Questions 1 - 4 (18 points) are multiple choice questions. There will be no partial credit given for these problems. Problems 5 - 14 (82 points) should be worked out on the exam. Partial credit will be given for work shown. The answer by itself is not satisfactory for full credit.

Academic Honesty Policy: Intentionally using or attempting to use unauthorized materials, information or study aids in any academic exercise, OR intentionally or knowingly helping or attempting to help someone else to commit an act of academic dishonesty, such as knowingly allowing another to copy information during an examination or other academic exercise constitutes Academic Dishonesty and is **punishable with a possible grade of F** in this course!!!

There is a blank page at the end of this examination for use as scratch paper.

INFORMATION THAT MAY BE OF USE TO YOU IN THE EXAM.

$d = m/v$

N (Avogadro's number) = 6.02×10^{23} mol^{-1}

$E = h\nu$

$h = 6.63 \times 10^{-34}$ Js

$E = hc/\lambda$

$c = 3.00 \times 10^8$ m/s

$$n = \frac{\Delta E}{h} = \left(\frac{R_H}{h}\right)\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$$

$R_H = 2.18 \times 10^{-18}$ J

Periodic Table

Name:_____

1. (5) A free radical species catalyzes ozone destruction because:

   a. uv light interacts very strongly with them.
   b. catalysts must be free radicals.
   c. free radicals are so reactive due to an atom not having an octet of electrons.
   d. ozone is also a free radical species.
   e. none of the above.

2. (4) Which of the following types of radiation has the most energetic photons?

   a. ultraviolet
   b. microwaves
   c. infrared
   d. visible

3. (5) The Greenhouse Effect is based on what principle:

   a. Infrared light can come into our atmosphere, but it can't get out.
   b. The ozone hole lets in ultraviolet light and gives us cancer.
   c. Infrared light reacts with the water in the ocean and this trapped heat keeps the planet warm.
   d. Ultraviolet and visible light are converted into infrared light on the surface of the planet and certain molecules are able to trap much of this light on the planet.
   e. Gasoline produces NO_X and SO_2 which, along with the heat produced by automobiles, cause the planet to warm.

4. (4) According to the C cycle, if there were no anthropogenic (manmade) sources of CO_2 the earth would

   a. put more C into the atmosphere than it took out.
   b. take in more C than it put into the atmosphere.
   c. take in the same amount of C that it put into the atmosphere.
   d. none of the above, because CO_2 only has anthropogenic sources.

5. (4) Complete the following table:

Element	Element Name	Number of electrons	Number of neutrons	Number of protons	Number of electrons in outer shell
Na	_____	_____	_____	_____	_____
_____	_____	_____	128	82	_____

6. (6) Write the formulas or the names for the following compounds:

   carbon tetrabromide _____

   NO_____

   PI_3 _____

7. (6) List the possible values of the four quantum numbers for a *5p* electron of iodine.

8. (5) Write an electron configuration for cobalt. You may use a noble gas core.

Show your work on all problems!

9. (8) Draw a Lewis structure of N_2O. Draw all valid resonance structures of this molecule and determine the formal charges on each atom. Which structure is the least abundant structure?

10. (8) The Lewis structures of CH_3^+ and H_3O^+ are:

   respectively. Determine the electronic and molecular geometries of each species.

	CH_3^+	H_3O^+
Electronic	_____	_____
Molecular	_____	_____

11. (8) A C=O bond in CO_2 can be cleaved with 2.00×10^{15} Hz light while O=O bonds require 242 nm light. Compare the <u>energies</u> of these two and determine which is the stronger bond.

12. (15)   It's been suggested that the average American car puts out its' weight in CO_2 on an annual basis. Justify this claim assuming that the average car is driven 10,000 miles, weighs 2500 kg, and gets 25 miles/gallon. The gasoline is assumed to be octane (C_8H_{18}) and there are 2600 g/gallon. Begin by writing the combustion reaction.

13. (10)   In the lab, you made nitrogen monoxide and oxygen and then combined the two to make the brown gas nitrogen dioxide. Consider the mixture in the diagram below. Draw a representation of the product mixture assuming that the reaction goes to completion. What is the limiting reagent in this case?
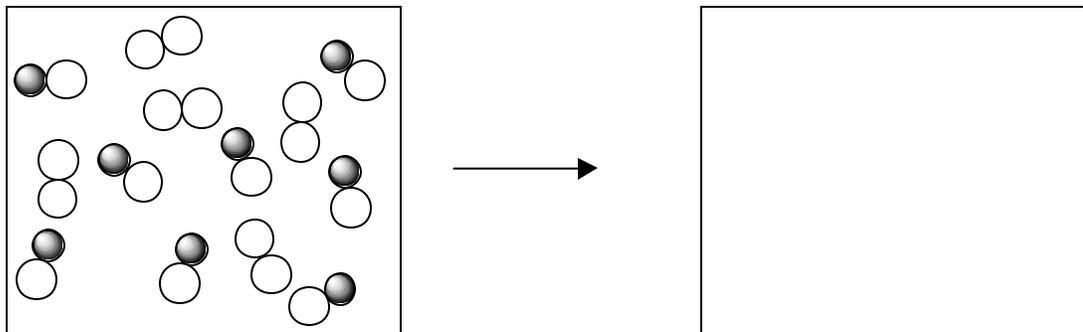
14. (12)   Suppose that you reacted 0.365 g HCl with 1.22 g of $CaCO_3$ and found that
0.402 g of carbon dioxide was released. Which of the two reagents is
limiting? Calculate the theoretical yield and the percent yield for the reaction.