Wednesday, May 8/13
Science 122

Announcements

**** Need an activity re a course topic before the end of <u>May</u>.**

1. Page 446 - Problems #40-45
2. Carnot's Principle
3. Carnot's Engine
4. Page 446 - Problems #46-51
5. Third Law of Thermodynamics
6. Assessment - Thermodynamics - Tuesday - Test Category
7. Electric Motors - Kits

42.

Engine A	Engine B.
$e_A = 28\%$	$e_B = 2(28) = 56\%$
72% discarded.	% discarded = 44%.

#44.

$$\Delta e = \underset{e_i}{0.42} - \underset{e_o}{0.23} = 0.19.$$

$$\frac{Q_{c\,improved}}{Q_{c\,original}} = \frac{(1-0.42)\cancel{Q_H}}{(1-0.23)\cancel{Q_H}} = 0.75$$

$$\left[e = 1 - \frac{Q_C}{Q_H} \right]$$

$$Q_C = (1-e)\,Q_H$$

#45: overall efficiency.

$\Rightarrow$ Express $e_{overall}$ in terms of e_1 and e_2.

$$e = \frac{W}{Q_H}$$

$$W_1 = e_1 Q_H$$

$$W_2 = e_2 Q_{H_2}$$

$$Q_{H_2} = Q_{C_1}$$

$$W_2 = e_2 Q_{C_1}$$

$$W_2 = e_2 (Q_H - W_1)$$

$Q_H = W_1 + Q_C$

$$e_{overall} = \frac{W_1 + W_2}{Q_H}$$

$$e_{overall} = \frac{e_1 Q_H + e_2 (Q_H - W_1)}{Q_H}$$

$$e_{overall} = \frac{e_1 Q_H + e_2 (Q_H - e_1 Q_H)}{Q_H}$$

$$e_{overall} = e_1 + e_2 - e_2 e_1$$

Carnot's Principle and Carnot's Engine

(Cutnell - Page 428)

Carnot: A heat engine has a maximum efficiency when the processes within the engine are reversible.

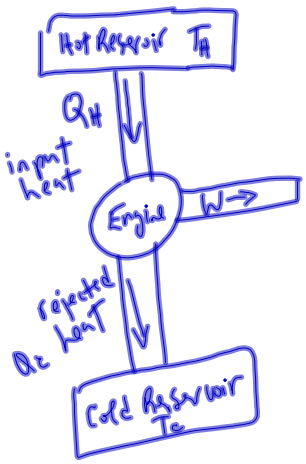
A reversible process is one in which both the system and its environment can be returned to exactly the states they were in before the process occurred.

Carnot's Principle: (Another way of expressing Law #2)

No irreversible engine operating between two reservoirs at constant temperatures can have a greater efficiency than a reversible engine operating between the same two temperatures.

Carnot (Ideal) Engine

- → engine is reversible
- → independent of the engine's working substance
- → depend on the temperatures of the reservoirs



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

$$\boxed{\frac{Q_c}{Q_H} = \frac{T_c}{T_H}}$$

Thermodynamic temperature scale

$$\boxed{e_c = 1 - \frac{T_c}{T_H}}$$

Carnot's efficiency

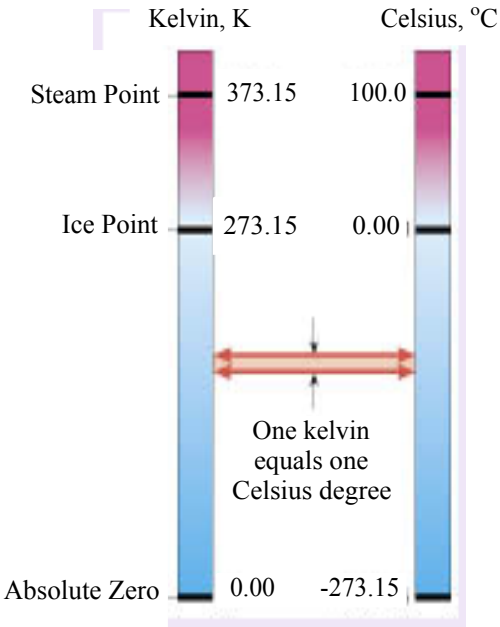
max eff.

⇒ The maximum efficiency is less than 1 (or 100%)

⇒ There will always be rejected heat

Thermal pollution

Kelvin Temperature Scale



Section 12.2 p.339

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#46. 3.00×10^3 J

#47. 0.208

#48. 256 K

#49. a) 1.26×10^3 K

b) 1.74×10^4 J

#50. 1.09×10^3 K

#51. 0.523