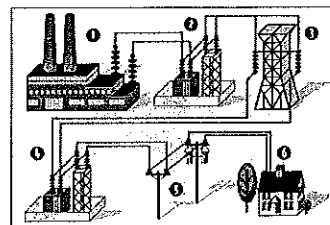


Name: Key Period: _____

Calculating your Carbon Footprint

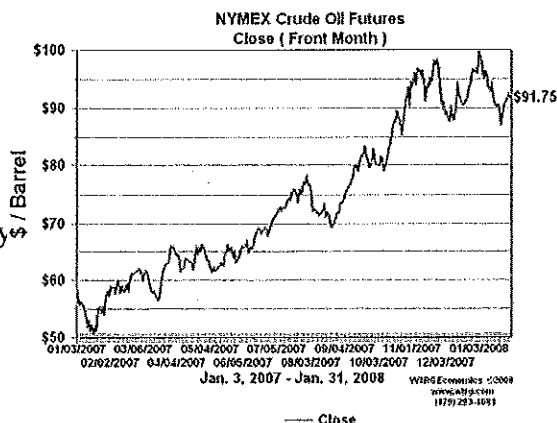


Background:

Currently the world's demands for natural resources, particularly petroleum-based products are at record high levels. Early in 2008 the price for a barrel of crude oil hit a new all time record of over 100 \$ a barrel sending gasoline prices well into 3 dollars a gallon range. As a result environmentalist as well average Americans are beginning to take a close look at the effect they are having on the environment and making an effort to conserve energy or at least be more informed about the energy conservation.

Useful Information:

1. 1 gal gasoline = 6.0 lbs
2. 1 lbs = 453.59 gram
3. 1 barrel oil = 42 gal
4. United State Environmental Protection Agency
 - a. www.fueleconomy.gov



Recently the term "carbon foot print" is becoming trendy way to access your affect on the environment. As we live out our daily lives we are constantly using and producing carbon. The carbon we produce on a daily bases comes from many sources besides the CO₂ produced from the driving cars. Some of the overlooked sources of CO₂ include, turning on lights, boiling water, and eating ice cream to name of few.

The internal combustion engine powers most cars and trucks, which most commonly run a regular unleaded gasoline. A cars power is produced when gasoline is sprayed through injectors located at the top of each of the cylinder. The injectors spray a fine mist of gasoline which is then ignited using spark plugs creating a explosion within the cylinder which forces a piston down which provides power to the wheels.

As we travel to and from school in our cars a combustion reaction is taking place under the hood. Gasoline (C₈H₁₈) reacts with O₂ gas to produce carbon dioxide and water. Based on the law of the conservation of mass the mass of the reactants must be equal to the mass of the products in all chemical reactions. The combustion reaction, which takes place in your car produces a specific amount of water and carbon dioxide for every gallon of gas, you burn which can be determined using stoichiometry. Your task is to determine how much CO₂ you produce traveling back and forth to school.

Tues

Day 1:

- Using the webpage listed above find the average mile per gallon (MPG) for your car. If you don't have a car use the website and pick your dream car and use the average MPG for that vehicle.

a. Instructions

- Go to www.fueleconomy.gov
- On the left side of the page click Compare side-by-side
- Use the page to look up the MPG information for your car.
 Make: Toyota
 Model: Matrix
 Year: 2004
 Gas tank size (gal): 13.2 (see auto makers website or Google it)
- The average MPG rating will be the combined number located in red.
 Combined Avg. MPG of your car: 28
 City MPG of your car: 25
 Highway MPG of your car: 31 $1 \text{ mol} = 31 \text{ mi}$
- What is your car's carbon footprint rating? 6.6
- How many barrels of oil does your car use in 1 year? 12.2
 1. How many gallons is that? 512.4

Google maps

- Using the Odometer in your car determine the number of mile you live from school. If you pick friend up on the way to school make sure to include those miles traveled

Distance to school: 34.0 mile

- Determine the size of the gas tank of your car. (see auto makers website or Google it)

Gas tank size (gal): 13.2

Mass (g) of a full tank of gas: 35,924.33

$$\frac{13.2 \text{ gal} \times 6.0 \text{ lbs} \times 453.59 \text{ g}}{1.0 \text{ gal} \times 1 \text{ lbs}} =$$

media center

Day 2: (use the average MPG for the ALL calculations)

