

Chapter 5

Energy

Energy

- Energy is the ability to do work
 - There are many different forms
 - Kinetic Energy: energy of motion
 - Depends on mass and velocity
 - Potential Energy: energy of an object due to its position or condition
 - Mechanical Energy: energy of lifting, bending, or stretching
 - The sum of all potential energy and kinetic energy
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How to Measure Energy

- All energy is measured in the units called joules (J)
- To calculate work:
 - The transfer of energy as a result of motion

Work = Force x Distance

$$W = F \times d$$

Types of Energy

- Thermal energy: heat energy
 - Temperature: measure of average kinetic energy of the particles in matter

 - Chemical, Electrical, Magnetic, Radiant, and Nuclear energy are other forms discussed in several other chapters in physical science
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How to Measure Heat

- By using the specific heat of a substance you can calculate thermal energy changes
 - Specific Heat: the amount of energy that is needed to increase the temperature of 1 kg of any substance 1° C.
 - Every substance has a different specific heat
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To find the change in thermal energy

□ Use the formula: $Q = (\Delta T) \times (m) \times (C_p)$

Where: $Q =$ change in thermal energy

$\Delta T =$ change in temperature

$$T_{\text{final}} - T_{\text{initial}} \quad \text{or} \quad T_{\text{initial}} - T_{\text{final}}$$

$m =$ mass in kg

$C_p =$ specific heat

Example problem

An iron pipe with a mass of 510g cools from 20° C to 10° C. What is the change in thermal energy?

Your Data: $m = 510 \text{ g } (.51\text{kg})$

$$T_{\text{final}} = 10^{\circ} \text{ C}$$

$$T_{\text{initial}} = 20^{\circ} \text{ C}$$

$$C_p = 450 \text{ J/kg} \times \text{C}$$

$$Q = ?$$

Show your work

$$Q = (\Delta T) \times (m) \times (C_p)$$

$$Q = (20 \text{ C} - 10 \text{ C}) \times (.51\text{kg}) \times 450 \text{ J/kg} \\ \times \text{C}$$

$$Q = 10 \text{ C} \times (.51\text{kg}) \times 450 \text{ J/kg} \times \text{C}$$

$$Q = 2295 \text{ J}$$

Practice problems for Work

1. A student's full back pack weighs 10N. She lifts it from the floor to the shelf 1.5 meters high. How much work is done?
 2. A carpenter lifts a 45 kg beam 1.2 meters. How much work is done?
 3. A dancer lifts a 400N ballerina overhead a distance of 1.4 meters. How much work is done if she is held for several seconds?
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Practice problems for Heat

1. A 3.1g ball of aluminum foil cools from $30\text{ }^{\circ}\text{C}$ to $15\text{ }^{\circ}\text{C}$. What is the change in thermal energy?
 2. A copper block with a mass of 250g is heated from $15\text{ }^{\circ}\text{C}$ to $95\text{ }^{\circ}\text{C}$. How much energy is gained by the block?
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