2530023

THE UNIVERSITY of York

Degree Examination 2005

ENVIRONMENT DEPARTMENT

BSc in Environment, Economics and Ecology, Part II

CURRENT ISSUES IN ATMOSPHERIC SCIENCE

Time allowed: **two hours**

Answer **TWO** questions out of **FOUR**

Standard University calculators will be provided

Pay adequate attention to spelling, punctuation and grammar, so that your answers can be readily understood

Question 1

a. Describe how atmospheric temperature and pressure differences, along with the Coriolis force lead to the observed global circulation pattern. *(25 marks)*

b. Describe the difference between El Niño Southern Oscillation and non- El Niño Southern Oscillation conditions. Your answer should refer to temperature, trade winds and upwelling of water. *(25 marks)*

Question 2

a. Define the chemical lifetime of species X with respect to the OH radical *(3 marks)*

b. Given a global average OH concentration of 1×10^6 molecule cm^{-3}, calculate the lifetimes of the following species:

Species X	**$k_{(OH+X)}$ cm^3 $molecule^{-1}$ s^{-1}**
CCl_4	3.1×10^{-16}
Ethene	8.5×10^{-12}
Benzene	1.3×10^{-12}
1,3,5-trimethylbenzene	5.8×10^{-11}

Use appropriate units, hours, days, years *etc. (12 marks)*

c. What are the implications for the vertical and horizontal distribution in the atmosphere of these species, given the answers you have calculated for 2b? (*5 marks*)

d. Describe how combustion of a carbon/hydrogen fuel leads to products such as CO, hydrocarbons, NO_X and heavy metals as well as CO_2 and H_2O. *(15 marks)*

e. Define PM_{10} and $PM_{2.5}$. Why is there so much concern regarding high concentrations of PM_{10} and $PM_{2.5}$ in the atmosphere? *(7 marks)*

f. What is the composition and origin of these two species? *(8 marks)*

Question 3

For **ONE** of the five following topics:

indoor air pollution
biomass burning
impact of aircraft emissions on the atmosphere
recent issues in climate change
air quality in less developed countries

Discuss the topic including the following:

i) Why is it important to study this topic?
ii) Examples of current research issues in this area (use literature references to illustrate your answer).
iii) Identification of further research that needs to be carried out in the field.
iv) Compare the importance of the topic you choose with that of the other four

(50 marks)

Question 4

a. What are the 3 reactions that link NO_2 and O_3 chemistry in the troposphere and how does this steady-state become perturbed in the presence of peroxy radicals?

(15 marks)

b. Why would we expect to find higher ozone concentrations in the suburbs compared to city-centres? *(10 marks)*

c. What are the ideal conditions for producing high O_3 concentrations in the atmosphere?

(5 marks)

d. How would species responsible for OH loss differ between a clean environment, a polluted environment and one such as a forest that was subject to biogenic emissions and why?

(10 marks)

e. Name two ways in which atmospheric models can be validated and why is it vital to do so?

(10 marks)