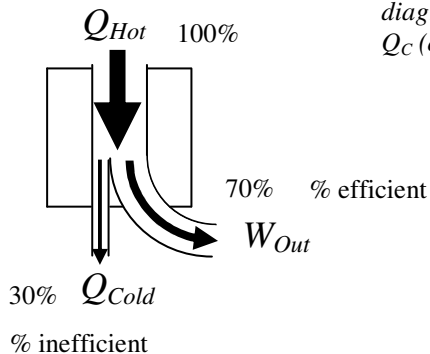


# 2012 Heat and Thermo 10

1. A ball is dropped.
  - A. As it falls its amount of usable energy: increases or decreases?
  - B. Since another definition of entropy is the amount of usable energy, the entropy of the falling ball is: increasing or decreasing?
  - C. After it hits the ground, the balls kinetic energy has increased or decreased?
  - D. Where has this energy gone?
  - E. The total energy of the ball/ground system has:
  - F. The total entropy of the ball/ground system has:

Heat Engine



Again, on the diagram, notice that  $Q_H$  is 100%.  $W_{out}$  is the efficiency. This diagram shows that the efficiency is 70% (which =  $W_{out}$ ). The inefficiency is  $Q_C$  (or 30% for this engine). This allows you to do very simple proportions.

$$\text{for this engine: } \frac{Q_H}{100\%} = \frac{Q_C}{30\%} = \frac{W_{out}}{70\%}$$

$$\text{for any engine: } \frac{Q_H}{100\%} = \frac{Q_C}{\% \text{ inefficient}} = \frac{W_{out}}{\% \text{ efficient}}$$

2. In one complete cycle a heat engine absorbs 450 J of heat from a hot reservoir (a reserve of heat) and expels 200 J of heat to a cold reservoir (a reserve that stays cold). What is the efficiency of the engine?
3. A heat engine is 45% efficient. It absorbs 600J of heat each second from a hot reservoir.
  - A. What percent is 600J?
  - B. What percent is the work done?
  - C. How much work is done each second by the engine?
4. A heat engine loses 2500 J of heat to a cold reservoir. The engine has an efficiency of 65%.
  - A. How inefficient was the heat engine?
  - B. What percentage is  $Q_H$ ?
  - C. How much heat was gained from the hot reservoir?
5. A piston circular cross sectional area with a diameter of 12 cm. The piston rises 8 cm in each stroke. 62 kJ of work is done and 84 kJ of heat is ejected into a river with each power stroke.
  - A. Calculate the pressure in the piston.

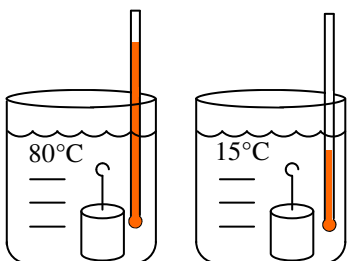
$$\begin{aligned} 2. \quad W &= 450 - 200 \\ &= 250\text{J, so eff} \\ &= 250/450 = \\ &= 55.6\% \end{aligned}$$

$$\begin{aligned} 3A: & 100\% \\ 3B: & 45\% \\ W/45\% &= \\ 600/100\% &= \\ W &= 270 \text{ J} \end{aligned}$$

$$\begin{aligned} 4A: & 35\% \\ (100-65) & \\ 4B: & 100\%, \text{ always} \\ 4C: & \text{set up a pro-} \\ & \text{portion:} \\ & 2500/35\%, \text{ etc} \end{aligned}$$

B. How much heat was added at the boiler?

C. How efficient is the engine?



6. A 400 g copper ( $c_p = 387$ ) mass is in a beaker of water at 80°C. The water is allowed to cool to 15°C. Calculate the amount of heat gained or lost by the copper object.