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THE UNIVERSITY *of York*

Degree Examination 2005

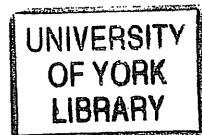
ENVIRONMENT DEPARTMENT

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

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

- Define the chemical lifetime of species X with respect to the OH radical (3 marks)
- Given a global average OH concentration of 1×10^6 molecule cm^{-3} , calculate the lifetimes of the following species:

Species X	$k_{(\text{OH}+X)}$ $\text{cm}^3 \text{molecule}^{-1} \text{s}^{-1}$
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)

- 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)
- 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)
- Define PM_{10} and $\text{PM}_{2.5}$. Why is there so much concern regarding high concentrations of PM_{10} and $\text{PM}_{2.5}$ in the atmosphere? (7 marks)
- 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)

