Work and Energy

I. Work
   - dot product
   - varying force

II. Work-Energy Theorem
   - Kinetic Energy

III. Potential Energy
   - Conservative Forces

IV. Machines, Power, Efficiency

	The student will be able to:	HW:
1	Define and apply the concept of work (and the joule) for constant or varying force and solve related problems. ✓	1 – 9
2	Define and apply kinetic energy. State and apply the work-energy theorem and solve related problems. ✓	10 – 15
3	Solve problems using conservation of mechanical energy, including situations involving nonconservative forces. ✓	16 – 23
4	Solve problems involving gravitational potential energy in which g is not taken to be constant. ✓	24 – 26
5	Solve problems involving work and energy for a mass attached to a spring. ✓	27 – 29
6	Define and apply the concepts of conservative force and potential energy and solve related problems. ✓	30 – 32
7	Define and apply the concept of power (and the watt) and solve related problems.	33 – 37
8	Solve problems involving machines and efficiency.	38 – 40

Power

Power is the rate at which work is done (or the rate of energy transfer/transformation):

$$P = \frac{dW}{dt}$$

where: W = work
t = time

Units of measure:

1 watt = 1 joule ÷ 1 second

W = J/s

W = kg m^2/s^3

1 horsepower (hp) ≈ 746 W

Power

The **instantaneous power** of a particular force acting on an object equals the dot product of force and the object's velocity:

$$P = \vec{F} \cdot \vec{v}$$

This result may be derived from the definitions of work and velocity.

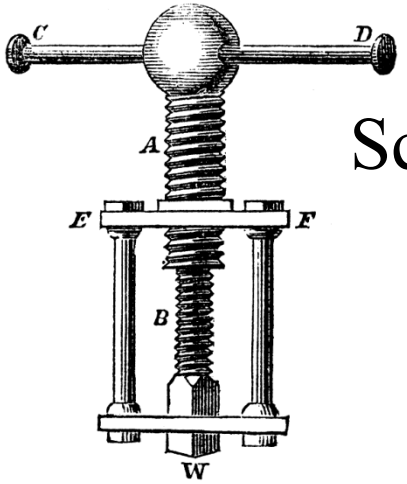
On an electrical device the number of watts typically indicates the power input – rate of energy usage.

Horsepower traditionally is used to quantify mechanical output – rate at which work can be done.

