THE USE OF VENN DIAGRAMS IN INDEPENDENT STUDY OF THEORETICAL MECHANICS

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Abstract: *This article describes the use of Venn diagrams in the organization of independent study of theoretical mechanics and the use of interactive methods in the organization and implementation of lessons.*

Keywords: *Venn diagram, independent study, question bank, friction force, general vector, general moment, invariant, acceleration, moment of inertia, interactive method.*

Over the past five years, great work has been done in our country to ensure that young people are getting an education, gaining a profession and living a healthy lifestyle. The increase in the quotas for admission to higher education institutions, the benefits provided for the involvement of girls in higher education, the work being done to dramatically increase student housing, the opportunities provided in the neighborhoods of young people are all proof of our opinion. It is also noteworthy that the world's leading countries are modeled on the education system in educating young people. In particular, the use of credit-module system in the education of students is widespread in all universities of the country. In this system, a great deal of attention is paid to the student's independent learning. The main task of today's professors and teachers is to provide students with methodological support for independent learning and the provision of advanced pedagogical technologies in the acquisition of knowledge. This article discusses the use of Venn diagrams in the study of topics from theoretical mechanics to independent study.

At present, great attention is paid to the basic principles of teaching students on the basis of advanced pedagogical technologies, independent education, credit-module system. The number of scientists conducting research in this field is growing day by day. The organization of lectures and practical exercises using Venn diagram is given in [1,4,8,13,23]. Increasing the visualization of lessons using the widely used cluster method is reflected in the works [3,16]. Research on [2,12,15] discusses ways to increase student engagement. An unconventional method based on the production of electricity using wind energy, which is considered relevant today, has been described in [5,14,17,18]. The results of research in the field of digitization of the educational process [7,19-22] are given. The application of the confusing logical chain method in training is detailed in the work [6,9,10,11].

Theoretical mechanics is taught to students of "Technological machines and equipment" in the second semester of the first year. Let us consider the application of the Venn diagram in the study of topics devoted to independent study. After studying the materials on the topics of independent study in the subject studied in this interactive way, the student is required to analyze and generalize the specific and general aspects of two or more concepts of science to check their knowledge. Inside

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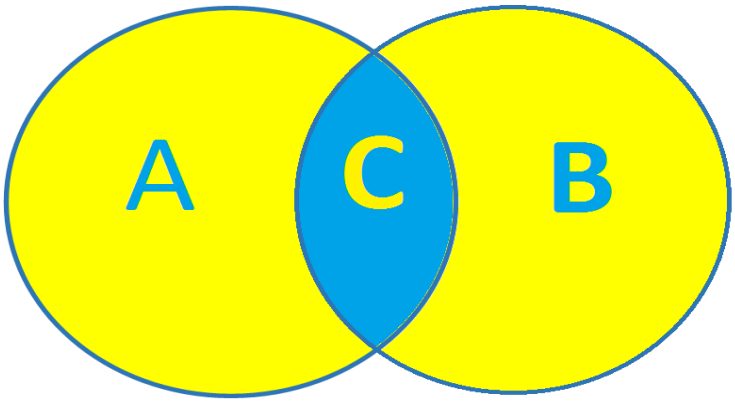
the circle, only the specific features of the concept are recorded, and the intersection is marked with general features.

The following example shows a Venn diagram on the topic "Frictional forces in sliding and rolling" for first-year bachelors of "Technological machines and equipment" for independent study in the department of statics of theoretical mechanics. It compares the concept of sliding friction with the concept of rolling friction.

A	Frictional force in sliding
C	Common aspects of A and B as a result of comparison
B	Friction force in rolling



A	**Frictional force in sliding** **- occurs when objects move relative to each other;** **- the amount is equal to the product of normal pressure and the coefficient of friction in sliding;** **- friction force does not depend on the size of the friction surfaces of objects;** **-depends on the material of friction bodies;** **- depends on the level of surface treatment of friction bodies;** **- non-dimensional coefficient of friction.**
C	**In both cases** **- both are directed in opposite directions;** **- Divided into static and dynamic types;** **- the total reaction force is equal to the geometric sum of the normal reaction force and the friction force;**

