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# STEREOMETRIC ISSUES IN SOLUTION VECTORS IMPLEMENTATION

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**Abstract**
This article analyzes the advantages and practical significance of using the vector method in solving planimetric problems. The vector method allows you to express the relationships between geometric figures in algebraic form, which simplifies and generalizes the process of solving problems. The article considers solutions to planimetric problems involving triangles, parallelograms, circles, and other geometric figures using vector operations - addition, subtraction, scalar and vector products. The vector method provides greater logical consistency compared to traditional geometric approaches, reduces calculation errors, and serves to develop students' spatial and analytical thinking. The results of the study show that the use of the vector method in the planimetry course is an effective tool for students to develop a deeper understanding of mathematical concepts and independent thinking skills.

**Keywords**: Vector, geometric problem, collinear vectors, noncollinear vectors.

## Introduction

**Problem 2.2.1:** In a unit cube *ABCD, the diagonals of the sides are* $A_1B_1C_1D_1A$ $D_1$and a in $D_1B_1E$ and respectively $F$ points obtained. In this case, $D_1E=\frac{1}{3}AD_1$, $D_1F=\frac{2}{3}D_1B_1$. Find the length of the line EF.

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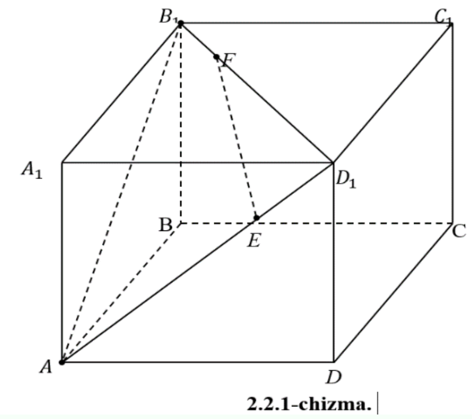
**Solution .** $\overrightarrow{AD} = \vec{a}, \overrightarrow{AB} = \vec{b}, \overrightarrow{AA_1} = \vec{c}$(Figure 2.2.1), where$|\vec{a}| = |\vec{b}| = |\vec{c}|$ =1, $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c} = \vec{b} \cdot \vec{c}$=0. We represent $\overrightarrow{FE}$the vector $\vec{a}, \vec{b}, \vec{c}$in terms of basis vectors:



2.2.1-chizma.

$\overrightarrow{EF} = \overrightarrow{EA} + \overrightarrow{AB_1} + \overrightarrow{B_1F} = -\frac{2}{3}(\vec{a} + \vec{c}) + (\vec{b} + \vec{c}) + \frac{1}{3}(\vec{a} - \vec{b}) == -\frac{1}{3}\vec{a} + \frac{2}{3}\vec{b} + \frac{1}{3}\vec{c}$

Vector module find formula according to $|\overrightarrow{FE}| = \sqrt{\overrightarrow{FE}^2} = \sqrt{\left(-\frac{1}{3}\vec{a} + \frac{2}{3}\vec{b} + \frac{1}{3}\vec{c}\right)^2} == \sqrt{\frac{1}{9}\vec{a}^2 + \frac{4}{9}\vec{b}^2 + \frac{1}{9}c^2 - \frac{1}{9}\vec{a}\cdot\vec{b} + \frac{2}{9}\vec{b}\cdot\vec{c} - \frac{1}{9}\vec{a}\cdot\vec{c}} =$

$= \sqrt{\frac{1}{9} + \frac{4}{9} + \frac{1}{9}} = \frac{\sqrt{6}}{3}$. **Answer** :$\frac{\sqrt{6}}{3}$.

**Hint :** $\overrightarrow{FE}$the coordinates of the basis vector $\left\{-\frac{1}{3}; \frac{2}{3}; \frac{1}{3}\right\}$,

$$|\overrightarrow{AB}| = \sqrt{a^2 + b^2 + c^2}$$

We can find the length of the line by the formula, where

$$|\overrightarrow{AB}| = \sqrt{\frac{1}{9} + \frac{4}{9} + \frac{1}{9}} = \frac{\sqrt{6}}{3}$$

**Problem 2.2.2:** $ABCDEFA_1B_1C_1D_1E_1F_1$ hexagonal right in the prism all edges length 2 equals . From point $A$ $C_1$Find the distance to the point.

