

Written Exam
Analytical Strategy
Summer 2013
MSc CHAB

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!

Exam Analytical Strategy Summer 2013

When determining air pollution, the contents of **elemental carbon (EC)** and **organic carbon (OC)** in aerosol fractions are of great interest.

One operational definition of the two fractions is:

- OC is the carbon that produces CO₂ from an aerosol heated in a helium atmosphere at low temperature (below 550°C)
- EC is the carbon that produces CO₂ from an aerosol heated in an oxygen atmosphere at high temperature (above 550°C)

Modern legislation demands that all particulate matter with a diameter of less than 10 μm (PM10), or sometimes even less than 2.5 μm (PM2.5), is analyzed. In Switzerland the legal limit for PM10 is 20 μg/m³ annually (arithmetic mean), and a 24-hour average of 50 μg/m³ that may only be exceeded once per year.

Please answer the following questions:

1. Propose a method to measure the size distribution of particulate matter in polluted air, taking into account that aerosol particles cover a large size range (10⁻⁹ - 10⁻⁴ m).
Comment on what limits the lower and upper size that can be measured by your proposed method.
2. How would you sample normal air (i.e. not heavily polluted) to collect measurable quantities of PM10?
Be specific in terms of describing the sampling method, the volume of air, the flow speed, etc. assuring that PM10 is quantitatively retained.
3. There are other operational definitions of EC and OC. What, in your opinion, could be possible problems of the definition given above
4. What other carbon fractions (except for EC and OC) could contribute to the total carbon in the aerosol?
5. Propose a simple, cost effective set-up to quantitatively determine EC and OC in collected particulate matter simultaneously. How would you calibrate your measurements?
6. Imagine that you would have to determine the highly complex molecular composition of the OC fraction.
Which state-of-the-art analytical method (or combination of methods) would you apply to determine the molecular composition as comprehensively as possible? What are the main challenges? Based on this, justify your strategy and sketch an analytical protocol.