Review Ideas for the Final Exam

KNOW: What is Hubbert's peak? How is coal mined? How does it form? How old is much of the coal that we use? What is exponential growth? How does it relate to population growth? Nuclear fission? Why must we be careful interpreting resource lifetime calculations (what assumptions go into such calculations?)? What is meant by EROEI (EROI)? Is best for EROEI to be high or low? Why? Which resources have pretty low EROEI values? How is offshore drilling different from onshore drilling? Contrast near-shore to deep-water drilling. What is the ANWR? Why do many US citizens care about it? What are tar sands? Why are the Athabasca tar sands now a viable oil resource? What is OPEC? How do OPEC exports relate to US imports, historically? What are peat, lignite, bituminous, and anthracite?

KNOW: Batteries provide electrical energy. what are the CAFÉ standards intended to do? Can be used in electric vehicles (EV) and hybrids. What's a hybrid? Electromagnetic induction is important: it lies behind <u>most</u> electricity production! [BUT not all of it – photovoltaic conversion does not!] How does it work? What is it? What are the more efficient types of light bulbs? What do "LED" and "CFL" stand for?

KNOW: The difference between radioactivity, fission, and fusion. Are all isotopes radioactive (what's an isotope?)? What are the radioactive decay products? (neutrons, gamma rays and …) What are daughters, α-particles, β-particles, and γ-rays? Half-life and how to solve simple problems using it? Why is radon a concern? Know parts of the nuclear atomic model. The four fundamental forces in nature (from weakest to strongest)? Which play a role in the atom? Which are harnessed in fusion? Fission? How to balance nuclear equations (remember: charge and nucleon number are conserved!). What are the primary fission fuels? Which is of most concern (RE: nuclear proliferation)? Natural uranium is what % ^{235}U? (0.7%) How enriched does it need to be for fission ? Weapons? What are advantages/disadvantages to fission as a power source? How to BWRs and PWRs work (remember, in part, they are just like coal-fired power plants)? What do control rods do? Why are slow neutrons important? What is shielding for? Currently, where is most radioactive waste from US nuclear power plants stored? What is the nuclear fuel cycle? What is the main fuel for fusion? What are the drawbacks of fusion? What powers the Sun? $E = mc^2$ relates to all of this somehow – how?! Health effects of nuclear radiation? What happened at Fukushima? At Chernobyl?

KNOW: What is light? How do we model it? Like electric charges do what? Unlike magnetic poles do what? What is electric current? What are electric and magnetic fields? What is meant by the electromagnetic spectrum? Electromagnetic radiation? Is all radiation bad? Most solar radiation is in what part of the spectrum? What is meant by the solar constant? Insolation? Only about 1/2 the solar radiation that hits the upper atmosphere reaches the Earth (why?). What is the greenhouse effect? Why is it important for life to exist? Why is it a threat to life? What does burning fossil fuels have to do with it? Most of the UV radiation is blocked by what? What did the Montreal protocol accomplish? How does energy from the Sun vary with the seasons? What causes the seasons? Why are the equinoxes and solstices relevant (particularly for solar energy collection)? Do aphelion and perihelion have anything to do with the seasons? What basic physical principles lie behind solar home and solar cooker design? How does one maximize the insolation on a solar collector? Most U.S. solar power is for domestic hot water . How can solar energy be harnessed on a large scale? What are photovoltaics (PVs)? Where have you seen their use? What's a typical PV efficiency? Is amorphous or single crystal more efficient? More expensive? How do PVs work, in a nutshell? How does concentrating solar power work? What the difference between active and passive solar energy collection systems?

KNOW: For each of the following, the basic energy conversion principle (how we actually harness the energy), how it relates to the hydrologic cycle (what's that?!), disadvantages and advantages for their use: hydropower, windpower, & biomass. Which of these renewables use the heat engine concept? How does a wind turbine work? Which is growing the most rapidly? Which use electromagnetic induction (*i.e.*, electric generators)? Why is biomass produced ethanol NOT a net source of CO_2 when used as a fuel (in principle)? What are advantages and disadvantages of ethanol as a fuel? Which is a better source of ethanol: sugar cane or corn? Why? What role does photosynthesis play in the production of biomass fuels? What about in the production of fossil fuels?

KNOW: The two different meanings of the phrase ENERGY CONSERVATION!

Look at the *Review Ideas for the Midterm Exam* sheet (it's also on the website)
Study the **Midterm Exam**
Know <u>all</u> of the **Key Terms** from the lists I gave you! Look at <u>all</u> the old **quizzes**.
Study the **homework** assignments!

<u>Numbers you should know:</u>
$g = 9.8\ m/s^2$, Per capita energy consumption in the US (know how to <u>calculate</u> it!), US (324 million) & world populations (7.3 billion), Average annual US total energy use (about 100 QBtu, ~ 24 % of total world energy use).

I will give you all the formulas that you need. No need to memorize them!

<u>IMPORTANT</u>: <u>Bring a calculator</u> (not a cell phone!) – you will not be allowed to swap them during the exam!