

HONR238W Homework # 2 – Due Monday, April 8, 2013

Homeworks will be posted on the web at <http://www.astro.umd.edu/~hamilton/HONR238W/>. You are welcome to work together on the problems, but try them on your own first for practice, and write them up in your own words. I will have homeworks graded and back to you within a week.

1. Choose the make and model and year of a car and find out its price when new. Next find out its rated fuel economy in miles per gallon (mpg). Compare the cost of the vehicle to the estimated cost of the fuel that it will use over its lifetime (assume a 150,000 mile lifetime and gas at \$3 a gallon). Repeat for a second vehicle. Use your own car, a 70's station wagon, a Hummer, a limo, a motorcycle, a hybrid, or anything else that you'd like.

2. In June 2004, Burt Rutan's SpaceShipOne won the \$10 million X Prize for reaching 100km altitude twice in a two week period. It did so by flying straight up. How much energy did this 3600kg spacecraft require to reach an altitude of 100km? To go into orbit around the Earth like the Space Shuttle does, requires reaching a speed of 7.8km/s at a similar altitude. How many times more energy would it take to put SpaceShipOne into orbit?

3. a) A large wind turbine costs about \$1.5 million dollars per MW of electricity generating capacity. If the wind blows such that, on average, your 1MW wind turbine generates electricity with 20% efficiency what is the value of the electricity generated per year assuming that 1kWh of electricity costs \$0.10?

b) After how many years will a 1MW wind turbine pay for itself (ignore maintenance issues).

c) If you pay a farmer \$4,000/year to put a wind turbine on her farm and you have additional maintenance costs of \$36,000/year, now how long does it take the wind turbine to pay for itself plus its expenses?

d) How does your answer to c) compare to the turbine's 20 year design lifetime? Is wind a poor, good, or great deal?

Note: Hidden costs of wind include i) needing to build additional transmission lines to remote high wind areas and ii) the need to have and run a backup plant to generate electricity when the winds ebb.