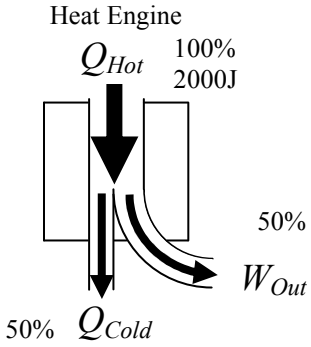
Due Thurs., Mar 8

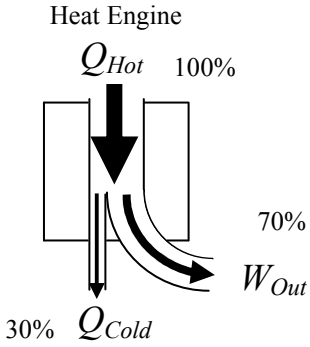
2012 Heat and Thermo 9



Notice that the Q_H arrow is equal to the Q_C and W arrows. So Q_H is the whole and the others are the parts. W is the useful work done by the engine. Q_C is the heat that is not used, so is "wasted" and is the inefficiency of the engine. This engine is 50% efficient.

$$In\ general:\ Eff = \frac{W_{out}}{W_{in}} \times 100$$

$$For\ heat\ engines:\ Eff = \frac{W_{out}}{Q_H} \times 100$$



This engine is more efficient because less heat is lost at Q_C and the useful work is a greater percentage of the absorbed heat (Q_H). This engine is 70% efficient. Only 30% is lost to the environment.

1. A heat engine does 55 J of work each cycle and expels 29 J of heat in the radiator.
   A. How much heat was added at the boiler?

   B. How efficient is the engine?

2. A heat engine absorbs 4500 J per second from its fuel source. It gives up 3000 J to a cold reservoir each second.
   A. How much work is done each second?

   B. Calculate the engine's efficiency?

A. 55+29 = 84J

B. W/Q_H =
= 55/84 = 65%

A. $Q_H = Q_C + W$
$W = Q_H - Q_C$
$W = 4500 - 3000$
$W = 1500$ J

3. Adiabatic, isovolumetric, or isothermal?

   A. _____ In the <u>compressor</u> of a refrigerator.
   B. _____ In the boiler of a heat engine.
   C. _____ In the piston of a heat engine.
   D. _____ * When heat is absorbed by the refrigerant while inside the refrigerator.
   E. _____ When heat is dissipated in the coils at the back of the refrigerator.
   F. _____ Steam is cooled after the piston of a heat engine.
   G. _____ At the expansion valve of a refrigerator.

4. +, −, or 0?

   A. ____ * Q for the refrigerant (the gas) inside the refrigerator compartment.
   B. ____ W *by the gas* at the refrigerator's expansion valve.
   C. ____ Q for the refrigerant when outside the refrigerator compartment.
   D. ____ ΔU for the refrigerant during one entire cycle.
   E. ____ W by the gas in a heat engine's piston.
   F. ____ ΔU for any cyclic process.
   G. ____ Q in the boiler of a heat engine.
   H. ____ W for the refrigerant inside the refrigerator compartment.
   I. ____ Q in the radiator of a steam engine (after the piston).