**Solution .**$\overrightarrow{A_1B_1} = \vec{a}$ $\overrightarrow{B_1C_1} = \vec{b}$ $\overrightarrow{A_1A} = \vec{c}$(Figure 2.2.2), where$|\vec{a}| = |\vec{b}| = |\vec{c}|$ =2, $\vec{a} \cdot \vec{c} = \vec{b} \cdot \vec{c}$=0, $\vec{a} \cdot \vec{b} = 2$. $\overrightarrow{C_1A}$We use the vector $\vec{a}, \vec{b}, \vec{c}$i through the vectors : $\overrightarrow{C_1A} = \overrightarrow{C_1A_1} + \overrightarrow{A_1A}$,$\overrightarrow{A_1C_1} = \vec{a} + \vec{b}$ from this $\overrightarrow{C_1A} = \vec{c} - \vec{a} - \vec{b}$

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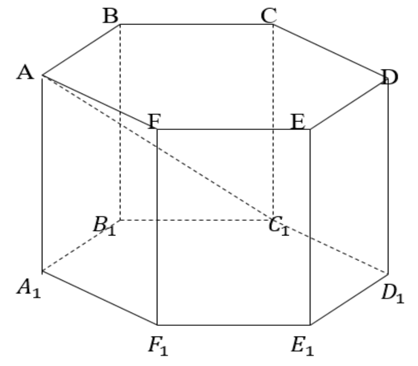


**2.2.2-chizma.**

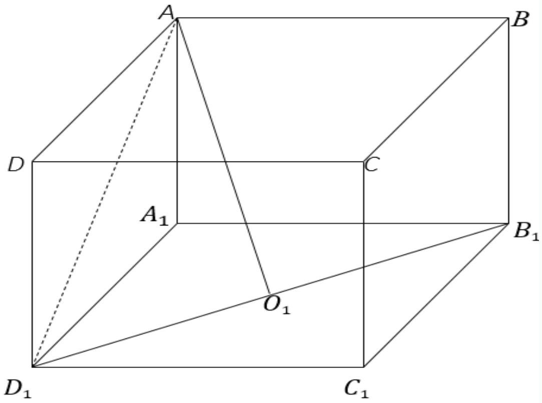
$$|\overrightarrow{C_1A}| = \sqrt{\overrightarrow{C_1A}^2} = \sqrt{(\vec{c}-\vec{a}-\vec{b})^2} == \sqrt{\vec{c}^2+\vec{a}^2+\vec{b}^2-2\cdot\vec{c}\cdot\vec{a}-2\cdot\vec{c}\cdot\vec{b}+2\cdot\vec{a}\cdot\vec{b}} = \sqrt{4+4+4+2\cdot 2} = \sqrt{16} = 4.$$

**Answer:** 4

**Problem 2.2.3:** $ABC\,DA_1B_1C_1D_1 is\ A$ in the unit cube from the point $B_1\ D_1$Find the distance to the line.

**Solution :**$\overrightarrow{D_1A_1} = \vec{a}\ \ \overrightarrow{A_1B_1} = \vec{b}\ \ \overrightarrow{AA_1} = \vec{c}$ (Figure 2.2.3) , this on the ground $|\vec{a}| = |\vec{b}| = |\vec{c}|$ =1, $\vec{a}\cdot\vec{b} = \vec{a}\cdot\vec{c} = \vec{b}\cdot\vec{c}$=0.$\overrightarrow{AO_1}$ vector $\vec{a},\vec{b},\vec{c}$We express it in terms of basis vectors: $\overrightarrow{D_1A} = \vec{a}+\vec{c}$,$\overrightarrow{D_1B_1} = \overrightarrow{D_1A_1}+\overrightarrow{A_1B_1} = \vec{a}+\vec{b}$

$$\overrightarrow{D_1O_1} = \frac{\vec{a}+\vec{b}}{2}.$$



**2.2.3-chizma.**

$$\overrightarrow{AO_1} = -\vec{a}-\vec{c}+\frac{\vec{a}+\vec{b}}{2} = \frac{\vec{b}-\vec{a}}{2}-\vec{c}$$

$$|\overrightarrow{AO_1}| = \sqrt{\overrightarrow{AO_1}^2} = \sqrt{(\frac{\vec{b}-\vec{a}}{2}-\vec{c})^2} = \sqrt{\frac{\vec{a}^2}{4}+\frac{\vec{b}^2}{4}+\vec{c}^2-\frac{\vec{a}\cdot\vec{b}}{2}-\vec{b}\cdot\vec{c}+\vec{a}\cdot\vec{c}} =$$

$$= \sqrt{\frac{1}{4}+\frac{1}{4}+1} = \sqrt{\frac{3}{2}}$$

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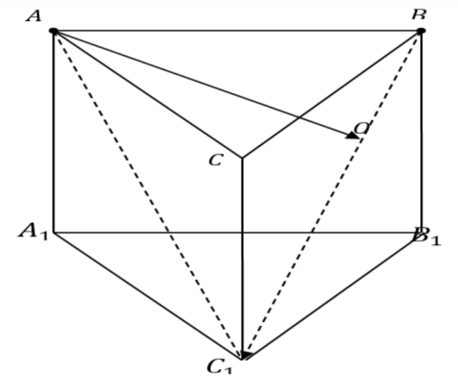
**Answer:** $\sqrt{\frac{3}{2}}$

**Problem 2.2.4:** $ABCA_1B_1C_1$ triangular right in the prism height 1 , base sides by 2 Find the distance from the point to $BC_1$the $A_1$line.

