Chemistry / Environmental Studies L111
Environmental Concerns and Chemical Solutions
Professor Dransfield
Homework 4: Due March 1, 2007

Chapter 3 – The Chemistry of Global Warming

Fifth Edition Question Numbers:

Emphasizing Essentials

#1a) Yes, the Greenhouse effect is going on now, and is responsible for Earth's surface being warm enough to sustain life. Without it, we would expect the sun to only warm the surface to about -18 °C.

#1b) It is extremely likely that the increased concentrations of greenhouse gases can explain the increasing temperatures since the beginning of the industrial revolution. This is the enhanced greenhouse effect.

#7a) The concentration of CO_2 at the moment is about 375 ppm. However, in the figure, we're looking at averages over VERY long time scales, and the "present" data still average out to the historical mean of about 280 ppm. 20,000 years ago, the average CO_2 concentration was 190 ppm. 120,000 years ago, the CO2 concentration was about 270 ppm.

#7b) The present day temperature is slightly higher than the 1950-1980 mean. 20,000 years ago, the temperature was about 9°C colder than the 1950-1980 mean. 120,000 years ago, the average temperature was only about 2°C colder than the 1950-1980 mean.

#7c) There is clearly correlation between T and CO_2 in the historical record. However, that record on its own can say nothing of causation.

12a) CH_2Cl_2 has a central carbon surrounded by 4 different single bonds. It is a classic **tetrahedron**.

#12b) CO only has two atoms. It is, by definition, **linear**.

#12c) PH_3 has a central P atom with 3 single bonds and a lone pair of electrons. If you remove one vertex of the tetrahedron, the shape you are left with is a trigonal **pyramid**.

#24 and 25 were not covered yet. We'll do them next week again/instead.

#31a) Coal which is burned emits CO2 directly into the atmosphere; this is clear **causation**.

#31b) This is a little sneaky, since you need stats on the per capita income. If we make a table showing per capita CO2 from figure 3.27 and per capita GDP from question 58, we can see the following:

Country	GDP	CO2
US	$36,300	5.5 metric tons
Canada	$29,400	3.9
Japan	$28,000	2.5
Australia	$27,000	4.9
Brazil	$7,400	0.5
China	$4,600	0.7
India	$2,540	0.3

While there is a clear **correlation** between these two factors (with Australia being an interesting outlier), there is no clear evidence of causation.

#31c) It is now known the smoking cigarettes is directly responsible for lung cancer. Thus, this is actual **causation**.

#31d) I would say this is **causation** – there is a **causal** link between the two. But here's a question to ponder: which causes the other?

#31e) If there is a **correlation** here, it is weak. A greenhouse certainly helps to raise plants, but it isn't necessary, and it doesn't do the job for you.

#31f) I suspect there's at best a very weak correlation here. If I had to guess (i.e., without seeing the statistics), I'd say **no relation**. Millions of people buy roller blades without breaking their legs. There's clear causation between "falling while roller blading" and "breaking legs", but not so much between the two we're asked to discuss.

#36) Lewis structures predict the pairing of electrons in bonds and lone pairs, but say nothing about how those electrons positions themselves in 3-D space. The Lewis structure itself is 2-dimensional. However, we can **use** the Lewis structures to help us **predict** 3-D geometries.

#37) Because water vapor and CO_2 are both present in the air at all times, and yet we can see through the air, it is easy to suggest that they are both transparent to visible radiation. Recall that if visible light is absorbed, we see colors – and the air is most definitely not colored, most of the time. We CAN see both clouds and steam – why?

#40) Let's save this for next week, although we can certainly do part a) now!
a) $C_2H_5OH + 3\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$

#51) BF_3 has only 6 electrons surrounding it, rather than an octet. These 6 electrons are arranged in 3 bonds, and the best way to maximize the separation of three objects in space – even in 3-D space! – is to arrange them in a plane 120° apart from each other. NH_3, however, has a complete octet. There are 6 electrons paired up in the three N-H bonds, but there is also a lone pair of electrons on the N. That means the electrons need to distribute themselves in FOUR directions, which leads us to the tetrahedral structure of methane. In the case of NH_3, one of the vertices of the tetrahedron is missing, and the resulting structure is a pyramid.

#52a) Assuming X, Y and Z each need to have a full octet, we need to have 24 electrons total. If we are only allowed to make single bonds, and we assume that the molecule is bonded X-Y-Z (rather than in a triangle), then we can only share 4 electrons. (S=N-A)

#52b) The molecule is **bent** – the central Y atom has a complete octet, but if it is only making single bonds, then it must have 2 lone pairs. This is the same structure as H2O, and is described as bent.

#52c) If we allow double bonds to be made, then the lone pairs on Y can be used to make additional bonds to X and Z. Some possibilities:

X=Y-Z or X-Y=Z	This structure only requires **18** valence electrons, but is still **bent** because there is still one lone pair on Y.
X=Y=Z	This structure only requires **16** valence electrons. Furthermore, both lone pairs on Y have been used in making additional bonds, and the molecule is now **linear**.