

Analysis of Core Competencies from the 2023 College Entrance Examination Chemistry Experimental Questions Implement and Cultivate

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Abstract: “Chemistry experiment” is one of the key contents of high school chemistry learning, and it is also a necessary way to develop students’ core literacy in chemistry. This article focuses on the experimental question section in the 2023 National College Entrance Examination Paper, analyzes the test points and proposition characteristics from multiple dimensions such as content, context, presentation method, score and score ratio, and puts forward suggestions that are consistent with teaching practice and provide guidance for the chemistry teaching process. Provide reference for the cultivation of core competencies.

Keywords: College entrance examination chemistry; Experimental questions; Core literacy

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Introduction

Core Competencies In order to implement the fundamental task of cultivating moral character and cultivating people, each discipline has condensed the core competencies of the subject based on the nature of the subject, and clarified the correct values, necessary character and key abilities that students should achieve after studying the course ^[1]. “General High School Chemistry Curriculum Standards (2017 Edition)” proposes that the core competencies of the chemistry subject are divided into five dimensions, “macro identification and micro analysis”, “changing concepts and balanced thinking”, “evidence reasoning and model cognition”, “scientific inquiry and innovation” Awareness” and “Scientific Attitude and Social Responsibility”^[2]. The new curriculum actively implements the integration of “teaching, learning, and assessment” and strives to enable students to develop well in all aspects of their chemistry core competencies^[3].

The goal and purpose of research

In addition to imparting knowledge, teachers hope that students will have a broader vision, deeper thinking and more solid literacy in the process of learning chemistry^[4]. In order to further study the implementation of core competencies in college entrance examination questions, this study takes the experimental questions in the 2023 college entrance examination chemistry test paper as the object, analyzes and puts forward suggestions from multiple dimensions such as content, context and score ratio, for front-line chemistry teachers Provide reference for implementing core competencies in propositions and teaching.

The test content and knowledge points of the experimental questions were analyzed The author made statistics on the test contents of 3 sets of experimental questions for the 2023 Chemistry College Entrance Examination (Table 1).

Table 1 Contents of 2023-year college entrance examination chemistry experimental questions

Test paper	Question number	Investigation	Inspection content
Nationwide A examination paper	9	Chemical experiment basics	Instruments needed to prepare solutions of a certain concentration
	26	Chemical process flow questions	Purpose of reagents and reasons for reagent selection
	27	Comprehensive chemistry experiment questions	Preparation of inorganic cobalt complexes
Nationwide B examination paper	9	Judgment of experimental devices	Preparation of CO ₂ , separation of acetic acid and ethanol, SO ₂ acidity test, determination of gas volume
	26	Comprehensive chemistry experiment questions	C ₄ H ₆ O ₄ using Liebig elemental analysis method
	27	Chemical process flow questions	Reagent selection and reasons
Shandong examination paper	2	Chemical experiment basics	Basic properties of common inorganic and organic substances
	4	Chemical experiment basics	Solution to laboratory safety issues, basic operations of chemical experiments, commonly used instruments and usage specifications
	6	Chemical experiment basics	three solutions: NaClO, Ba(OH) ₂ and Al ₂ (SO ₄) ₃
	8	Chemical experiment basics	Basic operations and steps of acid-base neutralization titration experiments and related instruments
	10	Chemical experiment basics	Application of acid-base neutralization titration principle, error analysis of acid-base neutralization
	17	Chemical process flow	H ₂ CO ₃ using high magnesium brine as raw material, chemical experimental evaluation
	18	Chemistry experiment comprehensive	Preparation of trichlorosilane

The statistical results show that the selected test papers test various types of experimental questions. The inspection content is ① understanding and operation of basic experimental instruments, ② testing the writing of equations, ③ preparation, identification, testing and inference of substances and ④ analysis of experimental phenomena.^[3]

College Entrance Examination Experimental Questions Analysis, Evaluation and Suggestions

(1) Multiple choice case

(National Volume B·9) The following devices can be used for corresponding experiments ()

A	B	C	D
Preparation CO ₂	Separation of ethanol and acetic acid	Verify SO ₂ acidity	Measure O ₂ volume

