HEAT AND THERMODYNAMICS NOTES, continued…..

CHAPTER 10, 11

ΔQ = ΔU + ΔW (=Press*ΔVol)

HEAT ADDED = INTERNAL ENERGY CHANGE + WORK CHANGE

Fast Process, no time for heat transfer (ΔQ=0)

ADIABATIC:

Compress, temp goes up

Expand, temp goes down

(open soda bottle, inflate tire quickly)

ISOTHERMAL: happens slow ΔU = 0

Heat added makes object expand without raising temp.

(tire expands slowly by heat)

ISOVOLUMETRIC: (strong container ΔW and thus ΔV=0)

Add heat, temp goes up… pressure goes up too, but not volume. (Pressure cooker)

2nd Law….. No machine can transfer all energy from heat to do work. Heat flows from high to low temp, so some heat is lost to surroundings. (entropy, order to disorder)

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4) A steam boiler completely converts 155 kg of water to steam. The process involves the transfer of 350,000,000 Joules of heat. ($\Delta Q=mHv=155kg*2,260,000J/kg$). If the steam pressure is 1.76 million Pascals and the volume change is 100 cubic meters so the work done by the expanding steam is $\Delta W=P\Delta V= 1.76*10^6$ Pa* $100m^3 = 1.76*10^8$ Joules), what is the net change in the internal energy of the water-steam system?

$\Delta Q=mHv=155kg*2,260,000J/kg=350,000,000$ Joules

$\Delta W=P\Delta V= 1.76*10^6$ Pa* $100m^3 = 1.76*10^8$ Joules

$\Delta U = \Delta Q- \Delta W = 3.5 * 10^8 - 1.76 * 10^8 = 1.74 * 10^8$ Joules

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1) Why does an automobile engine require a cooling system?

It needs to give heat to surroundings in order to do work. Heat flows from hot to cold, thus it needs to be cold in order to lose heat, otherwise it would just get hotter and no work could be done.

2) Why are power plants located near rivers?

Need to lose heat, the cold river acts as a heat sink

* A water balloon is dropped. When it hits the ground all of the energy is converted to heat. The water heats up, changes to steam, and the steam heats up and causes the balloon to expand, doing work.

Write the equation showing how heat is transformed into the three types of internal energy change and work.

$GPE = mgh = \Delta Q$

$\Delta Q = \Delta U + \Delta W (=Press*\Delta Vol)$

HEAT ADDED = INTERNAL ENERGY CHANGE + WORK CHANGE

ΔU = heat water to 100, phase change, heat steam from 100

$\Delta U = mC_{water} \Delta T + m\ Hv + mC_{gas} \Delta T$

$mgh = mC_{water} \Delta T + m\ Hv + mC_{gas} \Delta T + P \Delta V$

$m\ (9.8)\ h = m\ (4187)(100-Ti) + m(2,260,000) + m(2020)\ (Tf-100) + P \Delta V$