Study questions for Exam 1, section on climate change.

1. Explain how CO2 in the atmosphere is converted to organic carbohydrates, and then to hydrocarbons. What is coal? Oil? How do energy content and CO_2 emissions per unit of energy vary among coal, oil and natural gas?

2. Draw a diagram of the major carbon cycles, explain the movements of carbon into and out of the atmosphere from the other major natural carbon pools. How much CO_2 enters the atmosphere annually due to burning fossil fuels, in recent years? How much does the atmospheric carbon pool increase annually?

3. Explain the Keeling curve, which shows atmospheric CO_2 measurements in Hawaii since the 1960s. What is the current concentration of CO_2 in the atmosphere? How does this relate to measurement of atmospheric CO_2 for the past?

4. How does matter interact with electromagnetic radiation? How does this relate to explaining why some gasses (for example O_2 and N_2) are not greenhouse gasses, and others (for example, H_20 and CO_2) are?

5. Draw and fully label a graph of the blackbody radiation spectrum from the sun and from the earth. Explain the differences. How does this relate to the greenhouse effect?

6. Explain the heuristic 'bare rock model' of the earth's energy budget. Explain the 'layer model' of the earth's energy budget.

7. Draw (and label) a graph with lines showing the blackbody spectrum for 220K, 240K, 260K, and 280K. Then add a line with the spectrum of infrared that actually exits the earth's atmosphere. Explain how these curves relate to the greenhouse effect. In particular, use the graph to explain what is expected to happen with an increase in CO_2 concentration.

8. Explain how band saturation and the wavelengths absorbed by CO_2 and methane (CH_4) affect how strong a greenhouse effect is exerted by each of these gasses.

9. Explain why the lapse rate (or the rate at which temperature decreases as you increase in altitude from sea level to the tropopause) has an important influence on the greenhouse effect.

10. Explain the interaction (positive feedback) between climate change and sea ice.