Physical Chemistry Experiments (A)

Applied courses Physical Chemistry Experiments (A)
Total experimental hours: 48
Course credit hour: 1.5
Course name: Physical Chemistry Experiments (A)
Scheme foundation: the requirement for this course in the scheme A of Physical Chemistry.

A Experimental type and experimental properties

Experimental type: basic subject course

Experimental properties: proving experiment, operating experiment

B Applied majors for the experiments and its schedule

Applied majors: chemical engineering and processing, material science and engineering, pharmaceutical engineering.

The schedule is arranged in the third and fourth semesters.

C Experimental purpose and basic requirements

1. Experimental purpose:

1) Learn to comprehend the research methods for physical chemistry, learn some experimental skills in the physical chemistry experiments, develop students' abilities for observing, analyzing and solving problems.

2) Learn to perform experimental data reduction by graphing method and calculating method, learn to judge the reliability of experimental results and to analyze the main error sources comprehensively by applying both the theoretical and experimental knowledge.

3) Test and verify the validity of the main theories of physical chemistry to comprehend these theories further.

4) Develop serious and seeking the truth science attitude.

2. Basic requirements:

The requirements for students through physical chemistry experimental training are listed as below:

1) Master the basic temperature measurement and controlling technique and its principles

(1) Normal temperature measurement;

(2) High temperature measurement;

(3) Temperature difference measurement;

(4) Constant temperature control;

2) Heat measurement technique

3) Methods and principles for gas pressure measurement and constant pressure control

(1) Atmospheric pressure measurement;

(2) Pressure measurement for low vacuum system;

(3) Constant pressure control

4) Technique and principles for electrical measurement

(1) Electric conductance measurement;

(2) Electromotive force measurement for galvanic cell;

5) Technique for simple optical measurement

(1) Refraction ratio measurement;

(2) Polarimetry;

6) Comprehend the measurement principles and application methods for the following instruments:

(1) Instruments for temperature measurement and control:

a) Application and correction of mercury thermometer;

b) Structure, adjustment and application methods of Beckman thermometer;

c) Temperature measuring principles, application and correction of thermocouple;

d) Structure and application of conductivity meter;

e) Application of digital thermometer;

f) Temperature controlling principles and application of relay;

(2) Instruments for gas pressure measurement:

a) Structure, application and correction of atmospheric pressure meter;

b) Application of U type pressure meter;

c) Principles and application of pressure gauge;

d) Application of gas relief pressure valve;

(3) Instruments for electrical measurement:

a) Chemical composition, structure, application and correction of standard cell;

b) Structure, application and correction of calomel electrode;

c) Preparation, application and correction of Ag AgCI electrode;

d) Selection and application of conductive electrode;

e) Preparation and application of salt bridge;

f) Application of galvanometer;

g) Application of DDS-11A conductivity meter;

h) Application of regulated power supply;

i) Application of recorder;

(4) Instruments for optical measurement:

a) Structure, principles and application of Abbe refractometer;

b) Structure, principles and application of polarimeter;

(5) Instruments for heat measurement:

a) Structure and application of bomb calorimeter;

(6) Instruments for constant temperature;

a) Structure and application of ebulliometer;

b) Installation and application of glass thermostatic bath;

c) Application of super thermostatic bath;

(7) Instrument for vacuum technique:

a) Principles and application of mechanical vacuum pump

D. Experimental grouping and contents:

SN	Contents	Experimental hours	Basic teaching requirements	Experimental character	Required/ selective	Students number each group
1	The control and application of thermostatic bath Measurement of liquid viscosity	4	1. Have a good command on the structure of thermostatic bath and its temperature controlling principles and methods. 2. Have a good command on the structure of Beckman thermometer and its adjustment technique and application methods. 3. Comprehend the structure of Ubbelode viscometer and its application methods. 4. Be further familiar with the controlling methods of thermostatic bath and its applications.	operating	required	2
2	Measurement of enthalpy of combustion	4	1. Comprehend chemical calorific effect and the definition of combustion heat further. 2. Comprehend the principles, structure and application methods of calorimeter, and obtain the general knowledge and basic training of thermochemistry. 3. Measure the combustion heat of naphthalene by oxygen bomb calorimeter.	Operating, proving	required	2
3	The equilibrium	4	1. Comprehend the measuring method of gas-liquid equilibrium criterion in	Operating,	required	2

