# SPH3U UNIVERSITY PHYSICS

ENERGY & SOCIETY

- Power
  (P.250-254)

## Power

*It takes time to change one form of energy into another. The rate at which energy is transformed depends on certain factors. For example, your muscles transform the chemical energy in food into kinetic energy (motion) and thermal energy much faster if you run up a set of stairs than if you walk slowly up the same set of stairs.*




## Power

*Whether you walk or run up a set of stairs, your body applies the same force against gravity and travels the same vertical distance. In other words, your body does the same amount of work in each case. However, the rate at which the work is done depends on how fast you move.*


## Power

*Physicists use the word **power (P)** to describe the rate at which energy is transformed, or the rate at which work is done. Like work, energy, and time, power is a scalar quantity. The SI unit for power is the watt (W).*




## Power

**POWER(P)**

- rate at which energy is transformed or work is done

$$P = \frac{\Delta E}{\Delta t} \quad \text{or} \quad P = \frac{W_{net}}{\Delta t}$$

where P is the power (W)
ΔE is the work done or the energy transformed (J)
Δt is the time (s)

***NOTE!***

*1 W = 1 J/s = 1 N·m/s = 1 kg·m²/s³*



## Power

**PRACTICE**

1. How much power does a swimmer produce if she transforms 2.4 kJ of chemical energy (in food) into kinetic energy and thermal energy in 12.5 s?

   P = 190 W

## Power

**PRACTICE**

2. A 64 kg student climbs from the ground floor to the second floor of his school in 5.5 s. The second floor is 3.7 m above the ground floor. What is the student's power?

   P = 420 W



## Power

*Like other energy-transforming devices, electrical devices may transform energy quickly or slowly. So the rate at which an electrical device transforms energy is sometimes referred to as the device's power rating.*


***NOTE!***

*Rearranging the power equation yields the equation $\Delta E=Pt$ which can be used to calculate the amount of energy transformed by a device.*




## Power

**PRACTICE**

3. The Pickering Nuclear power plant has a power rating of 3100 MW.
   (a) How much output energy can the generating station produce in one day? Express your answer in MJ.

   (a) $E_{out} = 2.7 \times 10^8$ MJ

## Power

**PRACTICE**

3. The Pickering Nuclear power plant has a power rating of 3100 MW.
   (b) If the power plant is 38% efficient, how much input energy is required?

(b) $E_{in} = 7.0 \times 10^8$ MJ



## Power

**PRACTICE**

3. The Pickering Nuclear power plant has a power rating of 3100 MW.
   (c) How much energy, in MJ, is lost during one day's operation?

(c) $E_{lost} = 4.3 \times 10^8$ MJ (100% - 38% = 62% lost)



## ✔ Check Your Learning

**TEXTBOOK**

P.254 Q.2,4