Simple Machines

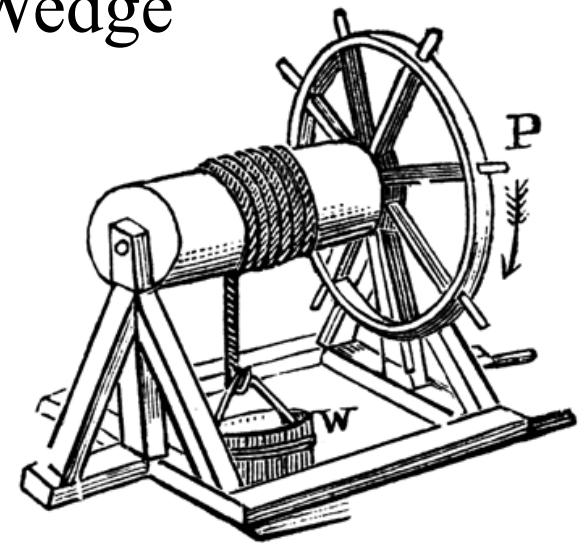
Inclined Plane

Wedge

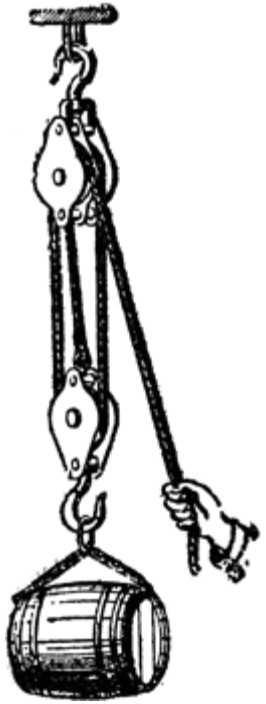


Screw

Lever



Wheel and Axle



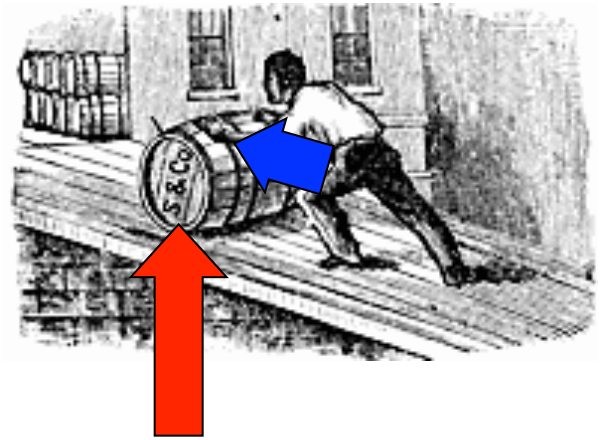
Pulley

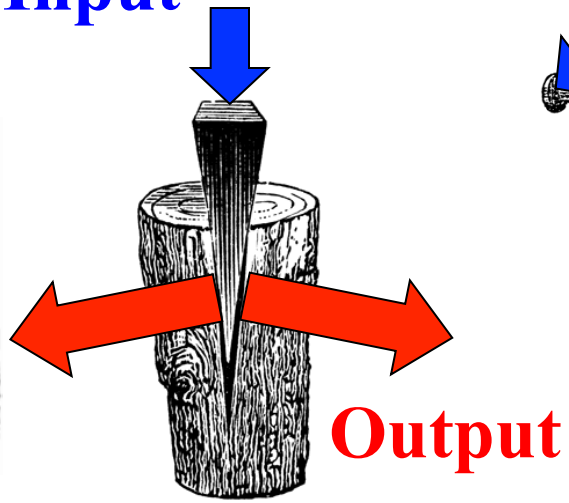
Simple Machines

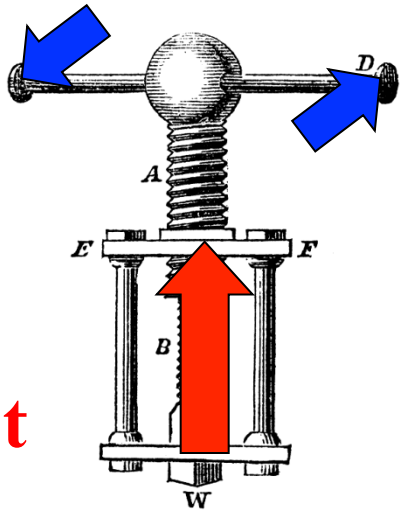
All simple machines are "force multipliers" that can make a task easier to accomplish.

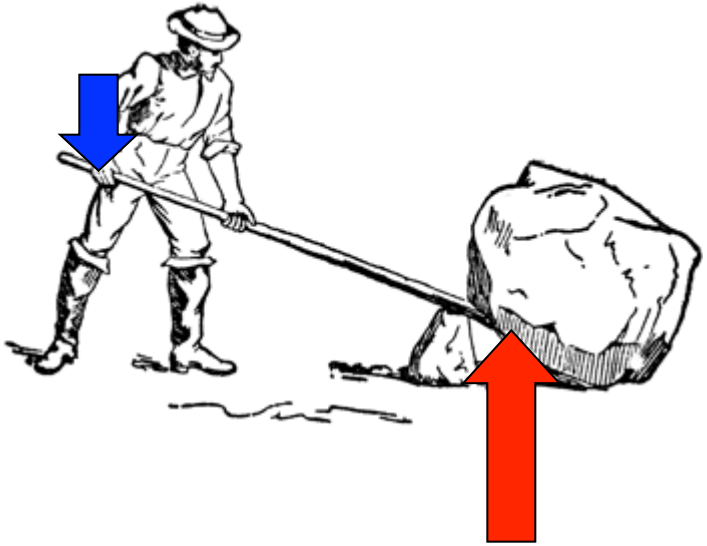
Although a machine may provide an increased force it cannot violate conservation of energy.

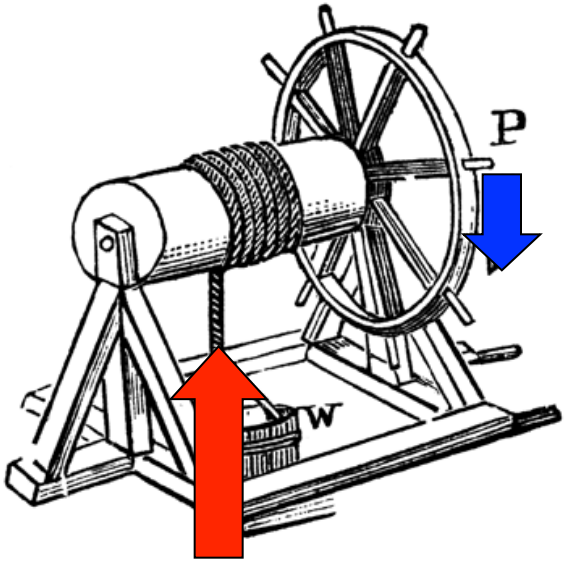
The work (or energy) output of a machine cannot exceed the work (or energy) put into it.

