Here’s what you have to be doing with all this thermo stuff.

# Temperature and Heat

# You should understand the "mechanical equivalent of heat" so you can calculate how much a substance will be heated by the performance of a specified quantity of mechanical work.

This just means that you should be able to convert from calories to Joules and Joules to calories. It also involves the use of the law of conservation of energy. Mechanical work done on a thermodynamic system will increase its thermal energy &tc. 1 cal = 4.186 J

# You should understand the concepts of specific heat, heat of fusion, and heat of vaporization so you can:

# Identify, given a graph relating the quantity of heat added to a substance and its temperature, the melting point and boiling point and determine the heats of fusion and vaporization and the specific heat of each phase.

***This requires you to interpret a standard temperature Vs energy graph. Consult the earlier unit to see how to do that. The basic idea here is to recognize the various sections of the graph and to know what sort of heating events they represent.***

# Determine how much heat must be added to a sample of a substance to raise its temperature from one specified value to another, or to cause it to melt or vaporize.

***This requires you to use specific heat, the heat of fusion, or the heat of vaporization. Very straight forward stuff. It’s basically pie. There are only two equations that you would have to use,  (for phase changes) and  (to increase or decrease the temperature of the system).***

1. You should understand heat transfer and thermal expansion so you can:
2. Determine the final temperature achieved when substances, all at different temperatures, are mixed and allowed to come to thermal equilibrium.

***This is an application of the law of heat exchange – heat lost by one system is equal to the heat gained by the other system. The final temperature is the same for both – the equilibrium temperature. Several lovely problems were given you as part of your homework.***

1. Analyze qualitatively what happens to the size and shape of a body when it is heated.

***“Qualitatively” means that you just have to say if it gets bigger or smaller, but not precisely by what amount this would happen. You basically use the kinetic theory of matter. You could also use the equation for linear expansion, since objects expand in all directions when heated. *** ***Basically a body will expand in all directions when heated. It does this because the particles that make it up move with greater energy, taking up more space.***

B. Kinetic Theory and Thermodynamics

1. Ideal Gases

1. You should understand the kinetic theory model of an ideal gas so you can:
2. State the assumptions of the model.

***Here they are:***

* ***The number of particles in a system is enormous and the separation between the particles is huge.***
* ***All the particles move randomly.***
* ***The particles have perfectly elastic collisions with each other and other atoms.***
* ***There are no forces of attraction between the particles of a gas.***
* ***All the particles are identical.***

1. State the connection between temperature and mean translational kinetic energy, and apply it to determine mean speed of gas molecules as a function of their mass and the temperature of the gas.

***The mean translational kinetic energy of a particle is given by: ***

***The mean speed of a gas molecule is given by: ***

***You were fortunate enough to have a chance to do many of these problems as part of your beloved homework. Previous units showed you how to do them. Also, you will be provided with the equations.***

1. State the relationship among Avogadro's number, Boltzmann’s constant, and the gas constant R, and express the energy of a mole of a monatomic ideal gas as a function of its temperature.

***Boltzmann’s constant only shows up in two of our equations;  and ***

***If you look at the first one, you see:***

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***Get rid of the temperature and the 3:  Solve for ***

***M is the molecular mass which is: ***

***(the mass of a single molecule multiplied by Avogadro’s number)***

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***So Boltzmann’s constant is simply the ideal gas constant divided by Avogadro’s number. Unfortunately, this equation will not be provided to you on the test. You’ll just have to know it or be able to develop it.***

1. Explain qualitatively how the model explains the pressure of a gas in terms of collisions with the container walls, and explain how the model predicts that, for fixed volume, pressure must be proportional to temperature.

***This is pie. The Physics Kahuna has explained it all in the thermo handout.***

1. You should know how to apply the ideal gas law; and thermodynamics principles so you can:
2. Relate the pressure and volume of a gas during an isothermal expansion or compression.

