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Original Article

The Effectiveness of Information and Communication Technology in Finding the Distance Between Straight Lines Non-Intersecting in Space

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Abstract *- In the lessons of geometry, it is understood that it is possible to know the world in the minds of students, and the dialectic character of the process of cognition is that the material unity of the world is an integral part of matter and behavior, the elements in nature are interconnected, the properties of the material world do not end inexhaustible, the process And this plays an important role in the correct formation of their scientific outlook. The article is devoted to the study of the possibilities of using GeoGebra software, which helps to visualize the location of non-intersecting straight lines in space and the distance between them.*

Keywords *- Thinking, Contemplation, Space, Forms, Bodies, Visual, Distance, Straight lines, GeoGebra.*

1. Introduction

The mutual arrangement of straight lines in space, the distance between them and the imagination of angles, the difficulty in solving issueschiliklar is mainly due to the incomprehensible and complex nature of the drawings, as a result of which the images of the spatial bodies are not clearly visible in the plane. After studying the concepts about the spatial bodies in the students, understanding the images of spatial forms, the introduction of additional forms, the ability to think logically on the basis of theoretical confirmations, the analysis, synthesis, personalization, generalization, thinking with the help of deduction and induction methods, the development of independent creative thinking competences.

These issues of the last century were created with the help of models of spatial forms and elements called "stereometric bodies", which consisted in imagining the mutual arrangement of straight lines and planes through the edges of the polygons. Today, it is possible to model spatial forms and form the necessary spatial bodies with the help of various software.

Here we will consider the possibilities of using the GeoGebra software tool. In this program, the modeling of various spatial forms, the implementation of additional constructs, the visual representation of spatial forms can be applied to students in the study of finding distances and angles in space and solving other issues.

2. Lines Non-Intersecting In Space

Description. The cross section, which intersects the nearest points of the straight lines to each other, is called the distance between the straight lines of the arc (Figure 1). This incision is the general and only perpendicular of the straight lines of the bear. The length of the cross section adjacent to the optional other points of the Ayqash straight lines is greater than the total length of the perpendicular.

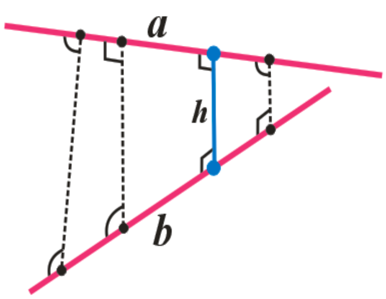

Fig. 1

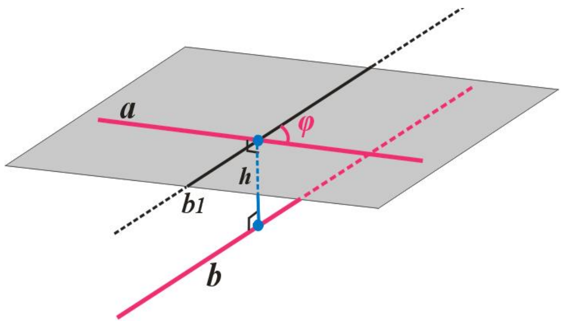

Fig. 2

To determine the angle between the straight lines of the arc, a plane is passed through one of them parallel to the other. The second straight line is projected onto the plane. The intersection angle of the projection and the first straight line is called

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the angle between the ayqash straight lines (Figure 2). In the Figure, α planes were parallel to b straight lines through a straight lines, and b straight lines were projected onto a straight lines. Here b_1 projection straight line is formed. b_1 and a are straight lines between φ given the angle a and b is the angle between the straight lines of the moon. As an example, we will consider the solutions of the following Malas.

3. Materials and Methods

1-problem. In the $ABCDA_1B_1C_1D_1$ Cube, whose edge is equal to a, find the distance between the A_1B and B_1C straight lines.

Solution. Let there be non-intersecting diagonals of the side edges of the arc A_1B and B_1C Cube, these diagonals are not easy to transfer to the general perpendicular straight line. But it is easy to transfer A_1B plane passing through B_1C straight lines with B_1D_1C diagonalalga parallel, to this Earth $D_1C \parallel A_1B$.

