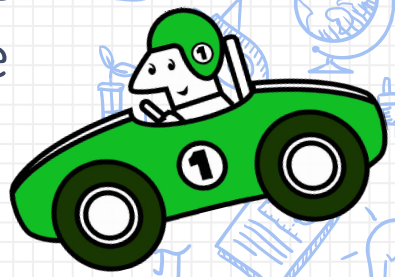
$$Efficiency = \frac{Mechanical\ Advantage}{Speed\ Ratio} \times 100$$



# Complex Machines

- Complex machines have several subsystems that are each affected by friction and other factors – because of this complex machines are often very inefficient!

- For example, a car engine has an efficiency of about 15%...this means that 85% of the energy from the gasoline is not used to move the car. Most is lost as heat, which does not help the car run – in fact it can cause problems if there is too much heat



# Left Side – Student Input

# Left Side Page – Requirements

## Calculating Efficiency

- ✘ Use your MA/SR worksheet to calculate efficiency
- ✘ Show your work for each question in your ISJ – NOT ON THE WORKSHEET
- ✘ Circle your final answer