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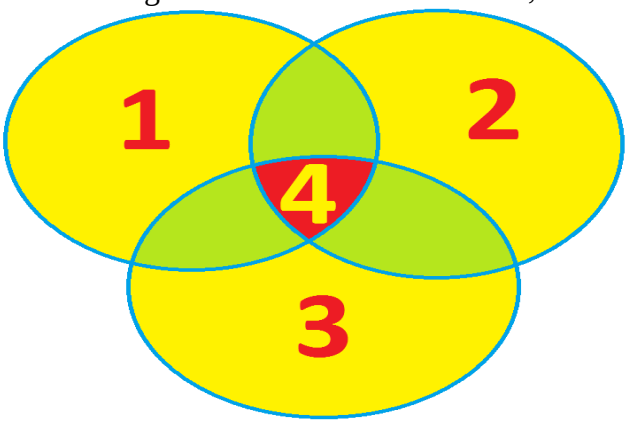
	- the formula for the friction force in solving the problem is added to the series of equations of equilibrium; **- both belong to the solid body.** **- both have a friction angle, a friction cone** **- coefficient of friction is determined experimentally.**
B	**Friction force in rolling** **- occurs when objects roll relative to each other;** **- depends on the radius of the rotating body;** **- static friction force is sharply less than dynamic friction force;** **- the amount is equal to the ratio of the coefficient of friction to the radius to the normal pressure;** **-friction coefficient is measured in units of distance.**

Independent completion of the above diagram by students will allow them to expand their knowledge of the two basic concepts of the department of statics, to have a clear idea, to understand their peculiarities, to understand the laws of generality and to solve them in the future.

In the second diagram of the Venn diagram, three concepts are now selected as the object of comparison. In this case, the three methods of determining the velocity of an arbitrary point of a body in a plane parallel motion in the kinematics section of theoretical mechanics are compared with each other.

In this example, the essence of the problem is determined by three intersecting circles. The table below details the specifics and general features of each circle, as well as the similarities.



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1.	Free vibration action	- occurs under the influence of repulsive force; - differential equation of motion $\ddot{x} + k^2 x = 0$; - the law of motion $x = c_1 \cos k\,t + c_2 \sin k\,t$; - characteristic equation $\lambda^2 + k^2 = 0$ - sinusoidal graphs - the amplitude is constant - another view of the law of motion $x = a\sin(kt + \alpha)$.
2.	Extinguishing vibration action	- is formed under the influence of repulsive force and environmental resistance; - differential equation of motion $\ddot{x} + 2b\dot{x} + k^2 x = 0$; - the law of motion $x = \ell^{-bt}(c_1 \cos\sqrt{k^2 - b^2}\,t + c_2 \sin\sqrt{k^2 - b^2}\,t)$; - characteristic equation $\lambda^2 + 2b\lambda + k^2 = 0$; - graph extinct sinusoid; - the amplitude decreases.
3.	Forced vibration action	- occurs under the influence of repulsive force and excitatory force; - differential equation of motion $\ddot{x} + k^2 x = Q_0 \sin(pt + \delta)$; - the law of motion $x = A\sin(k\,t + \alpha) + (Q_0/m)\sin(pt + \delta)$ - there is a resonance phenomenon - has a frequency of free and forced oscillations. - repulsive, environmental resistance and arousal forces also occur under the influence.
4.	General features between actions 1,2,3	**in all actions** **- there is oscillating motion;** **- the differential equation of motion of the second order;** **- all have repulsive power;**

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		- there is a law of motion; **- has amplitude;** **- linear oscillating motion.**

To use the Venn diagram in the study of independent study of theoretical mechanics, students must have the following level of knowledge:

students must have the skills and abilities to study independently.

students should have sufficient knowledge of the topics allocated to independent study;

have the ability to distinguish between the basic concepts that make up the topic being studied;

be able to compare the specific and general aspects of each concept;

Thus, by applying Venn diagrams in the study of theoretical mechanics, the level of knowledge acquired by students increases qualitatively, their ability to observe concepts expands, the feeling of comparing and dividing facts is formed, first the subject, then the chapter, then the science as a whole and will be able to depict through the pieces. All of these factors ultimately lead to an increase in a student's level of knowledge and skills.

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