A. A

B. B

C. C

D. D

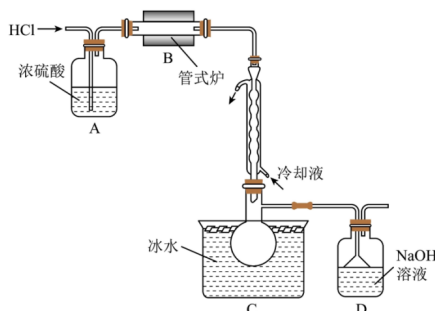
This question is based on the basic operations of chemical experiments as the background, and the questions are presented in the form of tables to test students' mastery of the basic operation methods and principles of chemical experiments. For teaching the basics of chemical experiments, teachers can carry out extracurricular activities and provide materials to allow students to design experiments independently, giving students a more realistic experience. Based on this, students can cultivate students' inquiry and innovative thinking and cooperation awareness, and exercise students' hands-on ability and independent thinking ability^[4].

(2) Comprehensive test case

This question is based on the real situation of preparing SiHCl₃ crude product, and the students' mastery of basic knowledge of

the subject is tested through the experimental device diagram. For this type of questions, teachers can carry out scientific activities so that students can more deeply remember the basic operations of experiments, and develop students' "evidence reasoning and model cognition" and "scientific inquiry and innovation consciousness"[2].

(Shandong Volume·18) Trichlorosilane (SiHCl_3) is an important raw material for producing high-purity silicon. It is a colorless liquid at room temperature, with a boiling point of 31.8°C and a melting point of -126.5°C , and is easily hydrolyzed. According to the reaction $\text{Si} + 3\text{HCl} \xrightarrow{\Delta} \text{SiHCl}_3 + \text{H}_2$, the laboratory uses the following equipment to prepare SiHCl_3 crude products (heating and clamping equipment are omitted). Answer the following questions:



SiHCl_3 Operations during preparation: (i)...; (ii) Place the porcelain boat containing the calcined powder in the tube furnace; (iii) Pass it in HCl , turn on the condensation device after a period of time, and heat to start the reaction. Operation (i) is _____. The experimental phenomenon to judge the end of the preparation reaction is _____. The two shortcomings of the device shown are that _____.

Suggestions

Pay attention to the connection between chemistry and life Chemistry is closely related to life. When teaching new courses, teachers should connect them with real life, stimulate students' interest in learning through real situations, and guide students to apply and learn new knowledge in the process of solving problems[5].

Strengthen the ability of experimental inquiry Chemistry is an experiment-based science. Teachers must understand the content and goals of experimental teaching in middle schools. They should arrange teaching reasonably during review, appropriately guide students to conduct real experimental inquiry, and make good use of chemical experiments to serve teaching[4].

Constructing a cognitive model Teachers need to pay attention to the logical relationship between knowledge points during the teaching process, reasonably plan blackboard writing, guide students to actively participate in inquiry activities through selected examples, and apply cognitive models[6].

References:

- [1]Feng Jialiang. Research on teaching design based on core competencies of chemistry subject [D/OL]. Southwest University, 2021.
- [2]Nong Xueying. High school chemistry teaching practice based on the core competencies of the subject - taking the teaching of "the simplest aromatic hydrocarbon-benzene" as an example [J]. Middle School Teaching Reference, 2021(5): 61-63.
- [3]Ran Jia. Research on college entrance examination chemistry experimental questions based on core competencies of the subject [D/OL]. Southwest University, 2021.
- [4]Shi Yimin. Research on the implementation status and development of general high school chemistry courses from the perspective of core literacy [D/OL]. Sichuan Normal University, 2020.
- [5]Li Qiao, Yan Chungeng, Wang Limin, et al. Analysis and Enlightenment on the Characteristics of Chemistry Experimental Questions in the 2020 College Entrance Examination [J/OL]. Chemistry Education (Chinese and English), 2021, 42(9): 6-11.
- [6]Yu Yang. Core competencies corresponding to the chemistry organic test questions of Zhejiang New College Entrance Examination - Taking the 2018-2020 test questions as an example [C/OL]. New Curriculum Research Magazine, 2021: 30-31.

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