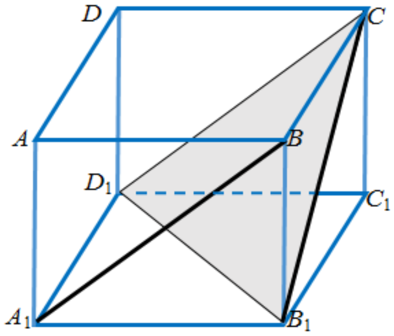


Fig. 3

A_1B the distance from the optional point of the straight line to the B_1D_1C plane will be equal to the distance between the diagonals A_1B and B_1C.

Therefore, we find the distance from B points to B_1D_1C plane. And this will be the height of the BB_1D_1C pyramid, where B is the tip of the pyramid, B_1D_1C is the base of the pyramid (Figure 4).

We find a classical triangle whose base side is equal to $a\sqrt{2}$, the height of the pyramid whose side edges are equal to a and $a\sqrt{3}$.

$$B_1C = B_1D_1 = D_1C = a\sqrt{2}\ ,\ BC = B_1B = a\ ,\ BD_1 = a\sqrt{3}.$$

Let F $-B_1C$ be the middle of the incision. In that case, the height of the pyramid BB_1D_1C will be equal to the height of BFD_1 falling from the B end of the Triangle (Figure 5).

$$BF = \sqrt{B_1B^2 - B_1F^2} = \sqrt{a^2 - \left(\frac{a\sqrt{2}}{2}\right)^2} = \frac{a}{\sqrt{2}},\quad D_1F = \sqrt{B_1D_1^2 - B_1F^2} = \sqrt{2a^2 - \left(\frac{a\sqrt{2}}{2}\right)^2} = \frac{\sqrt{3}a}{\sqrt{2}}.$$

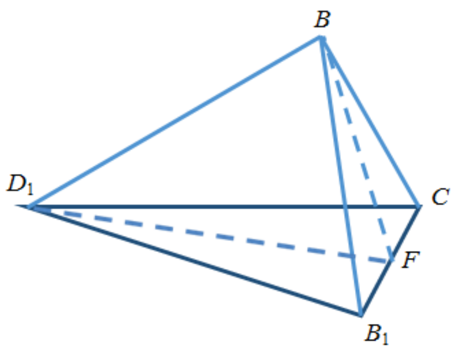


Fig. 4

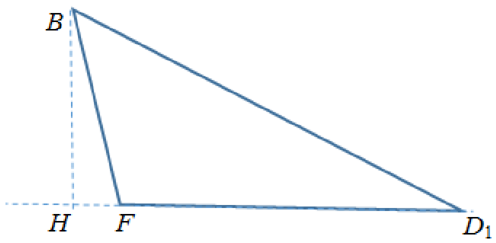


Fig. 5

We determine the type of ΔBFD_1. To do this, we compare BD_1^2 and $BF^2+FD_1^2$: $BD_1^2=3a^2$, $BF^2+FD_1^2=\frac{a^2}{2}+\frac{3a^2}{2}=2a^2$. From this it follows that the angle of ΔBFD_1 to F is an impenetrable angle.

For ΔBFD_1, we apply the theorem about the side Square opposite the blunt angle: $D_1B^2=BF^2+FD_1^2+2\cdot FD\cdot FH$ or $3a^2=\frac{a^2}{2}+\frac{3a^2}{2}+2\frac{\sqrt{3}a}{\sqrt{2}}\cdot FH\Rightarrow\sqrt{6}a\cdot FH=a^2\Rightarrow$ $FH=\frac{a}{\sqrt{6}}$.

It turns out that the distance between the diagonals A_1B and B_1C, where the side edges of the cube do not intersect, is equal to $\frac{a}{\sqrt{3}}$.

2-problem. In the hexagonal prism a, whose edge is equal to $ABCDEFA_1B_1C_1D_1E_1F_1$, find the distance between A_1B and B_1C straight lines.

Solution. Let the A_1B and B_1C prisms be non-intersecting diagonals of the side edges of the arc, for these diagonals the total perpendicular straight line, we pass the plane B_1C, passing through the A_1B straight line with the parallel to the diagonal, to this Earth $F_1E \square B_1C$ (Figure 6).

