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# INTERDISCIPLINARY INTEGRATION IN TEACHING CHEMISTRY

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**Abstract**
In this article, the prospects for the development of students' knowledge and skills in interdisciplinary relations, which are considered a priority part of modern education, and the didactic foundations are disclosed. It is expressed how effective the lessons organized in the process of mastering are related to other subjects. The article shows ways to increase the effectiveness of education and solve problems in mathematical methods within the framework of harmony of chemistry with mathematics.

**Keywords**: scientific and popular methods, discriminant, chemical equilibrium, equilibrium constant, quadratic equation, teaching tools, mixture, object, subject.

The connection between chemistry, mathematics, physics, biology, geography, natural science and ecology taught in general education, academic lyceum, and vocational schools is multifaceted and of particular importance. Because chemical laws were expressed in the form of formulas - mathematical equations. mathematical formulas are used in the analysis of chemical phenomena and drawing conclusions. In addition, mathematical concepts come in handy when solving problems and performing laboratory work. It is important for students to be able to independently work on problems and exercises to strengthen their theoretical knowledge of chemistry. The ability to solve problems allows school, lyceum and vocational college students, as well as students of higher educational institutions, to deeply study and understand many chemical processes and laws. In some manuals intended for students entering a higher educational institution, solving problems is considered a secondary task. Attention is not drawn to the characteristics of various types of problems and the method of solving them. Nowadays, it is not a secret to anyone that the education organized based only on the work and skills of the pedagogue does not give good results. Now the main task of the pedagogue is not to give students ready knowledge, but to help them acquire knowledge independently. For this, it is necessary to improve the educational process to the extent that allows students to fully demonstrate their abilities and opportunities and spend all their energy on learning. Now, in the teaching process, effective use of various methods and teaching tools, which do not make students bored and guide them to think and work independently, is gaining importance. Because the student is considered an object in the traditional teaching process, but today he is becoming a subject. Our goal is to introduce scientific and popular methods of solving problems in chemistry to students of general secondary schools, academic lyceums and vocational colleges, to use the most convenient methods of solving problems in chemistry, to solve problems of students' interest in chemistry. consists of increasing through Due to the improvement and complexity of test questions in recent years, it is natural that young people entering all higher educational institutions are interested in learning quick ways to find answers to test questions. We just want to remind students that it is convenient and fast to use mathematical methods of solving problems. One such method is the use of algebraic decimal logarithms and discriminant equations in solving chemical problems. Solving chemical problems by discriminant method is analyzed below. The rate of the correct reaction υ1 decreases with time, because reactants A and B are used up, and their concentration decreases. The rate of the reverse reaction increases by υ2, because as substances C and D are formed, their concentrations also increase. After a certain time $t_M$, the rates of the opposite reactions are equal: υ1=υ2. The state in which the rates of the forward and reverse reactions of the reverse process are equal is called chemical equilibrium.

Since it is $\upsilon_1 \cdot \upsilon_2$ when the chemical equilibrium is established: $k_1[A]^a \cdot [B]^b = k_2[C]^c \cdot [D]^d$ Hence $\frac{[C]^C \cdot [D^d]}{[A]^a \cdot [B]^b} = \frac{k_1}{k_2} = K_M$ $K_M$- is the equilibrium constant. The value of the equilibrium constant depends on the nature of the reactants and the temperature. The molar concentration of substances in a reaction system at equilibrium is called the equilibrium concentration. If the molar concentration of substance A before the start of the reaction is $C_A$ , then the equilibrium concentration [A] is accepted. When the chemical equilibrium is established, the reaction does not stop, a dynamic (shiftable) chemical equilibrium is established between two opposing processes.

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**Example 1**: In the equation A+B -------- C+D below, the concentrations of substances written in the order of equation 1 (mol/l) were 8,3,2,12. In the system at equilibrium, 2 mol/l of substance C was released. Determine the new concentrations of substances A and D.

**Solution:** 1) Based on their equilibrium concentrations initially, the equilibrium constant is found. $K_M = \frac{[C]*[D]}{[A]*[B]} = \frac{2*12}{8*3} = 1$

2) Based on $K_M$ , new concentrations of substances A and D are found. The equilibrium constant of the system does not change, no matter how many substances are added to the system in equilibrium, no matter how many substances are removed from it. 3) If a certain amount is removed from the side of the reaction, + |x is added to this side, and -x is subtracted from the opposite side. So, 8-x 3-x 2-2=0+x 12+x

A + B ⟺ C D

Based on this, an equation is created.

$$1 = \frac{[0 + x] * [12 + x]}{[8 - x] * [3 - x]} = \frac{12 + x^2}{24 - 8x + 3x + x^2} = \frac{12x + x^2}{24 - 11x + x^2} = 1$$

$$12x+x^2=24-11x+x^2$$

$$12x+11x=24$$

$$23x=24$$

$$x= \frac{24}{23} =1{,}0435$$

$$x=1{,}0435$$

4) So, x is the amount that is added to C and D after leaving A and B. Based on this, the new concentration of A and D will be as follows

|A|=8-1,0435=6,96 mol/l |D|=12+1,0435=13,04 mol/l

5) The results are checked by substituting the found value to ensure accuracy. $K_M = \frac{|1{,}0435| *|12+1{,}04|}{|8-1{,}04| *|3-1{,}04|} = 1$

**Answer :** A=6,96 mol/l; D=13,04 mol/l.

**Example 2**. If the initial concentrations of substances A and B in this A+B ⇔ 2C reaction are 0.5 and 0.7 mol/l, and the equilibrium constant of the reaction is equal to 50, determine their equilibrium concentrations.