**Solution : Let** $\overrightarrow{AA_1} = \overrightarrow{BB_1} = \vec{a}, \overrightarrow{B_1C_1} = \vec{b}, \overrightarrow{AB} = \overrightarrow{A_1B_1} = \vec{c}$be (Figure 2.2.4), since the base of $|\vec{a}| = 1, |\vec{b}| = |\vec{c}| = 2, \quad \vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c} = 0$, is a regular triangle $\vec{b} \cdot \vec{c} = -2$.



2.2.4-chizma.

$\overrightarrow{AO}$ vector $\vec{a}$, $\vec{b}$,$\vec{c}$ vectors through we express . $\overrightarrow{BC_1} = \vec{a} + \vec{b}$,$\overrightarrow{BC_1}$ and $\overrightarrow{BO}$Since is a collinear vector $\overrightarrow{BO} = \text{x}(\vec{a} + \vec{b})$,$\overrightarrow{AO} = \vec{c} + \text{x}(\vec{a} + \vec{b})$ $\overrightarrow{AO} \perp \overrightarrow{BC_1}$ happened for

$$\overrightarrow{AO} \cdot \overrightarrow{BC_1} = 0 \Rightarrow \left(\vec{c} + \text{x}(\vec{a} + \vec{b})\right) \cdot (\vec{a} + \vec{b})$$
$$\vec{b} \cdot \vec{c} + x \cdot \vec{a} \cdot \vec{b} + x \cdot \vec{b}^2 + \vec{a} \cdot \vec{c} + x \cdot (\vec{a}^2 + \vec{a} \cdot \vec{b}) = 0$$

here $x$,

$$x = \frac{-\vec{b}\vec{c} - \vec{a}\vec{c}}{2\vec{a}\vec{b} + \vec{a}^2 + \vec{b}^2} = \frac{\frac{1}{2} \cdot 2 \cdot 2}{1 + 4} = \frac{2}{5}$$

$\overrightarrow{BO} = \frac{2}{5}(\vec{a} + \vec{b})$.

So

$$\overrightarrow{AO} = \vec{c} + \frac{2}{5}(\vec{a} + \vec{b})$$

$$\overrightarrow{AO} = \sqrt{\vec{c}^2 + \frac{2}{5}\vec{a}^2 + \frac{2}{5}\vec{b}^2 + 2 \cdot \frac{2}{5} \cdot \vec{c}\vec{a} + 2 \cdot \frac{2}{5} \cdot \vec{c}\vec{b} + 2 \cdot \frac{2}{5} \cdot \frac{2}{5} \cdot \vec{a}\vec{b}} =$$

$$= \sqrt{4 + \frac{4}{25} + \frac{16}{25} - 2 \cdot 2 \cdot 2 \cdot \frac{2}{5} \cdot \frac{1}{2}} = \frac{4}{\sqrt{5}} = \frac{4\sqrt{5}}{5}$$

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**Answer :** $\frac{4\sqrt{5}}{5}$

**Independent solution for issues :**

**Issue 2.2.5:** Three *D* was Triangle *ABCD* in the pyramid all flat corners $\frac{\pi}{3}$ to equal to . *P, M* and *K* points suitable accordingly *AD, BD* and *BC* edges middles . *M* from the point To *the PK* line was Find the distance .

**Problem 2.2.6:** $ABCDA_1B_1C_1D_1$ in the cube *EF* and *PQ* lines between find the angle , this on the ground *E, F, P, Q* - suitable accordingly $DD_1$, $BC$, $AA_1$and $B_1C_1$are the midpoints of the edges.

**Problem 2.2.7:** $ABCA_1B_1C_1$ triangular right in the prism *AB* and $B_1C_1$on the edges respectively *E* and *K* points so It is obtained that , $AE: EB = 1: 2$, $B_1K: KC_1 = 5: 1$. If the base sides of the prism are 6 and the lateral edges are 2, then *EK* line Find the length .

**Problem 2.2.8:** Cube two neighbor of the sides non-intersecting diagonals between Find the distance . Of the cube all edges lengths *a* to equal

Vectors method stereometric issues in solution effective , logical consistent and generalized approach This is method using geometric of figures main properties algebraic in the form is expressed , this and issues analysis to do and to prove much simplifies . Vector approach not only of the students mathematician level increases , maybe their spatial thinking , analysis to do and independent work skills to develop help gives . Therefore planimetry in their classes vectors method application education efficiency increasing important from factors one is considered .

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