

## **FIRST MIDTERM EXAM**

### **Analytical Chemistry II**

- It is not allowed to put any additional items (e.g. cell phone) on the desk.
- You have to hand in the exam paper before leaving the classroom.
- You can answer in English or Mandarin language.
- Write down the answers on the answer sheet. Sign the answer sheet.
- Indicate the task number before answering.
- Do not use pencil; use pen.
- Answer every part of each task.
- Handwriting must be clear.
- Every item in the drawings must be clearly labeled.
- For each task, you can get 20 points (10 points for each part – a and b).
- If you cheat, you will get 0 points from this exam.

#### **Task 1:**

- a) What electronic components can be used to amplify weak electric signals?
- b) Draw a schematic of a simple amplifier circuit used to measure low voltage/current.

#### **Task 2:**

- a) What types of noise can we observe in signal measurements? Give 2 examples.
- b) How can we decrease/remove noise from the signal? Give 2 examples.

#### **Task 3:**

- a) Provide the formula for Beer's Law.
- b) Explain all the constants and variables in this formula.

#### **Task 4:**

- a) Draw a simplified scheme of atomic absorption spectrometer indicating its all main components.
- b) What kinds of light sources can we use in atomic absorption spectrometry? Draw the scheme and explain the principle of one common light source used in this technique.

#### **Task 5:**

- a) What interferences may occur in atomic absorption spectrometry? Give 2 examples.
- b) What method can we use to eliminate these interferences? Give 1 example.

## **SECOND MIDTERM EXAM**

### **Analytical Chemistry II**

- It is not allowed to put any additional items (*e.g.* cell phone) on the desk.
- You have to hand in the exam paper before leaving the classroom.
- You can answer in English or Chinese language.
- Write down the answers on the answer sheet. Sign the answer sheet.
- Indicate the task number before answering.
- Do not use pencil; use pen.
- Answer every part of each task.
- Handwriting must be clear.
- Every item in the drawings must be clearly labeled.
- For each task, you can get 20 points (10 points for each part – a and b).
- If you cheat, you will get 0 points from this exam, and the school will be notified.

#### **Task 1:**

- a) Draw schemes of (i) an absorption spectrophotometer, and (ii) an absorption photometer.
- b) In which case, would it be sufficient to use photometer rather than spectrophotometer?

#### **Task 2:**

- a) Draw a scheme of a spectrofluorometer.
- b) Explain the function of every part shown in the scheme.

#### **Task 3:**

- a) Draw a scheme of a Fourier transform infrared (FTIR) spectrophotometer.
- b) Explain what is the main advantage of FTIR spectrophotometer in comparison with dispersive IR spectrophotometer.

#### **Task 4:**

- a) Draw Jablonski diagram indicating various possible pathways of excitation and deexcitation in molecular spectroscopy.
- b) Explain the differences between fluorescence and phosphorescence.

#### **Task 5:**

- a) Define “quantum yield of fluorescence”.
- b) List three of the major factors that influence quantum yield of fluorescence, and explain why they are important.

## FINAL EXAM

### Analytical Chemistry II

- It is not allowed to put any additional items (e.g. cell phone) on the desk.
- Sign the exam paper, and sign the attendance list at the beginning of the exam.
- You have to hand in the exam paper before leaving the classroom.
- You can answer in English or Chinese language.
- Write down the answers on the answer sheet. Sign the answer sheet.
- Indicate the task number before answering.
- Do not use pencil; use pen.
- Answer every part of each task.
- Handwriting must be clear.
- Every item in the drawings must be clearly labeled.
- For each of the 10 tasks, you can get up to 10 points.
- If you cheat, you will get 0 points from this exam, and the school will be notified.

#### Task 1:

- (i) What is the operational principle of HCL lamp used in atomic absorption spectrometry?
- (ii) Why don't we use HCL lamp in molecular absorption spectrometry?

#### Task 2:

Why are the bands in molecular ultraviolet absorption spectra usually broad while the peaks in mass spectra are usually narrow?

(Explain this phenomenon taking into account the principles of these techniques.)

#### Task 3:

- (i) Compare the mechanism of inductively coupled plasma (ICP) ion source and electrospray ion (ESI) source, used in mass spectrometry.
- (ii) To what kinds of samples/analytes would you apply each of these two ion sources?

#### Task 4:

- (i) Give an example of a tandem-in-space mass spectrometry system.
- (ii) Why do we use tandem mass spectrometry in chemical analysis?

#### Task 5:

- (i) What are *hyphenated* chromatographic methods?
- (ii) Draw detailed scheme of one hyphenated chromatographic instrument.