

## Tutorial 6: Chapter 6

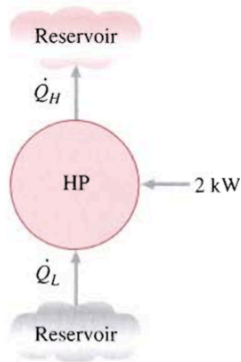
**6-20** A heat engine that pumps water out of an underground mine accepts 500 kJ of heat and produces 200 kJ of work. How much heat does it reject, in kJ?

**6-21** A heat engine with a thermal efficiency of 40 percent rejects 1000 kJ/kg of heat. How much heat does it receive?


*Answer: 1667 kJ/kg*

**6-37C** A refrigerator has a COP of 1.5. That is, the refrigerator removes 1.5 kWh of energy from the refrigerated space for each 1 kWh of electricity it consumes. Is this a violation of the first law of thermodynamics? Explain.

**6-42** The coefficient of performance of a residential heat pump is 1.6. Calculate the heating effect, in kJ/s, this heat pump will produce when it consumes 2 kW of electrical power.



**FIGURE P6-42**

**6-80**  A heat engine operates between a source at 550°C and a sink at 25°C. If heat is supplied to the heat engine at a steady rate of 1200 kJ/min, determine the maximum power output of this heat engine.

**6-85** It is claimed that the efficiency of a completely reversible heat engine can be doubled by doubling the temperature of the energy source. Justify the validity of this claim.

**6-94** Determine the minimum work per unit of heat transfer from the source reservoir that is required to drive a heat pump with thermal energy reservoirs at 460 K and 535 K.

**6-99** A Carnot refrigerator operates in a room in which the temperature is 25°C. The refrigerator consumes 500 W of power when operating and has a COP of 4.5. Determine (a) the rate of heat removal from the refrigerated space and (b) the temperature of the refrigerated space. *Answers: (a) 135 kJ/min, (b) -29.2°C*