

National Exams December 2019

18-Env-B4: Site Assessment and Remediation 3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is an OPEN BOOK EXAM.
Any non-communicating calculator is permitted.
3. Answer:
 - a) FOUR (4) of the FIVE (5) questions in Section A
 - b) ONE (1) of the TWO (2) questions in Section B.

Only the first four questions and the first question in each section will be marked as they appear in the answer booklet.
4. Each question is of equal value at 20 marks.
5. Questions require calculation and/or answer in essay format. Clarity and organization of the answer are important.
6. Clearly state and justify your assumptions in the beginning of your answers.

Section A: Answer only **Four** out of the following **Five** Questions

- A-1) Two trucks collided at a chemical transfer station, releasing perchloroethylene (PCE) onto the gravel parking lot. Approximately 10,000 L of PCE was released. Quick response by the operators with sorbent material captured nearly 90% of the PCE. The parking lot is sloped toward a ditch that on the edge of the parking lot. The spill happened about 20 m from the ditch. The soil type for the entire property is silty loamy. Describe the potential migration pathways that exist for the spilled PCE. How would you rate the risk of the spill reaching the drainage ditch? What type of sampling is needed to determine the extent of the spill?
- A-2) The GM Assembly plants are slated to close in Oshawa. What kind of preliminary site assessment needs to be completed before redevelopment of the property? Are samples required? If yes, what kind? Which site clean-up standards would you use?
- A-3) Toronto is facing a housing shortage. Brownfields are a potential source of properties that are ideal for redevelopment. Why should Toronto redevelop Brownfields? Discuss the advantages and disadvantages of doing so.
- A-4) Tailing, the development of mass transfer resistance, frequently happens when using soil vapour extraction (SVE) to remediate spilled gasoline in most types of soil. Tailing hinders the successful remediation of the site by minimizing the removal of petroleum hydrocarbons, preventing site closure. Bioventing is a remediation technology that could reduce the remaining contamination to a level below clean-up standards. Describe how you would implement bioventing and discuss why it is so effective.
- A-5) Consultants and clients are always looking for the quickest and cheapest way to remediate a site. In the past, "dig and dump" was such an approach. If your client has an industrial property that is contaminated with hydrocarbons, PAHs and heavy metals, would you consider the "dig and dump" approach? Discuss the merits and challenges of using "dig and dump"? Is a RSC required for the site post "dig and dump"?

Section B: Answer only **One** out of the following **Two** Questions

B-1) A subsurface investigation was completed at an abandon industrial property, and the presence of trichloroethylene (TCE) was detected in the soil. The soil concentration was 15000 g/kg on a wet basis. The dry bulk density of the soil was 1900 kg/m³, with a porosity of 0.35. The volumetric water content of the soil was 0.20 %, with an organic carbon content fraction of 0.03. The properties of TCE are as follows:

Chemical formula: C₂HCl₃

MWT: 131.4

Solubility at 20°C = 1,100 mg/L

Dimensionless Henry's Law Coefficient = 0.38

K_{ow} = 263

K_{SD} = 6.3 x 10⁻⁷ · f_{OC} · K_{ow}

Estimate the distribution in grams for the TCE in the various phases: water, air and on the soil. Assume no pure TCE exists in the soil.

B-2) A farmer's above ground gasoline tank started leaking. A significant amount was released before it was detected. Approximately 300 m³ of contaminated soil was excavated into a pile, with an average concentration of 800 mg/kg. The gasoline can be represented by C₇H₁₆. Soil conditions are sandy loam (Sand @ 62%; Clay @ 14%; OM @ 2.1 %, CEC @ 5.5 cmol/kg) with a density of 1400 kg/m³, porosity of 0.35, the water content of 25% (wt) and temperature 20°C. Gasoline density at 755 kg/m³.

- i) How much gasoline was released from the tank?
- ii) If bioventing is used to treat the contamination in the excavated pile with buried pipes, how many air exchanges are needed to satisfy O₂ consumption and promote bioventing if oxygen conversion is 50% efficient?