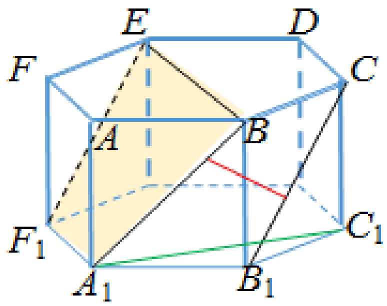


Fig. 6

B_1C the distance from the optional point of the straight line to the A_1BE plane will be equal to the distance between the diagonals A_1B and B_1C.

Therefore, the distance from B_1 points to A_1BE plains will be the height of the pyramid $B_1F_1A_1BE$, where B_1 is the tip of the pyramid, F_1A_1BE is the basis of the trapezium– pyramid.

Since the sides of the prism $B_1F_1A_1$ side fat $A_1B_1=A_1F_1=a$, B_1F_1 side is a small diagonal of the prism base, the length is equal to $\sqrt{3}a$. From this, the angle at the end of $\Delta A_1B_1F_1$ equal sides and A_1 is an impenetrable angle and is equal to 120° (7.a- figure). In that case, the height dropped from the end of B_1 falls out:

$$B_1M=B_1F_1\cdot\sin\angle F_1=\sqrt{3}a\cdot\frac{1}{2}=\frac{\sqrt{3}}{2}a\cdot$$

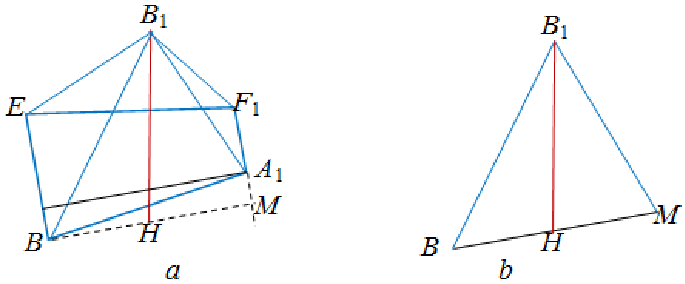


Fig. 7

According to the three perpendicular theorem $BM\perp A_1M$, and the distance we are looking for is equal to the height of ΔBB_1M, that is, the height at which the pyramid is lowered from the end of B_1. Since ΔBB_1M is the side edge of the right prism in the Triangle $B_1M=\frac{\sqrt{3}}{2}a$, $BB_1=a$, BB_1 the angle B_1 will be the right angle (7.b- figure). From $BM=\sqrt{B_1M^2+BB_1^2}=\sqrt{\frac{3}{4}a^2+a^2}=\frac{\sqrt{7}}{2}a$. The height of a right-angled triangle reduced to the hypotenuse

$$B_1H=\frac{BB_1\cdot B_1M}{BM}=\frac{\frac{\sqrt{3}}{2}a\cdot a}{\frac{\sqrt{7}}{2}a}=\frac{\sqrt{3}}{\sqrt{7}}a=\frac{\sqrt{21}}{7}a.$$

4. Now we solve these issues using the vector method

1. Let P and Q points are obtained in straight lines A_1B and B_1C respectively (Figure 8). From the collinear of vectors we get $\overrightarrow{B_1Q}=y\overrightarrow{B_1C}=y\left(\overrightarrow{B_1C_1}+\overrightarrow{B_1B}\right)$, $\overrightarrow{A_1P}=x\overrightarrow{A_1B}=x\left(\overrightarrow{A_1B_1}+\overrightarrow{B_1B}\right)$. Thus

$$\overrightarrow{PQ}=\overrightarrow{A_1B_1}+\overrightarrow{B_1Q}-\overrightarrow{A_1P}=\overrightarrow{A_1B_1}+y\left(\overrightarrow{B_1C_1}+\overrightarrow{B_1B}\right)-x\left(\overrightarrow{A_1B_1}+\overrightarrow{B_1B}\right)\Rightarrow\overrightarrow{PQ}=\overrightarrow{A_1B_1}(1-x)+y\overrightarrow{B_1C_1}+\overrightarrow{B_1B}(y-x)$$

