___ 1 A heat engine absorbs 250 J of heat from a hot reservoir and rejects 110 J to a cold reservoir. What is the efficiency of this engine?

A) 39.% B) 78.% C) 31.% D) 85.% E) 56.%

___ 2 A heat engine with an output of 300 W has an efficiency of 30% and works at a frequency of 10 cycles/second. How much heat is absorbed (Q_h) and how much rejected (Q_c) in each cycle?

A) $Q_h = 200.\,\text{J}$ $Q_c = 140.\,\text{J}$ B) $Q_h = 143.\,\text{J}$ $Q_c = 9.00\,\text{J}$ C) $Q_h = 1000.\,\text{J}$ $Q_c = 700.\,\text{J}$
D) $Q_h = 100.\,\text{J}$ $Q_c = 70.0\,\text{J}$ E) $Q_h = 129.\,\text{J}$ $Q_c = 90.0\,\text{J}$

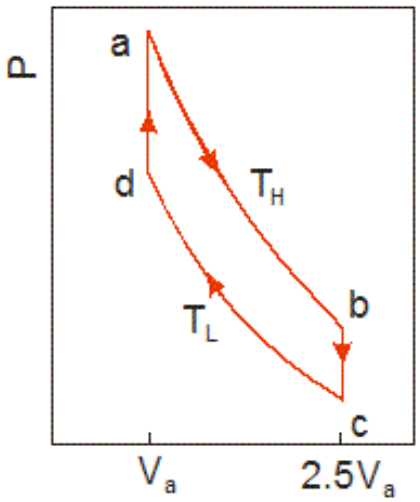

Figure 1: Problem 3

___ 3 Refer to Fig. 1. An ideal heat engine uses 0.300 mol of ideal gas and operates between a hot reservoir at $T_\text{H} = 400\,\text{K}$ and cold reservoir at $T_\text{L} = 300\,\text{K}$, in a cycle from $a \to b \to c \to d \to a$. From $a \to b$ the gas undergoes an isothermal expansion, changing its volume from V_a to $2.5V_a$. From $b \to c$, the pressure is reduced at a constant volume. From $c \to d$, the gas undergoes an isothermal compression, and from $d \to a$, the pressure is increased at a constant volume until the gas is back at the original condition at a. How much heat is absorbed in going from $a \to b$?

A) 1100. J B) 686. J C) 823. J D) 3050. J E) 914. J

___ 4 Two refrigerators, one with a COP of 3.5 and another with a COP of 5.0, both extract 400 kJ of heat from the cold reservoir (food). Calculate the difference in energy they exhaust to the hot reservoir and hence the room.

A) 34. kJ B) 24. kJ C) 38. kJ D) 31. kJ E) 41. kJ

___ 5 A water-cooled electric power plant generates 250 MW of power at an efficiency of 35.0%. At what rate must water be circulated past the condenser if the change in water temperature is not to exceed 10 °C? (The specific heat of water is $4.2 \times 10^3\,\text{J/kg}\,^\circ\text{C}$)

A) 11100. kg/s B) 8840. kg/s C) 2630. kg/s D) 6630. kg/s E) 111000. kg/s

___ 6 What is the maximum possible coefficient of performance of a heat pump that is capable of maintaining the interior of a house at 28 °C when the temperature outside is −40 °C?

A) 0.44 B) 0.41 C) 4.4 D) 0.56 E) 3.4