

Fill in numbers

- 1) What is the mass of a car? _____ kg
- 2) How many people live in the world? _____ people
- 3) How many people live in the US? _____ people
- 4) How many people live in California? _____ people
- 5) What is the average total world power consumption? _____
- 6) The average American uses in a year as much energy as how many average world citizens? _____ people
- 7) What portion of the world's readily accessible oil supply has humanity used up so far? _____
- 8) What portion of the readily accessible oil under the United States has Humanity used up so far? _____
- 9) What is the average total primary power consumption of an average American? _____
- 10) Name the three sources of primary energy to the earth

Short answers

- 1) Imagine that you're holding a cordless chargeable electric DRILL in your hand, and you can take it apart:
 - a) What about the physical drill itself determines its **energy**?

 - b) What about the physical drill itself determines its maximum **power**?

2) I have bearded dragons. They need a special UV light (25 W), and a small heater (25 W) on all day.... ~ 12 hours a day. State any assumptions that you make..

a) How much do they cost me a day in electricity?

b) Say that the electricity is produced by a NGCC facility. How much NG is consumed each day for me to keep dragons?

c) How much CO₂ is emitted into the atmosphere each day from my dragons' electrical use?

3) Your friend is very excited and wants to invest in a new energy start up. An inventor has found a way to generate electricity directly from heat energy. You put in heat, and electricity comes out. It can take heat from room temperature sources. The by-product is that the machine gets cold (because heat is turned to electricity), which can be used for air conditioning. Should your friend invest? With reference to the appropriate law(s) of thermodynamics, give your friend some good advice, with reasons.

4) Imagine a community run on a grid powered by a single generator run by water coming through a turbine. The turbine turns as the water runs through it, generating electricity for everyone.

- a) Every day at 8:00 AM in this society, everyone runs their electrically heated showers. How does this power consumption affect the electrical facility? State: what does the increased load change at the facility, and what they must do to respond to the increased load.

- b) What law of physics is demonstrated in this affect and response? Describe why you chose this law?

- c) Suppose after growth in population and opulence, the use of electricity exceeded your ability to provide for everyone with this single facility and there is the worry that demand would exceed supply. Name something the community could do from supply side management that would solve the problem.

- d) Addressing question c) above, name something that the community could do from demand side management that would solve the problem.

- e) explain clearly what two things are necessary to make a “smart grid” properly serve society.

- f) How might a “smart grid” have changed the California energy crisis?

5) Coal electricity:

a) Coal has a dirty reputation. What are three problems *ABOUT* coal (not what it does) that cause it to be bad for the atmosphere, compared to Natural Gas.

1

2

3

b) What portion of the electric load do we use coal for in California? _____ Nationally? _____

c) What is it about coal that motivates society to use it?

d) Why don't we use more coal electricity in California?

6) (2 pts) Some say that rather than running out of oil, the amount of accessible oil will just increase. Please explain how this could be true.

7) Your friend has found a way to focus sunlight to get a target VERY hot. She is pretty excited about it and asks you how she might generate electricity with it.

a) Explain to her how you could make an electrical generation facility by using this heat. A drawing should be included and good explanation for **4 points** showing how the mechanism works.

b) If she could focus the light to a smaller spot, the temperature would be hotter with the same amount of power. Would this improve her machine? Why or why not?

8) Plutonium is a problem we need to address if we want to have nuclear electricity.

a) Where does plutonium come from?

b) What is it about Plutonium that raises societal concern?

9) If most of our appliances use DC or could use DC, why do we have AC at all? For full credit, please be complete.

10) Please give an example of how some specific material from this class has changed something in the way you see the world. Please make specific reference to some class material. If you don't want to do this, please describe the difference between a two-stroke and four-stroke engine, and explain why a two-stroke has more emissions.