So it is necessary to find the numbers *x* and *y* so that the vector is orthogonal to the vectors A_1B and B_1C. To do this, we solve the following system:

$$\begin{cases}\left(\overrightarrow{A_1B_1}(1-x)+y\overrightarrow{B_1C_1}+\overrightarrow{B_1B}(y-x)\right)\left(\overrightarrow{B_1C_1}+\overrightarrow{B_1B}\right)=0,\\ \left(\overrightarrow{A_1B_1}(1-x)+y\overrightarrow{B_1C_1}+\overrightarrow{B_1B}(y-x)\right)\left(\overrightarrow{A_1B_1}+\overrightarrow{B_1B}\right)=0.\end{cases}$$

Assuming $\left|\overrightarrow{A_1B_1}\right|=\left|\overrightarrow{B_1C_1}\right|=\left|\overrightarrow{B_1B}\right|=a$, and since these vectors are $\overrightarrow{A_1B_1}\cdot\overrightarrow{B_1B}=\overrightarrow{B_1C_1}\cdot\overrightarrow{B_1B}=\overrightarrow{A_1B_1}\cdot\overrightarrow{B_1C_1}=0$ from the perpendicular, we have formed the following system:

$$\begin{cases}2y-x=0,\\ y-2x+1=0.\end{cases}$$

We take $x=\frac{2}{3}$, $y=\frac{1}{3}$ solution by solving the system. The P and Q ends of the common perpendicular sought are equal to the following equations $\overrightarrow{B_1Q}=\frac{1}{3}\overrightarrow{B_1C}$ and $\overrightarrow{A_1P}=\frac{2}{3}\overrightarrow{A_1B}$. Furthermore

$$\overrightarrow{PQ}=\overrightarrow{A_1B_1}\left(1-\frac{2}{3}\right)+\frac{1}{3}\overrightarrow{B_1C_1}+\overrightarrow{B_1B}\left(\frac{1}{3}-\frac{2}{3}\right)=-\frac{1}{3}\overrightarrow{A_1B_1}+\frac{1}{3}\overrightarrow{B_1C_1}-\frac{1}{3}\overrightarrow{B_1B}\Rightarrow$$

$$\overrightarrow{PQ}^2=\frac{1}{9}\left(\overrightarrow{A_1B_1}-\overrightarrow{B_1C_1}+\overrightarrow{B_1B}\right)^2=\frac{1}{9}\left(a^2+a^2+a^2\right)=\frac{1}{3}a^2\Rightarrow PQ=\frac{1}{\sqrt{3}}a.$$

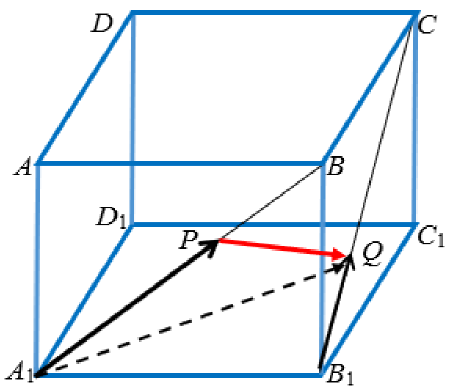


Fig. 8

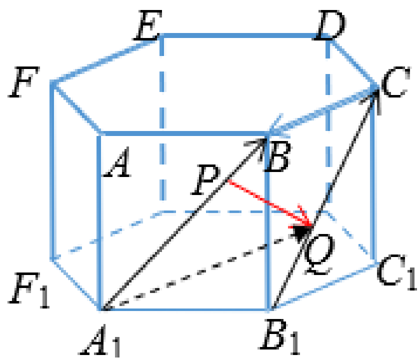


Fig. 9

2. Let the P and Q points be on the forehead in the A_1B and B_1C straight lines in the alignment (Figure 9). From the collinear of vectors we get $\overrightarrow{AP}=x\overrightarrow{A_1B}=x\left(\overrightarrow{A_1B_1}+\overrightarrow{B_1B}\right)$, $\overrightarrow{B_1Q}=y\overrightarrow{B_1C}=y\left(\overrightarrow{B_1C_1}+\overrightarrow{C_1C}\right)$. Thus

