2530023

THE UNIVERSITY of York

Degree Examination 2004

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

1a. Describe how land-sea breezes arise and sketch the situation for daytime and night time. *(15 marks)*

1b. How could the concept of land-sea breezes be extended and used to describe the general circulation of the atmosphere? *(20 marks)*

1c. Explain the difference between a high and low-pressure system in terms of movement of air in the northern hemisphere? *(10 marks)*

1d. What type of weather would you expect to find associated with high and low pressure systems? *(5 marks).*

2a. Define the lifetime of a chemical species, X, in the atmosphere with respect to the OH radical. *(3 marks)*

2b. Given that the global average concentration of OH in the atmosphere can be assumed to be 8×10^5 molecule cm^{-3}, calculate the lifetimes of the following species given the information in the table below:

Species X	**$k_{(OH+X)}$ cm^3 $molecule^{-1}$ s^{-1}**
α-pinene	5.3×10^{-11}
Benzene	1.3×10^{-12}
CH_2F_2 (a HCFC)	1.1×10^{-14}
CCl_4 (a CFC)	3.1×10^{-16}

Present your answers in appropriate units, i.e. years, days etc. *(12 marks)*

2c. How might you expect the vertical and horizontal profiles of each of these species to vary in the atmosphere, given the lifetimes you have calculated for part 2b.
(10 marks)

2d. Why do many trace gas species exhibit a seasonal trend? *(5 marks)*

2e. What are polyaromatic hydrocarbons (PAHs) and what are their origins in the atmosphere? *(10 marks)*

2f. Using benzo(α)pyrene as an example, show how PAHs can be carcinogenic once they meet genetic material *(10 marks).*

3a. For **ONE** of the five following topics:
- indoor air pollution
- biomass burning
- impact of aircraft emissions on the atmosphere

- climate change
- stratospheric ozone depletion

write a discussion on the topic that should include the following:

i) Why it is important to study this topic
ii) Examples of current research issues in this area (use literature references to illustrate your answer). *(35 marks)*

3b. For **ONE** of the **REMAINING** four topics in section 3a, give a brief overview of some recent research in the area and explain how it helps the overall understanding of this topic. *(15 marks).*

4a. What are the 3 reactions that link NO_2 and O_3 chemistry in the troposphere and how does the steady-state between them become perturbed in the presence of peroxy radicals? *(15 marks)*

4b. Using these reactions to illustrate your answer, explain where you would expect to find the highest ozone concentrations in the troposphere and why this is the case. *(10 marks)*

4c. How does the form of NO_X vary from the point of emission (e.g. from vehicle exhausts) to clean background air? *(10 marks)*

4d. Using NO_2 as an example, describe why it is difficult to control the concentration of a secondary pollutant. *(15 marks).*