Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Written Exam
529-0043-00S - Analytical Strategy
Winter 2017

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.

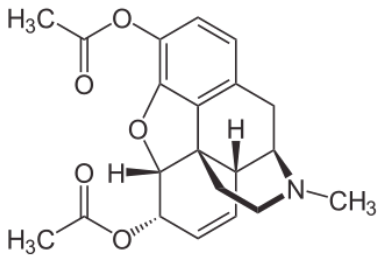
- Dieses Deckblatt ist ausgefüllt abzugeben. Die Aufgabenstellung ist ebenfalls einzureichen.
  Please fill in the first page. Hand in all pages including cover page and questions.

- Wir bitten Sie um Fairness und wünschen Ihnen viel Erfolg!
  We ask you for fairness and wish you good luck!

Prüfung Winter 2017 / Analytical Strategy

(Answers can be given in German or English)

You are commissioned with the surveillance of suspected (and of course prohibited) heroin and morphine use in a prison. Heroin is diacetylated morphine, with the structure shown in the figure. A euphoria-inducing drug with a large potential for addiction, heroin is typically injected, which leads to the fastest action, but can also be smoked, snorted, or swallowed (decreasingly slower action). Heroin itself has a very short half-life in the body (few minutes); the de-acetylated form, morphine, on the other hand, has a half-life of ≈ 3 h. Other downstream metabolites have even longer half-lives.



Answer the following questions:

1. What metabolites of heroin and morphin do you expect to find in samples of human origin? Draw the structures! What do you think is the general fate of the parent drugs (heroin and morphine) and their metabolites in the organism, i.e., what happens after the effects of the drugs have worn off? (2P)

2. Propose an analytical method to detect and quantify heroin and morphine in solution (= moderately clean sample in aqueous or organic solution). How does the analytical method have to be designed to be able to detect both the parent compounds as well as their metabolites? Be as specific as possible when describing the analytical system and procedure for identification and quantitation. (3P)

3. Propose a way to assess the overall level of illicit drug use in the prison without taking samples from individual inmates, in order to do the assessment in a clandestine way. What information can one obtain from this procedure? (1P)

4. Propose a way to test individual inmates for suspected drug use within 1 day of drug consumption. (1P)

5. A single dose of heroin of 50 (injected) mg for a heavy drug user is typical. Estimate, for target molecules (e.g., a metabolite) of your choice, the limits of detection needed in the methods you proposed for questions 3 and 4 to unambiguously determine that heroin is being used in the prison as a whole (Q3) and by an individual (Q4). Specify your assumptions. (3P)

6. Propose a strategy to follow an individual inmate's drug use over longer periods of time (weeks - months). In what sense does the analytical method have to be adapted? (2P)

(Max. 12 Points)