$$\overrightarrow{A_1Q} = \overrightarrow{A_1P} + \overrightarrow{PQ} \Rightarrow \overrightarrow{QP} = \overrightarrow{A_1Q} - \overrightarrow{A_1P} = \overrightarrow{A_1B_1} + \overrightarrow{B_1Q} - \overrightarrow{A_1P} = \overrightarrow{A_1B_1} + y\overrightarrow{B_1C} - x\overrightarrow{A_1B} \Rightarrow$$

$$\overrightarrow{QP} = \overrightarrow{A_1B_1} + y\left(\overrightarrow{B_1C_1} + \overrightarrow{C_1C}\right) - x\left(\overrightarrow{A_1B_1} + \overrightarrow{B_1B}\right) \Rightarrow \overrightarrow{QP} = \overrightarrow{A_1B_1}(1-x) + y\overrightarrow{B_1C_1} + \overrightarrow{B_1B}(y-x).$$

So it is necessary to find the numbers x and y so that the vector is orthogonal to the vectors A_1B and B_1C. To do this, we solve the following system:

$$\begin{cases} \left(\overrightarrow{A_1B_1}(1-x) + y\overrightarrow{B_1C_1} + \overrightarrow{B_1B}(y-x)\right)\left(\overrightarrow{B_1C_1} + \overrightarrow{B_1B}\right) = 0, \\ \left(\overrightarrow{A_1B_1}(1-x) + y\overrightarrow{B_1C_1} + \overrightarrow{B_1B}(y-x)\right)\left(\overrightarrow{A_1B_1} + \overrightarrow{B_1B}\right) = 0. \end{cases}$$

$\left|\overrightarrow{A_1B_1}\right| = \left|\overrightarrow{B_1C_1}\right| = \left|\overrightarrow{B_1B}\right| = a$ va $\overrightarrow{A_1B_1} \cdot \overrightarrow{B_1C_1} = a^2 \cos 60° = \frac{1}{2}a^2$, $\overrightarrow{A_1B_1} \cdot \overrightarrow{B_1B} = \overrightarrow{B_1C_1} \cdot \overrightarrow{B_1B} = 0$

as it is, the following cystema is formed:

$$\begin{cases} 4x - 3y = 2, \\ 3x - 4y = 1. \end{cases}$$

We take $x = \frac{5}{7}$, $y = \frac{2}{7}$ solution by solving the system. The ends P and Q of the common perpendicular sought are equal to the following equations $\overrightarrow{BQ} = \frac{2}{7}\overrightarrow{BC_1}$ and $\overrightarrow{AP} = \frac{5}{7}\overrightarrow{AB_1}$. Furthermore

$$\overrightarrow{PQ} = \left(1 - \frac{5}{7}\right)\overrightarrow{A_1B_1} + \frac{2}{7}\overrightarrow{B_1C_1} + \left(\frac{2}{7} - \frac{5}{7}\right)\overrightarrow{B_1B} = \frac{2}{7}\overrightarrow{A_1B_1} + \frac{2}{7}\overrightarrow{B_1C_1} - \frac{3}{7}\overrightarrow{B_1B} \Rightarrow$$

$$PQ^2 = \frac{4}{49}a^2 + \frac{4}{49}a^2 + \frac{9}{49}c^2 + \frac{4}{49}\vec{a}\vec{b} = \frac{21}{49}a^2 \Rightarrow PQ = \frac{\sqrt{21}}{7}a.$$

5. We solve issues using the coordinate method

Let lines $\frac{x-x_1}{a_x} = \frac{y-y_1}{a_y} = \frac{z-z_1}{a_z}$ and $\frac{x-x_2}{b_x} = \frac{y-y_2}{b_y} = \frac{z-z_2}{b_z}$ of mirrors be given in space, "the distance between these lines is calculated by the following formula;

$$d = \frac{mod\begin{vmatrix} x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}}{\sqrt{\begin{vmatrix} a_y & a_z \\ b_y & b_z \end{vmatrix}^2 + \begin{vmatrix} a_z & a_x \\ b_z & b_x \end{vmatrix}^2 + \begin{vmatrix} a_x & a_y \\ b_x & b_y \end{vmatrix}^2}}$$

