

EVSS 650 Energy Production & Resource Management
Mid-Term Exam
due by 4 PM on Monday, 11 March 2013

You may use your class notes, the textbook, your returned homework, the handouts distributed in class, the course web site (but not links to other sites except for problem #1), and a calculator. You may not use other materials. You may not discuss any part of the exam with anyone except the instructor.

I am a zero-based grader. Getting the right answer is not enough: show ALL of your work, make it clear how you get from one step to the next, and clearly identify your final answer. Explicitly show all unit conversions (and provide a citation if it's a strange one). For the/essay questions, use your own words. Be concise but complete.

1. Use and provide references to authoritative sources for this problem.
(a) What is the current world population (give or take a few hundred million)?
(b) What is the current world population annual percent growth rate? (c) What was it in 1900, 1950, and 2000? (d) What is it predicted to be in 2050? (e) What was its maximum value in the past 100 years? (f) At the current growth rate, what age will you be when you can safely claim that half of the world's population is younger than you are?
2. A double meat, double cheese WhopperTM contains (according to a reliable source) roughly 1000 (food) Calories. (a) How many Btu, kWh, and Joules is that equivalent to? (b) If your car requires 40 horsepower to travel at 60 mph (=88 ft/s) how far would your car travel on the energy equivalent of one WhopperTM
3. (a) How much coal must be burned (assuming **maximum thermodynamic efficiency** with a high temperature of 1200° F and an exhaust temperature of 120° F) to power ten 15-watt compact fluorescent light bulbs for 12 hours? Assume that 20% of the power is lost between the power plant and your house. (b) Ten 75-watt incandescent light bulbs produce the same amount of light. How much coal would have to be burned in the same power plant to light those for 12 hours? (c) How much total current (in Amps) is required to light the ten compact fluorescent bulbs simultaneously when wired in parallel and operating at 120 Volts? (d) How much total current would be required in the same circuit to light the incandescent bulbs?

(over)

Answer 2 of the following 3 somewhat open-ended essay questions. Limit your response to 2 pages handwritten (or 1 typed page) each.

4. Describe and advocate a course of action that could lead to a *stable population* (population neither increasing nor decreasing) with a total world population of 10 billion or less. Be as complete and realistic as possible.
5. (a) Describe why a "crisis" in the production rate or cost of oil or coal should be expected much sooner than the time when those resources actually run out. (b) Describe a few key indicators of this crisis. In other words, what will happen, and how will we know it's a crisis (or is crisis even the right word)?
6. Describe what is meant by the terms "mechanical kinetic energy", "mechanical potential energy", and "thermal energy". List all the forms of internal kinetic and potential energy you can think of. What do we mean by "temperature", and what does it measure?