**Efficiency of Heat Transfer**

Engineers try to make energy conversions as efficient as possible so that the maximum amount of energy is converted into a useful form. The efficiency of an energy transformation refers to the amount of useable energy it produces compared to the original amount of energy. It is usually expressed as a percentage and can be calculated using the formula:

$$efficiency=η=\frac{useful energy output}{total energy input}×100\%$$

1. Maria, a technician, needs to find out the efficiency of a new design of car engine. She runs the engine on an amount of fuel that she knows contains 985 kJ of chemical energy. She measures the useful mechanical energy output of the engine to be only 215 kJ. Calculate the engine’s efficiency.
2. Mohammed measures that his racquet gives a squash ball 45.0 J of kinetic energy when he hits it with a particular shot. He also measures that it only has 18.0 J of kinetic energy after one bounce off the court wall. What percentage of its mechanical energy does the ball lose when it bounces off the wall?
3. A modern power station, or, more correctly, an energy station, converts heat into electrical energy at an efficiency of 50.0%. If the station produces electrical energy at a rate of 1.00 × 103 MW from burning coal, calculate the mass of coal it burns each day. The coal it uses produces 25.0 MJ of heat per kg when it burns completely. Remember that 1.00 W = 1.00 J s-1.
4. Ahmed is a heating consultant. One of his clients has a boiler that is 62% efficient and uses heating oil that releases 4.15 × 107 J kg-1 of heat energy when it burns in air. What mass of heating oil does the boiler need to heat 245 kg of water from 12.0 °C to 68.0 °C?
5. A stainless steel kettle of mass 5.25 kg contains 1.55 kg of water. If the kettle converts 65.0% of the supplied electrical energy to thermal energy in the water and itself, calculate the total amount of electrical energy needed to raise the temperature of the kettle and water from 12.0 °C to 96.0 °C.