1. If we mark the ends of the cube in the system of coordinates Decart $A(0;0;a)$, $A_1(0;0;0)$, $B(0;a;a)$, $B_1(0;a;0)$, $C(a;a;a)$, $C_1(a;a;0)$, $D(a;0;a)$, $D_1(a;0;0)$: $\frac{x-x_1}{x_2-x_1} = \frac{y-y_1}{y_2-y_1} = \frac{z-z_1}{z_2-z_1}$ using the formula, we draw the equation of AB_1 and BC_1 straight lines.

The equation of a straight line AB_1 is $\frac{x}{0} = \frac{y}{a} = \frac{z}{a}$; the equation of a straight line BC_1 is $\frac{x}{a} = \frac{y-a}{0} = \frac{z}{a}$.

$$d = \frac{mod\begin{vmatrix} 0-0 & a-0 & 0-0 \\ 0 & a & a \\ a & 0 & a \end{vmatrix}}{\sqrt{\begin{vmatrix} a & a \\ 0 & a \end{vmatrix}^2 + \begin{vmatrix} 0 & a \\ a & a \end{vmatrix}^2 + \begin{vmatrix} 0 & a \\ a & 0 \end{vmatrix}^2}} = \frac{a^3}{\sqrt{3\left(a^2\right)^2}} = \frac{a^3}{a^2\sqrt{3}} = \frac{a}{\sqrt{3}}.$$

2. If we mark the ends of the right prism in the system of coordinates Decart $A_1(-a;0;0)$, $A(-a;0;a)$, $B_1\left(-\frac{1}{2}a;\frac{\sqrt{3}}{2}a;0\right)$, $B\left(-\frac{1}{2}a;\frac{\sqrt{3}}{2}a;a\right)$, $C_1\left(\frac{1}{2}a;\frac{\sqrt{3}}{2}a;0\right)$, $C\left(\frac{1}{2}a;\frac{\sqrt{3}}{2}a;a\right)$, $D_1(a;0;0)$, $D(a;0;a)$, $E_1\left(\frac{1}{2}a;-\frac{\sqrt{3}}{2}a;0\right)$, $E\left(\frac{1}{2}a;-\frac{\sqrt{3}}{2}a;a\right)$, $F_1\left(-\frac{1}{2}a;-\frac{\sqrt{3}}{2}a;0\right)$, $F\left(-\frac{1}{2}a;-\frac{\sqrt{3}}{2}a;a\right)$: $\frac{x-x_1}{x_2-x_1}=\frac{y-y_1}{y_2-y_1}=\frac{z-z_1}{z_2-z_1}$, then using the formula we draw the equation of AB_1 and BC_1 straight lines.

The equation of a straight line AB_1 is $\frac{x+a}{-\frac{1}{2}a+a}=\frac{y-0}{\frac{\sqrt{3}}{2}a-0}=\frac{z-0}{a-0}$; the equation of a straight line BC_1 is

$$\frac{x+\frac{1}{2}a}{\frac{1}{2}a+\frac{1}{2}a}=\frac{y-\frac{\sqrt{3}}{2}a}{\frac{\sqrt{3}}{2}a-\frac{\sqrt{3}}{2}a}=\frac{z-0}{a-0}.$$

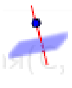
$$d=\frac{\mathrm{mod}\begin{vmatrix} a-\frac{1}{2}a & 0+\frac{\sqrt{3}}{2}a & 0-0 \\ \frac{1}{2}a & \frac{\sqrt{3}}{2}a & a \\ a & 0 & a \end{vmatrix}}{\sqrt{\begin{vmatrix} \frac{1}{2}a & \frac{\sqrt{3}}{2}a \\ a & 0 \end{vmatrix}^2+\begin{vmatrix} \frac{1}{2}a & a \\ a & a \end{vmatrix}^2+\begin{vmatrix} \frac{\sqrt{3}}{2}a & a \\ 0 & a \end{vmatrix}^2}}=$$

