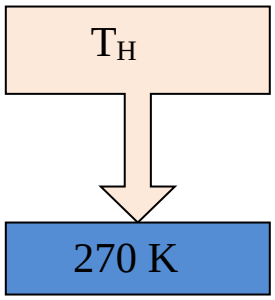
PHYS 2130 - Quiz #3 Name _____



Heat flows from a hot reserviour into a cold reserviour at 270 K. The designer of a new heat engine wants the efficiency to reach 72%.

A) What is the theoretical minimum temperature T_H can have to achieve this efficiency?

The maximum efficiency is attained by the Carnot cycle. Solving for T_H gives.

$$e_c = 1 - \frac{T_c}{T_h}$$

$$\frac{T_c}{T_h} = 1 - e_c$$

$$T_h = \frac{T_c}{1 - e_c} = \frac{270\ K}{1 - 0.72} = 964\ K$$

B) At this efficiency how much heat is drawn from the hot reservoir if 1000 J is deposited in the cold reservoir?

Using the definition of efficiency based on energy flow gives.

$$e = \frac{W}{Q_H} = \frac{Q_H - Q_C}{Q_H} = 1 - \frac{Q_C}{Q_H}$$

$$\frac{Q_C}{Q_H} = 1 - e$$

$$Q_H = \frac{Q_C}{1 - e} = \frac{1000\ J}{1 - 0.72} = 3570\ J$$

C) What is the entropy change for heat flowing out of the hot reservoir?

Using the definition of entropy.

$$\Delta S = \frac{\Delta Q}{T} = \frac{\Delta Q_H}{T_H} = \frac{-3570\ J}{964\ \mathrm{K}} = -3.70\ J/K$$