

Assessment #4. *I expect you to know each of these: 1-4*

- 1) Which of the following are true? *circle the dash in front of the correct answers.*
  - Global CO<sub>2</sub> emissions have been growing roughly exponentially since the dawn of the industrial revolution, around the late 1700s, with no apparent end in sight.
  - **Global CO<sub>2</sub> emissions** have been growing roughly linearly since ~ 1930, with no apparent end in sight.
  - Global CO<sub>2</sub> emissions rose quickly around 1970 and have since leveled off to almost constant.
  - As a country, the USA emits the greatest amount of CO<sub>2</sub> annually. **That's China Now**
  - **As a country, the USA** is responsible for the greatest amount of CO<sub>2</sub> in the atmosphere.
  - As a country, the CO<sub>2</sub> emissions of the USA are rising more than any other country. **That's neither the USA or China... both are pretty constant lately. India is rising rather quickly now.**
- 2) The mass of the total global CO<sub>2</sub> emissions last year were about:
- 3) The mass of CO<sub>2</sub> emitted per US American last year was about:
- 4) The mass of CO<sub>2</sub> emitted per average person on the earth last year was about:  
*Make sure that when you multiply the average emissions of a person by the number of people, you get global emissions.*
- 5) The climate has always been changing, so why might we care about this present change?  
*To me (and you don't have to agree because I graded this very generously) the real issue is that when we consider two things:*
  - 1) *When we look at these changes, we don't like what we see is going to happen... biologically, social, economically, etc.*
  - 2) *We the humans are causing this problem, and can therefore stop causing it. We should thus be compelled to do something.*
- 6) I drive my F-150 to San Francisco and Back. Estimate the CO<sub>2</sub> emissions from this journey.

*~300 miles, ~15 mpg → 20 gallons × 2 = 40 gallons*  
*gasoline has  $\frac{3}{4}$  density of H<sub>2</sub>O → ~3kg/gallon ×  $\frac{44.5}{14.5} = \sim 10 \text{ kg/gallon CO}_2$*   
*→ 40 gallons ×  $\frac{10 \text{ kg CO}_2}{1 \text{ gallon}} = 400 \text{ kg of CO}_2$  nice!*

- 7) What is the present value (with units) of Radiative Forcing?: *1.4 w/m<sup>2</sup>*
- 8) What is the meaning of Radiative Forcing?

*The change in the GH effect due to humans since industrialization began.*

*Radiative Forcing is not the difference in incoming radiation and outgoing radiation. This mistake indicates a fundamental misunderstanding in what causes climate change: The IR radiation that the earth emits to stay at the same temperature is preferentially absorbed by the GHGs. Then these molecules re-radiate the IR, and half of it comes back! This warms the earth, the increase in temperature increases the radiation to a higher level. At this higher level, the outgoing IR radiation from the earth is again roughly equal to that coming in from the sun... but it required the earth to be at a higher temperature. I have just described the greenhouse effect, something that has kept the earth nice and warm for us to live in. Radiative forcing is the **increase** in the GHG (this re-radiating) effect since the beginning of the industrial revolution with the increase in GHG do to our activities.*

Please note which wavelengths are involved in each of the two atmospheric conditions below.

9) Distinguish on each side: **Ozone Hole**

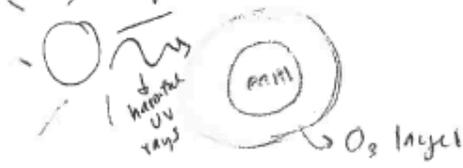
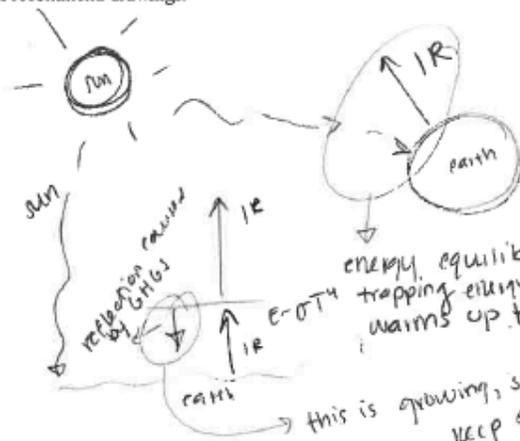
**Climate Change**

a) What "pollutants" cause each of these two "problems"?  
**CFC's (aerosol propellants & refrigerants)**

**CO<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>O, NO<sub>2</sub>, CFC's**

b) Describe the mechanism that causes each of these two problems. I recommend drawings.

CFC's destroy the ozone layer (ozone depletion) & harmful UV rays from the sun get through to earth



energy equilibrium, GHG's are trapping energy so the earth warms up to keep equilibrium

c) What is the biological effect of each of the problems?  
**harmful UV rays that hurt living creatures**

extinctions, migrations b/c of warmed earth, (rising sea levels, melting permafrost)

d) What are the policy solutions to each of these two problems?  
**change the chemicals we use**

use command & control or market mechanisms to cut toxic emissions & encourage lifestyle changes  
 More industry regulation too

e) To what degree has society "solved" each of these two problems?  
**changed chemicals, it's solved**

NOT solved, we need to make <sup>significant</sup> lifestyle changes & industry

f) How has the global youth engaged with each of these two problems?  
**encouraging changes in chemicals**

encouraging lifestyle changes, emotional testimony video we watched, younger people becoming more aware of climate change

10) Why are temperatures in the arctic regions rising at about 4 times the rate of temperatures in warm areas?

Melting snow reveals dark areas underneath that then stop reflections & instead absorb rays from sun. Melting permafrost also releases more GHG's. Water in arctic regions might also be positive feedback mechanism that warms earth. More positive than negative feedback.

This last question is an example of positive climate feedback. I expect you to know it. Don't be surprised if I ask you for it again.