

Review Ideas for the Midterm Exam

KNOW: Units of energy, power, *etc.* Scientific notation. Quads (= quadrillion Btu). Which units are MKS (SI) and which are English system? What other units have we discussed and to what physical quantities do they correspond (for example, the N = Newton is the unit of force, just like the pound)? What is inertia? How is inertia measured? How do we convert units from one system to another? Make sure you can perform dimensional analysis calculations – we’ve done a number of these! Know how to interpret the EIA energy flow diagram (I gave you a handout of this in class; also available on the EIA website and in our PowerPoint slides). Know how to read consumption and production data from the flow diagram. What makes a hypothesis a scientific one? What’s the scientific method? Know scientific notation.

KNOW: Types of energy; energy flow diagrams. Renewable energy vs. nonrenewable resources. Types of fossil fuels, relative amounts we use. What exactly IS crude oil? Natural gas (wet vs. dry)? What are proved reserves? What role does ANWR play in our reserves? What is most natural gas used for? Coal? How are the various fossil fuels formed? Know the basics of how we extract crude oil and natural gas from the ground. Remember that the resource is IN THE ROCK! What are the main porous and permeable reservoir rocks? What role does shale play as a reservoir rock? What is tight oil? What are primary, secondary, and tertiary recovery? What is fracking? How does petroleum recovery work? How much is typically left in the ground after various recovery methods? What is oil refining? Which countries are richest in oil, natural gas, and coal? How much oil do we import? What are several reasons we should be concerned about our use of fossil fuels? What are current environmental concerns regarding fossil fuel use? What are the two different meanings of “energy conservation?” What country uses the most energy? What is meant by energy content (measured in J/g)? Know how to calculate resource lifetimes when given the reserve amount and consumption/production rate

KNOW: What is heat? The 2nd law of thermodynamics – know several statements of it. How to do calculations for temperature changes for water ($Q = m c \Delta T$). What is a heat engine? What are the three types of heat transfer? Know examples of each. What is meant by efficiency (of heat engines, in particular)? What about the Carnot (maximum) efficiency? [Remember that the Carnot efficiency is essentially a restatement of the 2nd Law!] How are efficiencies calculated for several processes chained together one after another? What role does electromagnetic induction play in electricity generation? How about waste heat? Practical heat engines include steam engines (external combustion), gasoline & diesel (internal combustion). What is a steam turbine? Energy conservation for a heat engine: $Q_{in} = W_{out} + Q_{out}$. Know the details of how a coal fired power plant works (what is the working fluid?!). How do we determine the heat content of foods/fuels? What is a heat exchanger? What are the main greenhouse gasses? What fossil fuel emits the most CO₂? What is the greenhouse effect? How is it related to anthropomorphic climate change? What evidence do we have that global climate is changing? What’s meant by TANSTAAFL & NIMBY? How do they relate to energy consumption/production?

KNOW: What work and energy are. What are the various forms of energy we discussed? The first law of thermodynamics. How to use the Law (Principle) of Conservation of Energy to work problems involving kinetic energy and gravitational potential energy. Energy conversion. How to use energy equivalency relations. What is a pendulum? What is meant by power? What are the units of power? Know the difference between weight and mass. What are the four fundamental interactions in nature? Know a simple model of an atom and what an atom is made of.

Numbers you should know:

$$g = 9.8 \text{ m/s}^2$$

Per capita energy consumption in the US ~ 54 bbl

(note this can be easily calculated using two of the numbers below! Know how to do it!)

US (~320 million) & world (~7.3 billion) populations

Average annual US total energy use (about 100 QBtu, ~22 % of total world energy use)

Know all of the Key Terms from the lists I gave you! Look at all the old quizzes. Study the homework assignments! I will give you all the formulas and conversion factors that you need. No need to memorize them! **IMPORTANT:** Bring a calculator – you will not be allowed to swap them during the exam or use cell phones!