

CHEM/TOX*3360 ENVIRONMENTAL CHEMISTRY and TOXICOLOGY
TAKE-HOME ASSIGNMENT (this is worth 20% of your total mark)

Due: Wednesday, April 1, 2009, high noon, or any time before.

Late penalties will be assessed at 0.2% per hour late based on the 12:00 noon time.

Instructions:

All text should be typed. However, weird compounds/structures, arrows running off in all directions, sketches, etc. can be done by hand as long as they are clear. No mirror image text (da Vinci style) allowed!

Comments and advice:

The problems, *etc.* below require thinking about, they need researching and they need care in their presentation and conclusions. They are not something to be done at the last minute, for a rushed job will show up in the quality and erudition (or lack thereof) of the final product. In principle these are easy marks because you have control over the final output. The work should be your own. I clearly don't have any control over your discussions with colleagues, but the final submission should reflect your take on the issues at hand and your assessment and critical writing skills should come through. I will, of course, be alert to plagiarism.

1. Write down the series of steps (*i.e.* the equations) by which ethylene gas is oxidised (start with the hydroxyl radical) when it is in an atmosphere undergoing a photochemical smog process. Assume in this case that any aldehydes react completely by photochemical decomposition rather than by OH attack.

You should annotate (with text) the steps along the way to explain what is going on. This should be clear enough so that a first year student with some chemistry background can follow the process. HO₂ may show up at the end. Given the ambient conditions, provide a suitable sink reaction.

10 marks

2. Set out, again using annotated equations, the ClO dimer mechanism for ozone depletion. Then explain (clearly) why, in the lower stratosphere at mid-latitudes, this is not a significant ozone destruction mechanism..

8 marks

3. Water samples from three wastewater streams are analyzed. The important pollutants from each source are listed below ((a), (b), and (c)). In each of the three cases, devise economical, practical processes (other than activated carbon treatment) for purifying the water of the pollutants. Note: in each case, the sequencing of treatments may be important.

(a) phosphate ion, ammonium ion, and salt (NaCl) (all in water containing bicarbonate ion)

(b) nitrite ion, PCE (perchloroethene, C₂Cl₄) and Fe(II).

(c) cadmium ion, carbon tetrachloride and glucose.

12 marks

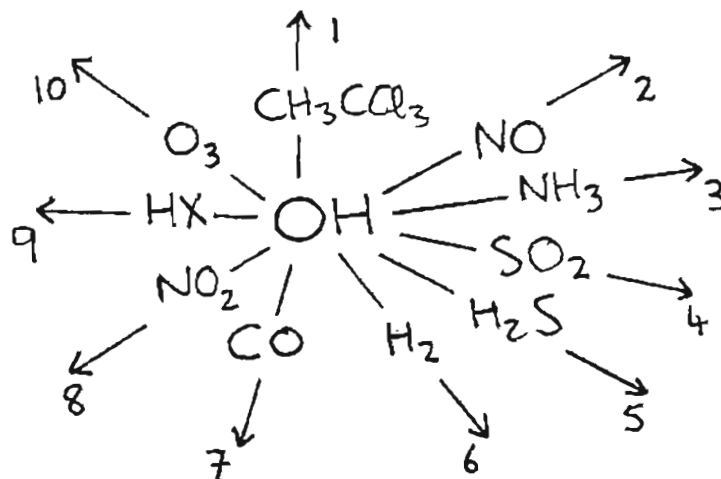
4. Humic material can interact with many species including metal ions, organic compounds, *etc.* found in water and soil. In this sense they can determine the health of an ecosystem. Start with a brief description of humic matter and then go on to discuss interactions (including binding) with pesticides and issues of toxicity, fate, degradation (if relevant), and any associated chemical transformations.

This can be done in note form, highlighting the issues. Clearly the sequencing of the issues/"talking" points will be important. This should take no more than 2 typed pages with a 3rd page allowed for references, (font; Times Roman or equivalent, 11 point, margins 0.7-1 inch, line spacing 1-1.5).

12 marks

5. Free radicals play a dominant role in many atmospheric reactions. The hydroxyl radical is especially prominent in both the stratosphere and the troposphere. Below you will see a sketch of some of the main reactions of OH in both the stratosphere and troposphere. They are numbered 1 - 10. Your initial task is, for each numbered reaction, to provide the immediate product (or products). Do this, not on the diagram itself, but on separate paper where you can also suggest, using equations (and/or text) if necessary, what the final endpoints of these reactions are if you think that they proceed further, either to termination points or to the beginning of new cycles. Indicate whether the reactions occur in the stratosphere or troposphere (or both).

15 marks.



6. Arsenic is prevalent in some water sources (often wells) in parts of Asia, especially Bangladesh. Discuss what the problem is (briefly) and then proceed to focus on the recent literature with regard to what is known about methods for determination of arsenic concentrations and possible solutions to the problem (*i.e.* remediation/purification).

Unlike the note form of question (4) this document is to be set out in a short essay format (font; Times Roman or equivalent, 11 point, margins 0.7-1 inch, line spacing 1-1.5, no more than 2 typed pages) with a 3rd page allowed for references. This restricted length requires that you write a cogent, clear, concise report, paying careful attention to the clarity of your discussion and the quality of your prose.

18 marks