For all of the questions on the following five pages, make sure you clearly explain your reasoning and show your work. You may use a calculator (you may not program information into your calculator) but may not use any other outside materials such as books or notes. If you are unsure of how to interpret any of the questions, please ask the instructor for help. On some of the following questions, you have a choice of which parts to answer. Circle the letters of the parts you want marked. When you are done, please hand your exam in to the instructor at the front and initial the attendance sheet before you leave. There will be a short period at the start of the exam to talk to the members of your team about the exam. After that, you must work alone.

Total Grade: /100 (i.e. 50% of the final grade)
1. (20 marks in total) For two out of three of the following parts, give an answer in the space provided. Clearly show which ones you want me to grade by circling its letter. Show your reasoning and/or your work.

a. Draw the Lewis structure and then predict the bond lengths and angles around the following molecule:

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H   H   H   F
N   C   C   N   C   C   C   H   F
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b. Define the term Halon, give two examples, and describe what they are used for.

c. Your car drives 132 miles and uses 6.2 gallons of gas. Calculate the gas mileage (use the correct number of significant figures).
2. (20 marks in total) For two out of three of the following parts, give an answer in the space provided. Clearly show which ones you want me to grade by circling its letter. Show your reasoning and/or your work.

a) Describe what Ozone is and why it is sometimes good for us and sometimes bad for us.

b) Calculate the molecular weight and %C, %H, and %F for CHF₃.

c) Define what beta and gamma radiation are. Which is normally more dangerous and why?
3. (20 marks in total) Clearly describe:

(a) The parts of an X-ray diffractometer and the purpose of each (use diagrams).

(b) The steps used to go from a single crystal to a picture of the molecule by diffraction methods.
4. (20 marks in total) For two out of three of the following parts, give an answer in the space provided. Clearly show which ones you want me to grade by circling its letter. Show your reasoning and/or your work.

(a) Using words and pictures, clearly describe the structure of a $^{19}$F atom and its nucleus.

(b) What is meant by the greenhouse effect? Clearly describe the roles of Chlorofluorocarbons in the greenhouse effect.

(c) Clearly describe what thermoelectric power generation is, include its advantages and disadvantages.
5. (20 points maximum) For one out of two of the following parts, give an answer in the space provided. Clearly show which ones you want me to grade by circling its letter. Show your reasoning and/or your work.

(a) Describe in detail the process by which a solid object burns. Include in your description a discussion of how this is related to three ways a material can be made less flammable.

Or

(b) Clearly describe the process by which crude oil is converted into gasoline in a modern refinery.