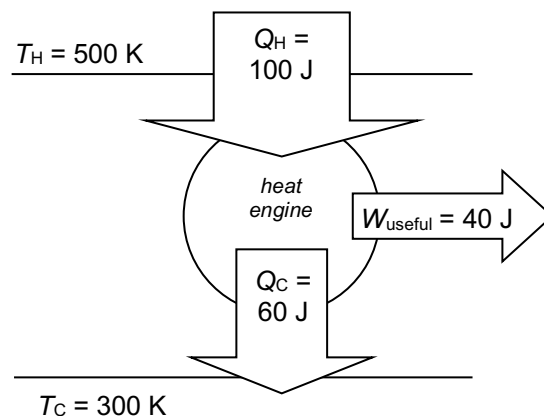
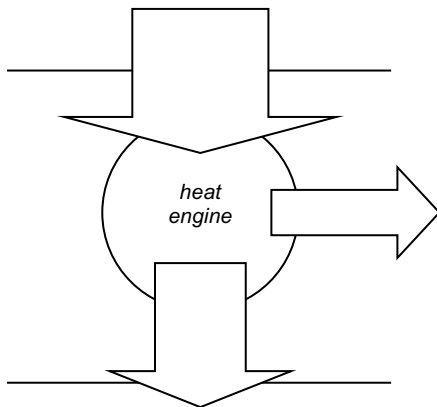


1. Here's an the energy flow chart for a heat engine. Calculate the Carnot efficiency from
 - a) *Only* the useful work done by the engine and the heat absorbed from the hot region
 - b) *Only* the heat absorbed from the hot region and the heat released to the cold region
 - c) *Only* the given temperatures of the two regions (hot and cold)



2. Here's another energy flow chart for a heat engine:



- a) Write the following values in the diagram: $Q_H = 200 \text{ J}$, $W_{\text{useful}} = 50 \text{ J}$, $T_H = 400 \text{ K}$.
- b) Calculate the heat released to the cold region and write your result in the diagram.
- c) Calculate the Carnot efficiency.
- d) Calculate the temperature of the cool region and write your result in the diagram.

3. When is the Carnot efficiency of a heat engine greater? If the difference between T_H and T_C is large or small? Give reasons for your answer.
4. An ideal heat engine operates at $\vartheta_H = 500 \text{ }^\circ\text{C}$ and $\vartheta_C = 20.0 \text{ }^\circ\text{C}$. It absorbs $Q_H = 2.60 \text{ MJ}$.
 - a) Calculate the Carnot efficiency.
 - b) What is the useful work done by the heat engine?
 - c) What is the heat released to the cold region („waste heat“)?
5. A heat engine with a Carnot efficiency of 30.0 % operates at $\vartheta_H = 200 \text{ }^\circ\text{C}$ and produces 1.00 GJ of useful electrical energy per second.
 - a) Calculate the „waste heat“ which is released per second.
 - b) What is the temperature of the cold region?
 - c) How could the Carnot efficiency be increased to 60 %? There are two options.

solutions:

- | | | |
|-----------------------|-----------|---|
| 1. a), b) and c) 40 % | | |
| 2. b) 150 J | c) 25 % | d) 300 K |
| 4. a) 62 % | b) 1.6 MJ | c) 986 kJ |
| 5. a) 2.33 GJ | b) 58 °C | c) $\vartheta_C = -84 \text{ }^\circ\text{C}$ or $\vartheta_H = 555 \text{ }^\circ\text{C}$ |