**Solution:** Based on the reaction equation, if we denote the concentration involved in it by x, the equilibrium concentrations can be determined as follows:

$[A]=C_A - x_A = 0{,}5 - x$

$[B]=C_B - x_B = 0{,}7 - x$ $[C]=C_C - x_C = 0 + 2x = 2x$ We determine the value of x by putting the parameters into the equilibrium constant formula:

$K_M=\frac{[C]^2}{[A]\cdot[B]}$ $50 = \frac{(2x^2)}{(0{,}5-x)\cdot(0{,}7-x)} = \frac{4x^2}{x^2-1{,}2x+0{,}35}$;

$$50x^2 - 60x + 17{,}5 = 4x^2$$

$$46x^2 - 60x + 17{,}5 = 0$$

From the resulting quadratic equation, we determine x1 and x2 using the discriminant method:

$$x_{1,2} = \frac{60 \pm \sqrt{(-60)^2 - 4\cdot 46\cdot 17{,}5}}{2\cdot 46} = \frac{60\pm 19{,}5}{92};$$

$$x_1 = \frac{60-19{,}5}{92} = 0{,}44 \text{ mol/l}$$

$$x_2 = \frac{60+19{,}5}{92} = 0{,}864 \text{ mol/l}$$

The value of 〖x〗_2 does not satisfy the problem. Because the value of x is 0.5 should not exceed Now we determine the starting concentrations of substances A and B: [A]=0,5 - 0,44=0,06 mol/l; [B]=0,7 – 0,44=0,26 mol/l. Hence the answer 0,06 mol/l va 0,26 mol/l.

**Example 3:** 3 moles of substances A, B, C were mixed. After the equilibrium A + B = 2C was established, 5 mol of C was formed in the system. Calculate the equilibrium constant. Determine the equilibrium composition of the mixture formed after adding A, B, C in the ratio of 3:2:1 mole to the equilibrium mixture at the same temperature.

**Solution:** $\overset{1}{A} + \overset{1}{B} = \overset{2}{2C}$ according to the reaction equation, for the formation of 2 mol of C substance (because according to the condition of the problem, initially 3 mol of C was present, after the equilibrium was established, 5 mol of C was formed, therefore, 5 – 3 = 2 mol of C substance was formed again as a result of the reaction) 1 mol of A and 1 mole of substance B must react. When there are 5 moles of substance C, 2 moles of substances A and B remain. At this time, the equilibrium constant was $K = \frac{5^2}{2\cdot 2} =$ 6,25. For the second case (substances A, B, C are added in 3:2:1 mole ratio)

$\overset{x}{A} + \overset{x}{B} \rightleftarrows \overset{2x}{2C}$ $K = \frac{(1+2x)^2}{(3-x)(2-x)} = 6{,}25$ x = 1,115;

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**Answer:** $\varphi_A = \frac{3-1,115}{6}$ = 0,314; $\varphi_B = \frac{2-1,115}{6}$ =0,148; $\varphi_C$ = 0,538.

**Example 4.** A mixture of CO2, CO and NH3 has a density of 13 relative to hydrogen. When this mixture was passed through a hydrochloric acid solution, the resulting mixture had a density of 16 relative to hydrogen. Determine the composition (%) of the initial mixture.

**Solution:** The molar mass of the CO2+CO+NH3 mixture is M=13·2=26g. NH3 is absorbed into the hydrochloric acid solution when the mixture is passed through the hydrochloric acid solution. After the reaction, a mixture of CO2 and CO gases remains. To solve the problem, we will make a system as follows:

$44x+28y+17(1-x-y)=26$; $27x+11y=9$; $\frac{44x+28y}{x+y}=32$; $44x+28y=32x+32y$;

$$\begin{cases} 12x = 4y \\ 27x + 11y = 9 \end{cases} \quad x = 0,15$$

Answer. So, the initial mixture contains 0.15 mol (15%) of CO2; From 12 4 there are 0.45 mol (45%) of CO and 0.4 mol (40%) of NH3.

In the process of education, the development of students' knowledge skills, the organization of practical training based on didactic principles from all the possibilities of interdisciplinary communication, serves to develop students' theoretical and practical activities. In general, didactic principles make it possible to perform practical tasks in the process of organizing lessons, to fully visualize the studied theoretical phenomenon.

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