Heat Engines Worksheet
Conceptual Physic

Name: Key Date:_____

HEAT ENGINES

$e = \frac{W}{W+Q_c}$

7. A heat engine exhausts 8200 J of heat while performing 3200 J of useful work. What is the efficiency of this engine?

Hint: Use the efficiency of heat engine equation.

$e = \frac{3200}{3200+8200} = 0.28$

8. A heat engine does 9200 J of work per cycle while absorbing 22.0 kcal of heat from a high-temperature reservoir. What is the efficiency of this engine?

Hint: Use the efficiency of heat engine equation.

92,048 J

$e = \frac{W}{Q_h} = \frac{9200}{92,048} = 0.099$

9. What is the maximum efficiency of a heat engine whose operating temperatures are 580°C and 380°C?

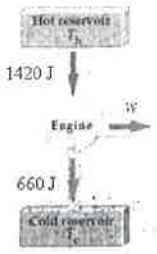
Hint: Change the temperatures to Kelvins.

580+273K = 853 380+273K = 653

$\frac{853-653}{853} = 0.23$

10. A heat engine takes in 1420 J of heat from the hot reservoir and exhausts 660 J of heat to the cold reservoir.

Hint: A heat engine does work as it extracts heat from the hot reservoir and rejects heat to the cold reservoir.



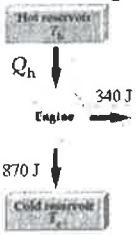
$W = Q_h - Q_c$

$1420 - 660 = 760\,J$

How much work is done by the engine?

11. What is the efficiency of an engine that exhausts 870 J of heat in the process of doing 340 J of work?

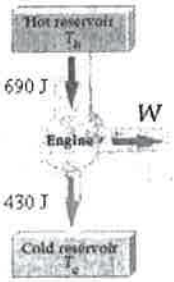
Hint: Same hint as problem 10.



$e = \frac{W}{W+Q_c} = \frac{340}{340+870} = 0.28$

12. An engine receives 690 J of heat from a hot reservoir and gives off 430 J of heat to a cold reservoir. What is the work done?

Hint: Same hint as in problem 10.



$W = 690 - 430 = 260\,J$

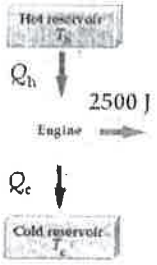
13. Based upon the information from problem 13, what is the efficiency of this engine?

Hint: Use the efficiency equation.

$e = \frac{260}{690} = 0.38$

14. A Carnot engine operates between the temperatures 410 K and 290 K. How much heat must be given to the engine to produce 2500 J of work?

Hint: Solve for the heat input then and then calculate the heat rejected.



$e = \frac{410-290}{410} = 0.293$

$0.293 = \frac{2500}{Q_h}$

$Q_h = 8541.7\ J$

15. Based upon the information in problem 14, how much heat is Discarded to the cold reservoir as this work is done?

Hint: Solve for Q_c

$2500 = 8541.7 - Q_c = 6041.7\ J$

Possible needed equations:

Note: The following are general formulas, are not in any order, and have not been modified to fit each individual problem.

$\Delta U = Q - W \rightarrow Q = \Delta U + W$ $\quad W = P\Delta V$ $\quad e = \frac{W}{Q_H} = \frac{W}{W + Q_L}$ ★ work, hot reservoir, heat change of low temp reservoir

$e = 1 - \frac{T_L}{T_H}$ $\quad W = Q_h - Q_c$ $\quad e = \frac{W}{Q_h} = \frac{W}{W + Q_c}$ $\quad Q_h = \frac{W}{1 - T_c/T_h}$ work

$\Delta S = \frac{Q}{T} = -\frac{mL_{vap}}{T}$ $\quad \Delta S = \frac{Q}{T} = \frac{mc\Delta T}{T}$ $\quad \text{COP} = \frac{Q_h}{W} = \frac{1}{e}$

★ $Q = mc\Delta T$