**2580066**

THE UNIVERSITY of York

**Degree Examination 2007**

**ENVIRONMENT DEPARTMENT**

**MSc Environmental Science & Management**
**MSc Marine Environmental Management**

# ENVIRONMENTAL CONTAMINENTS: PATHWAYS & BEHAVIOUR

Time allowed: **two hours**

You are required to answer **THREE** long-answer questions selected from the **FIVE** possible questions listed. All questions carry equal length.

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

**Question 1:**

a) Name eight major contaminants of continental waters (e.g. lakes, rivers or groundwater). **For each contaminant**: identify whether it is a contaminant of surface water, groundwater or both; identify an important source; and identify a detrimental effect. An answer in the form of a list or a table is acceptable. (40%)

(b) Why has arsenic become an important contaminant of drinking water in Bangladesh? Where does the arsenic come from, what are the properties of the different chemical forms (species) of arsenic present in the environment and what conditions promote transformation between the species. What options are available to reduce human exposure to arsenic and who do you think should pay to implement them? (60%)

**Question 2:**

You work for the Environment Agency of England and Wales and you are responsible for planning water quality monitoring programmes. You receive a phone call from a colleague in the United States to say that they have just detected the presence of a number of TXT chemicals in rivers of north-eastern USA.

TXT's are a group of chemicals that are present in various industrial and household cleaners. You have information that there are 90 TXT chemicals registered for use in England and Wales. You decide to undertake some rapid monitoring to investigate whether or not these chemicals are a potential threat to water quality in the UK. You have sufficient funds to collect thirty water samples and to analyse each for ten of the TXT chemicals (must be the same ten chemicals in each sample).

(a) Describe with reasons what information would you need to collect in order to determine which of the 90 TXT chemicals in use you should select to analyse? How could you handle any gaps in data availability? (60%)

(b) Describe your design for the monitoring programme. What type of locations would you monitor? How would you decide where to monitor, how frequently and at what times of the year? (40%)

**Question 3:**

(a). The World Health Organisation estimates that the global burden of disease due to indoor air pollution is greater than that due outdoor air pollution. Identify two factors that might lead to greater effects of indoor air pollution and for each of the factors explain in 1-2 sentences why they are important (20%).

(b) Explain the difference between primary air pollutants and secondary air pollutants and describe in 1-2 sentences why secondary pollutants are typically dispersed over a wider geographical scale than primary pollutants (20%).

(c). The concentrations of air pollutants measured at an urban monitoring station typically vary by about two orders of magnitude over the course of a year. Discuss the factors leading to this large variation in concentrations, explaining why each of them is important in influencing the measured concentrations (60%).

**Question 4:**

(a) Explain the main features of the equilibria established between carbon dioxide ($CO_2$), carbonate ($CO_3^{2-}$) and bicarbonate ($HCO_3^-$) in the oceans, including the interfaces with the atmosphere and deep-sea sediments. What are the main features of the oceanic environment that arise from these equilibria in an unpolluted environment? (60%)

(b) It is estimated that 90 gigatonnes of carbon are transferred in both directions across the ocean-atmosphere interface in an unpolluted environment. How do rising levels of carbon dioxide in the atmosphere affect this balance? Describe two projected consequences for the oceans and indicate whether we have evidence that the properties of the ocean are already changing. (40%)

**Question 5:**

(a) Explain what is meant by the terms “empirical model” and “mechanistic model”. Identify two advantages for each type of model. (20%)

(b) Explain what is meant by the term “sensitivity analysis” and how “uncertainty analysis” differs from sensitivity analysis. Why is sensitivity analysis an important tool to evaluate the structure of a model? Identify and briefly describe (1-2 sentences) four sources of uncertainty in environmental models. (30%)

(c) A dioxin is continuously released at small concentrations into the atmosphere from an incineration plant. Draw a schematic representation of a model to predict how the dioxin will partition between the different environmental compartments, including any compartments, flows, parameters and variables. Explain in 2-3 sentences why dioxins have been distributed around the globe when they have relatively low volatility and solubility. (50%)