

Schriftliche Prüfung Analytical Strategy Sommer 2014

Vorname : _____ Name : _____

- Zeit: 60 Min. Teilen Sie sich Ihre Zeit gut ein.
Time: 60 min, organize your time carefully.
- Sie können auf Englisch oder Deutsch antworten
Answers are accepted in German or English.
- Es sind alle Hilfsmittel mit Ausnahme von Computern und Telekommunikation erlaubt.
It is allowed to use all resources except for computers and communication devices.
- Unleserliche Texte, unklare Formulierungen oder unsaubere Skizzen können nicht bewertet werden. Bitte bemühen Sie sich um eine saubere Darstellung.
Unreadable text, unclear formulations or graphs are not graded. Please try to use clear illustrations and descriptions
- Schreiben Sie jedes abzugebende Blatt einzeln mit Ihrem Namen und Vornamen an.
Label every page with name and surname.
- Dieses Deckblatt ist ausgefüllt abzugeben. Die Aufgabenstellung ist ebenfalls einzureichen.
Please fill in the first page. Hand in all pages including cover page and questions.
- Wir bitten Sie um Fairness und wünschen Ihnen viel Erfolg!
We ask you for fairness and wish you good luck!

Prüfungsaufgabe Sommer 2014 - Analytische Strategie

You are the responsible scientist at the Zurich Water Works, and receive a call from a company located at the shore of the lake of Zurich, informing you that they had a chemical spill and suspect that a large quantity of chromium got released into the lake. This might be dangerous because the water purification stations Moos and Lengg together retrieve 330'000 m³/day water from the lake to be used as drinking water. The World Health Organization recommended maximum allowable concentration in drinking water for Cr(VI) is 50 µg/L; the LD50 for Cr(VI) is 100 mg/kg body weight.

Answer the following questions:

1. The lake of Zurich has an area of 88 km², and is fairly flat, with an average depth of 44.3 m. Assuming a uniform distribution, calculate the amount of Cr that needs to be released into the lake to reach the maximum allowable drinking water concentration. Do you consider it probable that such a chemical spill reaches dangerous levels as defined by the WHO, still assuming uniform distribution of Cr?
2. The company estimates that a total amount of 100 kg Cr was released into the lake. If the location of the spill is close to the intake of the water purification plant, local Cr concentrations could be 10'000 times higher compared to uniform distribution throughout the lake. Based on the results of (1.), and using such an elevated concentration near the water intake, what measures do you propose to either calm down, only inform, or to warn the population? What measures do you propose accordingly for the nearby water purification plant?
4. Under the assumption of an elevated concentration as specified in (2.), how much water would you have to drink to reach the LD50? Is it a likely scenario that someone gets poisoned?
5. Propose *three* different analytical methods that are sensitive enough to determine the Cr concentration at the inlet of the water purification plant and in the purified water. One of these should be able to measure Cr (VI) in an on-line fashion. Do you expect a large difference between the measurements taken at the inlet and at the outlet?
6. It turns out that speciation of Cr is important, with Cr (III) and Cr (VI) being the most abundant oxidation states. Cr (III) is considered an essential nutrient, whereas Cr (VI), occurring mainly in the form of chromate (CrO₄²⁻) and dichromate (Cr₂O₇²⁻) is toxic. Propose a detection method that allows the *simultaneous* determination of low concentrations (ppb) of these different Cr species.