PHYX-1800 **Homework 10** **Due: 9th April , 2010**

Name:_____ **(Show all your workings)**

1. The transfer of heat from a basement furnace to the house through ducts is by the process of _____ (1 point)

2. Heat is added to an ideal gas and the gas expands doing work. In such a process the temperature:
   A. must always increase. (1 point)
   B. will remain the same if the work done equals the heat added.
   C. will remain the same if work done is less than the heat added.
   D. will remain the same if the work done exceeds the heat added.

3. A physics student has to make a choice in the color of shingles to put on his/her house. Considering only energy conservation in heating and cooling the house, the decision of a light versus a dark color roof will be based on: (1 point)
   A. A dark roof would be better in the winter but worse in the summer.
   B. A light roof would be better in the winter but worse in the summer.
   C. A light roof would be better in both the winter and summer.
   D. A dark roof would be better in both the winter and summer.

4. Benjamin Franklin arbitrarily proposed that after a glass rod was rubbed with a silk cloth then:
   A. the rod will have a positive charge and the cloth negative. (1 point)
   B. both the rod and cloth with have a positive charge.
   C. the rod will have a negative charge and the cloth positive.
   D. both the rod and cloth will have a negative charge.

5. A negatively charged rod is brought close to an uncharged electroscope to induce a charge. While the rod is close one's finger touches the far side of the metal ball on the electroscope. The finger is removed and then the rod is taken away. The electroscope is: (1 point)
   A. Positively charged.
   B. Negatively charged.
   C. Uncharged.

6. A heat engine that would take in 1000 J of heat from a reservoir at 500 K and exhaust 500 J to a reservoir at 300 K would: (2 points)
   A. Not be thermodynamically possible.
   B. Be possible only for a Carnot cycle.
   C. Be thermodynamically possible.

7. Two equal charges are initially 10 cm apart and repel one another with a force of 4.0×10^{-4} N. If they are moved until the separation is 5.0 cm, the repulsive force between them will be:
   A. 4.0×10^{-4} N (2 points)
   B. 2.0×10^{-4} N
   C. 8.0×10^{-4} N
   D. 16.0×10^{-4} N
   E. 1.0×10^{-4} N

Name:_____ **(Show all your workings)**

8. A heat engine having an efficiency of 0.4 takes in 1000 J of energy from the hot reservoir in one cycle. In the same time it will perform how much work? (2 points)

A. 400 J
B. 500 J
C. 600 J
D. 800 J

9. A uniform electric field has a magnitude of 10 N/C and is directed upward. A charge brought into the field experiences a force of 5.0 N downward. The charge must be: (2 points)

A. +50 C
B. -50 C
C. +0.5 C
D. -0.5 C
E. -2.0 C

10. Assuming that a typical car engine operates at an efficiency of 26% and one gallon of gasoline releases approximately 150 x 10^6 J of heat when it is burned, determine: (3 points)

(i) Of the energy available in a gallon of gas, how much energy can be used to do useful work in moving the automobile?

(ii) How much heat per gallon is released to the environment in the exhaust gases and via the radiator?

(iii) Would you expect the efficiency of the engine to be slightly greater on a very hot day or on a cold day? Explain your answer.

11(a) Determine the best possible coefficient of performance that can be achieved for a heat pump maintaining a room temperature of 21°C when the outside temperature is 37°C (4 points)

Name:_____ **(Show all your workings)**

11. (b) Using your new knowledge of the laws of thermodynamics make a sketch of a flow diagram showing the basic operation of a refrigerator. Briefly describe what happens:

Additional (optional) question worth up to 5 points

Make careful sketches of the electric field lines for the following four electrostatic situations. In each case indicate the direction of the field lines.

(i). A unit positive charge:

(ii). A charge dipole:

Question continued over page…

Name:_____ **(Show all your workings)**

(iii) A positively charged rod close to a large hollow conducting sphere:

(iv). A conducting sphere in between the parallel plates of a capacitor: