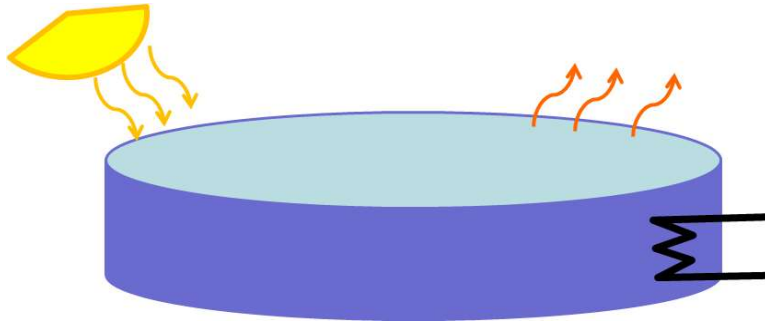


**Given:**

A heater running off 120 V and 5 A with an efficiency of 70% is used to heat a pool. The pool loses heat at a constant rate of 120 W. Over the course of the day, the sun provides 500 kJ of heat over a 6 hour period.

**Required:**

Determine the rate of heating (or cooling) in the pool. What is the net energy gain (or lost) by the pool after the 6 hour sunny period?

**Solution:**

The supplied voltage, and current are defined as

$$V_s := 120 \text{ V} \quad I_s := 5 \text{ A}$$

The heater efficiency is defined as

$$\eta_h := 70 \%$$

The heat loss of the pool is defined as

$$\dot{Q}'_{loss} := 120 \text{ W}$$

The heat provided by the sun is defined as

$$Q_{sun} := 500 \text{ kJ}$$

The time duration is defined as

$$\Delta t := 6 \text{ hr}$$

1st Law in rate form is

$$\frac{d}{dt} E_{sys} = \Sigma \dot{E}'_{in} - \Sigma \dot{E}'_{out}$$

The energy rate coming into the system is by way of the heater and the sun so

$$\Sigma \dot{E}'_{in} := \eta_h \cdot V_s \cdot I_s + \frac{Q_{sun}}{\Delta t} = 443.1 \text{ W}$$

The energy rate leaving the system is by way of the constant heat rate stated in the problem statement so

$$\Sigma \dot{E}'_{out} := \dot{Q}'_{loss} = 120 \text{ W}$$

The rate of heating of the pool may then be found by

$$\dot{E}'_{sys} := \Sigma \dot{E}'_{in} - \Sigma \dot{E}'_{out} = 323.1 \text{ W}$$

The net energy gained by the pool in the time period is then

$$\Delta E_{sys} := \dot{E}'_{sys} \cdot \Delta t = 6.980 \text{ MJ}$$