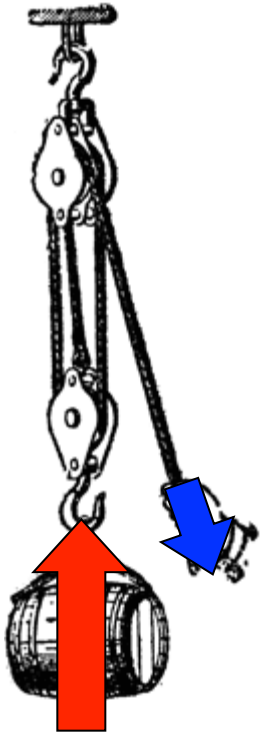




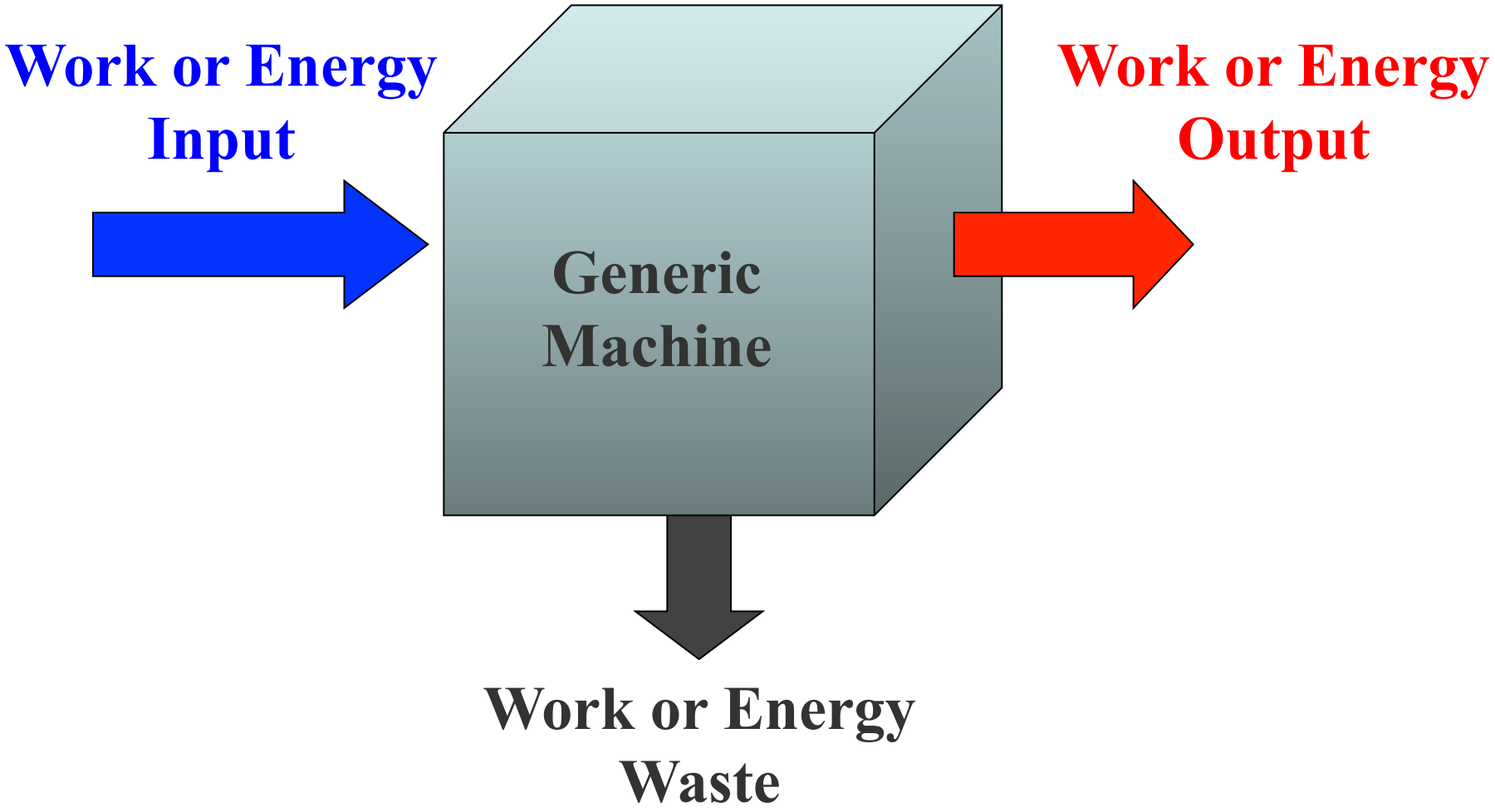








Efficiency



Efficiency

Efficiency is the amount of useful output relative to the input, usually expressed as a percentage.

$$efficiency = \frac{useful\ output}{input}$$