	phase diagram of mutually soluble gas-liquid system		constant pressure (atmospheric pressure), determine the equilibrium criterion of ethanol-cyclohexane system by ebulliometer and plot T X phase diagram. 2. Comprehend the structural features of ebulliometer. 3. Master the structure, principles and application methods of Abbe refractometer.	proving		
4	Measurement of liquid saturated vapor pressure	4	1. Comprehend the concept of gas-liquid equilibrium in unit system and Clapeyron-Clausius equation further 2. Master the operating methods and principles of decompression and constant pressure systems. 3. Comprehend the structure of pressure gauge and its application and correction methods. 4. Be familiar with application of digital pressure gauge for low vacuum system.	Operating, proving	required	2
5	The decomposition of amino formate amide	4	1. Measure the decomposition pressure of amino formate amide to get the reacting standard equilibrium constant and other related thermodynamic functions. 2. Comprehend the structural principles and application methods of vacuum pump; learn to know the methods for obtaining low vacuum degree.	Operating, proving	required	2
6	Plot the phase diagram of binary alloy systems	4	1. Learn to comprehend the basic principles of plotting phase diagram by thermoanalysis through Bi-Sn binary system. 2. Master the principles of electric potential generation due to temperature difference and the temperature measuring method of thermocouple 3. Master the working principles of DC potential difference meter and the measuring methods of electromotive force	Operating, proving	required	2
7	Measurement of electromotive	4	1. Master the principles of electromotive force measurement for cells by compensation method and the structural principles and correct application	Operating, proving	required	2

	force of cells		methods of DC potential difference meter. 2. Learn to prepare salt bridge and some electrodes. 3. Master the measuring methods and its applications of electromotive force for reversible cells. 4. Master the structure, principles, application methods and attention rules of standard cells.			
8	Measurement of adsorption of solution surface	4	1. Master the method to measure surface tension (maximum bubble method). Comprehend the relationship of bubble pressure, bubble radius and surface tension further through the measurement of bubble maximum pressure. 2. Measure surface tension of sec-Butanol water solution in different concentrations, calculate solution surface adsorption capacity and surface area occupied by each molecular when it is adsorbed according to Gibbs adsorption isothermal formula. 3. Be familiar with the applications of digital micro pressure difference meter.	Operating, proving	required	2
9	Measurement of the constant of hydrolysis rate for sucrose	4	1. Determine the constant of reaction rate, half-life and activation energy during sucrose transformation. 2. Comprehend the relationship of reactant concentration and optical rotation in this reaction. 3. Comprehend basic structural principles of polarimeter, master its correct application methods and operating technique	Operating, proving	required	2
10	Measurement of saponification reaction rate for acetic ester	4	1. Master the principles of electrolytic conductivity measurement and the application methods of conductivity meter 2. Measure the variation of electrolytic conductivity during saponification reaction for acetic ester, so as to calculate the constant of reaction rate. 3. Determine the constants of saponification reaction rate for acetic ester to obtain the reaction activity energy.	Operating, proving	required	2

11	Measurement of molar mass by freezing point depression method	4	1. Learn the technique and methods of freezing point measurement 2. Determine the molar mass of naphthalin by freezing point depression method 3. Plot the cooling curve 4. Comprehend the colligative properties of dilute solutions further	comprehensive	required	2
12	Experimental examination	4	Basic experimental principles, basic operations, instrumental application methods and attention rules, cautions, etc.	Operating, oral		2

E. Examination methods:

1. Mean time score (50%): The mean time grade is given according to students' experiments combined with experimental reports.
2. Final experimental examination (50%): Among all the done experiments, the basic operation and attention rules of some ones will be supplied as the examination contents. With two students in one group to draw the examination contents, the score is evaluated according to the operating situations.