***This is pretty simple. This is simply the old Boyle’s law from chemistry, you know,  except you aren’t given that equation. You have to derive it from the ideal gas law . If the system change is isothermal, then the  bit is a constant. This means that PV equals a constant, therefore, no matter what happens to the pressure or the volume, PV is still the same value. This means that .***

***It’s really pretty simple. Using the equation is super easy – more pie.***

1. Relate the pressure and temperature of a gas during constant-volume heating or cooling, or the volume and temperature during constant- pressure heating or cooling.

***This is another application of the ideal gas law.***

***If the volume is constant and the pressure and temperature change, we can do this with the ideal gas law:***

*** This means that  is equal to a constant and  is a constant. So .***

***Similarly, if the pressure stays constant, one can develop this equation just like we did before.***

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1. Calculate the work performed on or by a gas during an expansion or compression at constant pressure.

***The work done by an expansion or compression is given by the equation:***

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***Luckily this equation is one of the given ones. (Whew.)***

1. Understand the process of adiabatic expansion or compression of a gas.

***In an adiabatic processes no heat enters or leaves the system. It is the Physics Kahuna’s belief that he did a darn good job of explaining the thing in the handout. Please consult it. The main idea is that .***

1. Identify or sketch on a PV diagram the curves that represent each of the above processes.

***This is fairly simple stuff. Consult the handout on how to do this.***

2. Laws of Thermodynamics

1. You should know how to apply the first law of thermodynamics so you can:
2. Relate the heat absorbed by a gas, the work performed by the gas, and the internal energy change of the gas for any of the processes above.

***The heat absorbed by a gas can be determined by using the following equation: ***. ***The work performed by a gas is given by the *** ***equation, or else you can find it as the area under a P vs V curve. The inernal energy change of the gas is given by the first law of thermodynamics; ***.

1. Relate the work performed by a gas in a cyclic process to the area enclosed by a curve on a PV diagram.

***This is a favorite of the test writers. The basic idea is that the area under the curve represents the work for a single step in the cycle. The net work is the area enclosed by the entire curve. You got the chance to do several of these types of problems in the homework.*** ***This is an application of the first law and the idea that the work done is equal to PΔV and/or the area under the curve of a P vs V graph.***

b. You should understand the second law of thermodynamics, the concept of entropy, and heat engines and the Carnot cycle so you can:

1. Determine whether entropy will increase, decrease, or remain the same during a particular situation.

***The second law says that it is impossible to build a heat engine that can produce work equivalent to the input heat. It also says that heat will always flow from a hot system to a cold system and never the other way ‘round. It tells us that some of the heat put into a system must be returned back to the environment as heat – this implies that the efficiency of a system can never be 100%; it must always be less.***

***Entropy is a formalized measure of disorder. As disorder increases, entropy increases. The second law says that entropy tends to increase in all natural processes.***

1. Compute the maximum possible efficiency of a heat engine operating between two given temperatures.

***To find the maximum possible efficiency we use the ideal efficiency equation. Remember to convert the temperatures to Kelvins.***

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1. Compute the actual efficiency of a heat engine.

***To find this, use the general efficiency equation for a heat engine.***



1. Relate the heats exchanged at each thermal reservoir in a Carnot cycle to the temperatures of the reservoirs.

***Well, what the heck does this mean? Let’s try this. The greater the difference in temperature between the two reservoirs, the greater will be the amount of heat that is exchanged. So if more heat is exchanged, then the engine will be more efficient. The greater the temperature of the high temperature reservoirr, the greater will be the amount of heat that is transferred. Similarly, the lower the low temperature heat reservoir, the greater will be the amount of heat exchanged.***

Once again there’s a lot of stuff here.

There are all sorts of thermo questions that can be asked. A common thing on the test is to include a thermo question with some other topic. You might use electricity to heat up a resistor that is in water and the test will ask you for the temperature change of the water. Also possible is a mechanical energy to thermal energy type thing.