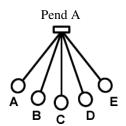# 2009 PreAP Thermo 3

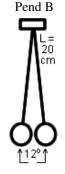**Second Law of Thermodynamics (Entropy):**

- **Clausius statement**: heat can flow spontaneously from a hot object to a cold object; heat will not flow spontaneously from a cold object to a hot object.

- **Clausius statement (formal)**: no device is possible whose sole effect is to transfer heat from one system at a temperature T_L into a second system at a higher temperature T_H.

- **General Statement:** The total entropy of any system plus that of its environment increases as a result of any natural process.

- **General Statement:** Natural processes tend to move toward a state of greater disorder.

- **General Statement:** In any natural process, some energy becomes unavailable to do useful work.

1. Q_H, Q_C, W or ΔU?

    A. _____Heat removed by the coils outside of a refrigerator.
    B. _____When the refrigerant passes thru the expansion valve of a refrigerator.
    C. _____Heat absorbed by the refrigerant inside the refrigerator.
    D. _____Changes inside the compressor of a refrigerator.
    1500 J of energy is added at the boiler of a heat engine. 600 J is lost when the steam is cooled.
    900 J of energy is produced by the engine.
    E. _____1500 J
    F. _____600 J
    G. _____900 J
    H. _____Is 0 for a cyclic process.

2. Adiabatic, isovolumetric, or isothermal?

    A. _____In the compressor 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.

3. +, −, or 0?

    A. _____Q for the refrigerant 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).

4. Write the First Law of Thermodynamics for the compressor stage of a refrigerator.   Be exact as for +'s or −'s.

5. A heat engine does 55 J of work each cycle and expels 29 J of heat in the radiator.
    A. How much heat is gained at the boiler?

    B. How efficient is the engine?

6. A heat engine has an efficiency of 84%. If 3500J of work is done by the engine, how much heat is lost in the cycle?

7. Explain why a heat engine MUST lose heat in the cooling part of the engine. Be specific.

8. What is entropy?

9. Which has more entropy a solid or a gas?

10. A. Which has more entropy a ball falling thru the air, or the ball when it hits the ground.
    B. Explain.

11. Equation for entropy: S = Q/T.
    A. In which case will more entropy be changed: if 250 J of energy is gained by a solid or by a gas?
    B. Explain.

12. Give two ways to decrease the entropy of something.

    Turn to the chapter 12.
13. What is periodic motion?

14. Use the mass-spring example in figure 12-1 to answer the following.   Give position a, b, or c.

    A. _____ v = 0.   E. _____ F of the spring = 0.
    B. _____ Ek is at a maximum.   F. _____ a is a minimum.
    C. _____ x is at a minimum.   G. _____ Equilibrium position.
    D. _____ Maximum potential energy.

15. Where will the mass-spring system come to rest?
16. What is damping?
17. As x increases for a spring, F:
18. Why is there a negative in Hooke's Law?

19. What is the spring constant?   Give units and physical property that exhibits the spring constant.

Pend A

20. Do Q 3 and 4 on p. 441.

21. P. 443—What is a bob?
22. What provides the restoring force for a pendulum, exactly?

23. Is a pendulum simple harmonic motion?
24. Where is the potential energy of a pendulum defined to be zero?
25. How does the total mechanical energy for a pendulum change during its cycle?

26. For pendulum A, if it takes 0.5 seconds from letter A to C, how long is one cycle?
27. For pendulum A, if the cycle starts at point C going right, when does the cycle end?

Pend B

28. What is the amplitude and period of pendulum B?