

PHYS-320 Energy: Demographics and Heat Engines
Schwartz Problem Set #2

1) Folks in the physics department are making a fuss about the fastest, most expensive production car in the world, Bugatti Veyron. Here's the video:
<http://www.youtube.com/watch?v=LO0PgyPWE3o> Then you can read about it in Wikipedia, or any place else you can find that interests you. You can skip down to the statistics if you like. We will look at the mechanics of the power in the next problem set. For now, let's address the demographics.

Demographics: You may not be able to find the exact information you are looking for below. Don't sweat it... Please innovate an answer that makes sense to you.

- a) If a group of (average income) people in the following countries wanted to buy a Veyron, and saved half of their salary for a year, how many people would they have to get together?: USA, China, Zambia, and one country that interests you.
- b) About what number of people in the following places could afford a Veyron USA, China, Zambia, and one country that interests you. Assume that the person had to be an Ultra Millionaire (worth more than \$30 million). Also state what % of the population of these countries these numbers represent. Site your sources.

For Activity Section*

2) Measure the power output of your body two different ways. Express it in Watts, horsepower, and BTU/hr:

- a) Calculate the total energy you produced and time the process.
- b) Calculate the power you put out in Watts, horsepower, and BTU/hr.
- c) Calculate how long it would take you to charge a 1 kWh battery (like a car battery) if you could keep up this activity.

3) What do you think has more energy: you riding fast on your bicycle, or a cup of coffee? Please do the calculations.

4) What takes more energy: Running up the flight of stairs in Baker or heating your tea (half a liter of water) 10 °C. Please explain your experience and please show a calculation.

****more questions****

5) I want to make a house out of adobe, (mud, cob, earth whatever you like to call it). If the wall is 10' x 20' and is 3' thick, when it is 70 °F inside and 30 °F outside,

- a) Please calculate the temperature gradient
- b) please calculate the rate of heat loss in Watts and BTU/hr through the wall.

6) Check out the : [Animated Engines \(http://www.animatedengines.com/\)](http://www.animatedengines.com/) website and write down an explanation of how the following engines work, which will be testable, so this is just practice for the exams:

- a) Reciprocating Engines: What's the difference between a four-stroke engine and a two-stroke engine? When would you use one rather than the other?

- b) What's the difference between a diesel and a gasoline engine?
- c) How does a Brayton Cycle (gas turbine) work?
- d) How does a Rankine Cycle (steam turbine) work? How is it different from a Brayton (gas turbine)?
- e) Pick one other kind of heat engine and explain how it works. – You could even look up the new Free Piston Linear Engine and see how it works. Up to you.