

SPH3U 5.4 Efficiency, Energy Sources, and Energy Conservation

## 1. Efficiency


Efficiency:	Ratio of useful energy out to energy in.
equation	$Eff = \frac{E_{out}}{E_{in}} \times 100\%$ No units.

A firefly's body transforms chemical energy in food into radiant energy to glow. What is a firefly's efficiency if its body transforms 4.13 J of chemical energy into 3.63 J of radiant energy?

$$Eff = \frac{E_{out}}{E_{in}} \times 100\%$$

$$= \frac{3.63}{4.13} \times 100\% = \underline{88\%}$$

What is the efficiency of a rope-and-pulley system if a painter uses 1.93 kJ of mechanical energy to pull on the rope and lift a 20.0 kg paint barrel at constant speed to a height of 7.5 m above the ground?



$$E_{out} = E_g = mgh$$

$$= (20)(9.8)(7.5)$$

$$= 1470 \text{ J} = \underline{1.47 \text{ kJ}}$$

$$Eff = \frac{E_{out}}{E_{in}} \times 100\%$$

$$= \frac{1.47}{1.93} \times 100\% = \underline{76.2\%}$$

## 2. Improving the efficiency of energy transformations

Device or Process	Transformation	Waste Energy	Efficiency
gas-powered vehicle	Chem $\rightarrow$ Kinetic.	Thermal	8-15%
electric vehicle	Electrical $\rightarrow$ Kinetic	Thermal	24-45%
bicycle	Kinetic $\rightarrow$ Kinetic	Thermal	90%
speakers	Elec $\rightarrow$ Sound.	Thermal.	1%
electric heater	Elec $\rightarrow$ Thermal	Radiant.	98%

Device or Process	Transformation	Waste Energy	Efficiency
hydroelectric power plant	Kinetic $\rightarrow$ Elec.	Thermal	80%.
nuclear power plant	Nuclear $\rightarrow$ Elec.	Thermal.	30-40%.
solar cell	Radiant $\rightarrow$ Elec.	Thermal.	20-40%.
photosynthesis	Radiant $\rightarrow$ Chemical	Thermal.	5%.
animal muscles (including human)	Chemical $\rightarrow$ Kinetic.	Thermal.	20%.

### 3. Sources of energy

Type	Resources	Pros	Cons
Renewable	Solar Hydro Geothermal Wind Tidal Biofuels.	-renewable (don't run out). -usually better for the environment. -use energy that is otherwise unused.	-not very efficient -expensive to build. -disrupt nature/wildlife.
Non-Renewable	Fossil fuels. (Gasoline, oil).	-have lots of energy. -easy to convert.	-limited. -very bad for environment.
	Nuclear.	-even more energy than fossil fuels -relatively clean (not much waste).	-safety (CANDU reactors are <u>very</u> safe). -radioactive waste.

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