CIVE 3331 - ENVIRONMENTAL ENGINEERING
Spring 2003

Document Name: CIVE3331_Exercises_014.doc

Purpose: Exercises related to Lecture # 14. These exercises develop skills in selected environmental groundwater quality problems. Critical thinking is exercised in determination of analogies between lecture examples and the problems in this exercise set. Direct relationships to various accreditation objectives are highlighted in **Bold** type in the following sections. The exercises start on the next page.

Relevant ABET EC 2000 Criteria: Criterion 3 Program Outcomes and Assessment

(3-a) an ability to **apply knowledge of** mathematics**, science,** and engineering.
(3-e) an ability to identify, formulate, and solve engineering problems.
(3-k) **an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.**

Relevant CEE Educational Objectives:

(3) Emphasize problem-identification, problem-formulation and **communication skills**, **problem-solving techniques** and the **many facets of engineering design** throughout the curriculum.

(5) **Prepare every student to develop the skills for critical thinking and lifelong learning.**

Relevant CEE Program Outcomes:

ii. **Students should acquire the ability to solve practical civil engineering problems by applying the knowledge of mathematics, science**, **engineering, modern techniques**, **skills and practical tools they gained in their courses.**

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Exercise_014-1

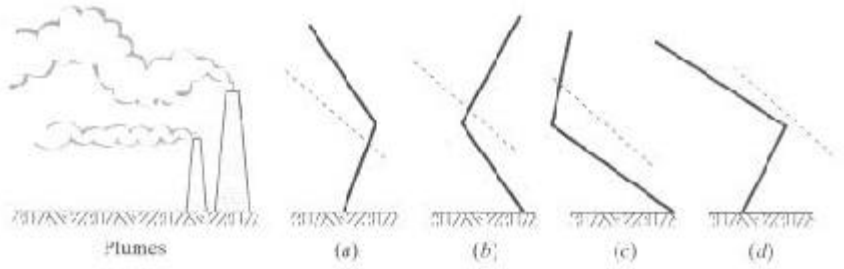
Suppose the following temperature profile is collected.

Altitude (m)	Temp (^{o}C)
0	20
100	18
200	16
300	15
400	16
500	17
600	18

a) What would the mixing depth be?
b) How high would you expect a plume to rise if it is emitted at 21^{o}C from a 100-m stack if it rises at the dry adiabatic lapse rate?
c) Would you expect the plume to be looping, coning, fanning, or fumigating?

Exercise_014-2

A tall stack and a nearby short stack have plumes as shown below. Which atmospheric temperature profile is most likely based on the two plume shapes? The dashed lines are the dry adiabatic lapse rate.



Exercise_014-3

Suppose 30oC ground air has a dew point of 14^{o}C. The atmosphere is unstable and there are rising parcels of air.

a) Estimate the altitude at which clouds begin to form if the dew point drops 2^{o}C/km.
b) If air continues to rise, estimate its temperature at an elevation of 3km. (Assume dry lapse rate until clouds form, followed by the wet rate as air continues to rise).
c) If an air parcel that started at ground level, rose to 3km, then fell back to ground level – what would its temperature be if the movement was entirely adiabatic?

Exercise_014-4

Find the residence time for a 10 μm particle with unit density at 1000 m elevation.

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Exercise_014-5

Find the settling velocity of a 20 mm particle with density 1500 kg/m3.

a) If this particle had been hurled to a height of 8000 m during a volcanic eruption, estimate the time required to reach the ground. Assume that viscosity of air does not change enough to matter.
b) If the winds average 10 m/s how far away will the particle be blown on its way down?

c) Exercise_006-6

Document History:

Author	**Action**	**Date**	**Archive File Name**
Theodore G. Cleveland	Created	January 23, 2003	CIVE3331_Exercises_009.PDF