- Calculate how many gallons of gas your car uses to get too and from school in one day?

$$\frac{34.0 \text{ mi}}{31 \text{ mi}} = 1.2 \text{ gal} \times 2 = \boxed{2.4 \text{ gal}}$$

- Determine the mass of gasoline your car combusts to get too and from school in one day. (you will need to use the avg. mpg of your car as well as the ratios given in the background section)

$$\frac{2.4 \text{ gal} \times 6.0 \text{ lbs} \times 453.59 \text{ g}}{1 \text{ gal} \times 1 \text{ lbs}} = \boxed{6531.7 \text{ g gas}}$$

- Determine and balance the chemical equation for the combustion of gasoline.



- Convert the ^Amass of gasoline consumed by your car in one day (too and from school) into ^{mols}moles of gasoline.

$$\frac{6531.7 \text{ g gas}}{114 \text{ g}} = \boxed{57.3 \text{ mol gas}}$$

- Using the answers from questions 5 and 6 calculate the mass (pounds and grams) of CO₂ ^{A B}mol-mass produced from drive too and from school in one day. **Hint:** the calculation is mass-mass

$$\frac{57.3 \text{ mol gas} \times 8 \text{ mol CO}_2 \times 44 \text{ g CO}_2}{1 \text{ mol C}_8\text{H}_{18} \times 1 \text{ mol CO}_2} = \boxed{20169.6 \text{ g CO}_2}$$

9. Determine the mass (pounds and grams) of CO₂ produced from driving to and from school in one week.

$$20169.6 \text{ g} \times 5 = 100848 \text{ g CO}_2/\text{week}$$

10. Determine the mass (pounds and grams) of CO₂ produced from driving to and from school in one school year.

$$20169.6 \text{ g} \times 180 = 3,630,528 \text{ g CO}_2/180 \text{ days}$$

11. Determine the mass of CO₂ produced from burning 1 tank of gasoline. (assume the MPG is based on your car's average MPG) *Mass A → Mass B*

$$\frac{35,924.33 \text{ g gas} \mid 1 \text{ mol gas} \mid 8 \text{ mol CO}_2 \mid 44 \text{ g CO}_2}{114 \text{ g gas} \mid 1 \text{ mol gas} \mid 1 \text{ mol CO}_2} = 110924 \text{ g CO}_2$$

12. If you were to burn 42 gallons of gasoline how many moles of CO₂ would be produced?

$$\frac{42 \text{ gal} \mid 6.0 \text{ lbs} \mid 453.59 \text{ g} \mid 1 \text{ mol gas} \mid 8 \text{ mol CO}_2}{1 \text{ gal} \mid 11 \text{ lbs} \mid 114 \text{ g gas} \mid 1 \text{ mol gas}} = 8021 \text{ mol CO}_2$$

13. How do you think the EPA website calculated the carbon footprint?

Using the same calculations you did.

Challenge Questions: molar volume of Gas

In chemistry gasses are often measured based on volume (liters) instead grams. As a result chemists can relate liters of a gas to moles of a gas based on a constant. 1 mole of any gas at STP (standard temperature and pressure) will occupy 22.4 liters. How many liters of CO₂ are produced in one day driving to and from school?

$$\frac{20169.6 \text{ g gas} \mid 1 \text{ mol gas} \mid 8 \text{ mol CO}_2 \mid 22.4 \text{ L}}{114 \text{ g gas} \mid 1 \text{ mol gas} \mid 1 \text{ mol CO}_2} = 31705 \text{ L CO}_2$$

Determine the mass of CO₂ produced based on the EPA's estimates for how many barrels of oil your car will use in one year?

$$\frac{12.2 \text{ barrels} \mid 42 \text{ gal} \mid 6.0 \text{ lbs} \mid 453.59 \text{ g} \mid 1 \text{ mol} \mid 8 \text{ mol CO}_2 \mid 44 \text{ g}}{1 \text{ barrel} \mid 1 \text{ gal} \mid 11 \text{ lbs} \mid 114 \text{ g gas} \mid 1 \text{ mol gas} \mid 1 \text{ mol CO}_2} = \frac{490870017.8}{110} = \frac{4305877 \text{ g}}{1000} = 4306 \text{ kg}$$