$$=\frac{\mathrm{mod}\left(\frac{\sqrt{3}}{4}a^3+\frac{\sqrt{3}}{2}a^3-\frac{\sqrt{3}}{4}a^3\right)}{\sqrt{\frac{3}{4}a^4+\frac{1}{4}a^4+\frac{3}{4}a^4}}=\frac{\frac{\sqrt{3}}{2}a^3}{\frac{\sqrt{7}}{2}a^2}=\frac{\sqrt{3}}{\sqrt{7}}a=\frac{\sqrt{21}}{7}a$$

6. We will consider the solution of the issues using the GeoGebra software tool

The fact that the moon in space is difficult to pass or imagine a general perpendicular to straight lines makes it difficult to solve the problem.

Such leggings can be shown in the software" Geogebra". For example, let's give two non-intersecting straight lines AB and CD, passing through $A(3;-2;0)$, $B(-2;3;1)$, $C(-6;3;0)$, $D(0;0;4)$ points, for these two lines we pass the total perpendicular (figure 10).

Using the  button on the tools panel of the program, we transfer the parallel straight line from the B point of the AB straight line to the CD straight line, and through these two intersecting straight lines α plane. From this we pass the perpendicular straight line from the  point of the CD straight line to the F plane using the α button. This straight line is perpendicular in AB straight lines.

We draw F points along CD straight lines perpendicular and AB straight lines until they intersect. Perpendicular we mark the point of intersection of a straight line AB with E. EF cross section length gives the distance between AB and CD *non-intersecting* straight line.

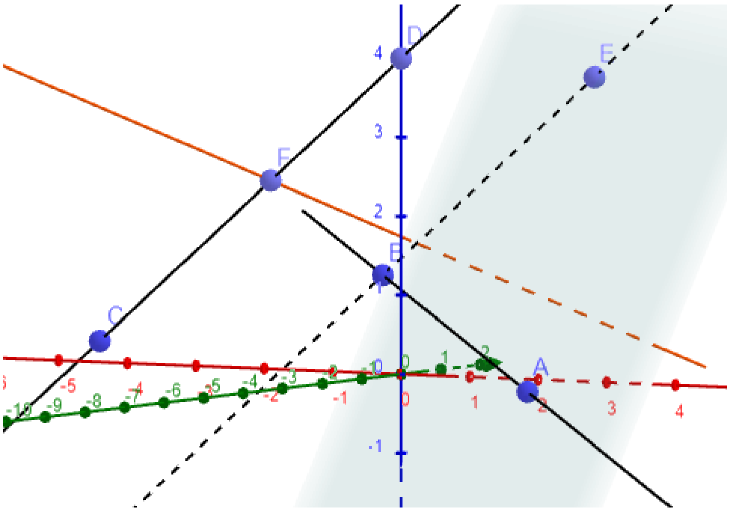


Fig. 10

The resulting image can be rotated from different sidestirib see the location of the overall perpendicular, change the color and thickness of the lines, the size of the letters and other details (Figure 11). And this is a more accurate formation of the imagination about the spatial bodies with the help of the image given in the readers. Now we make the drawings with the help of the program of the issues given above.

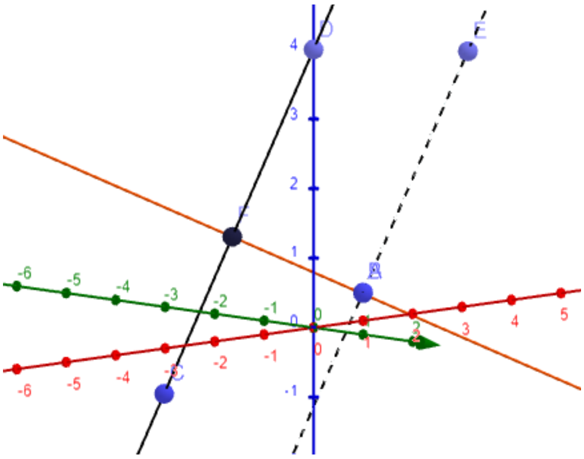


Fig. 11

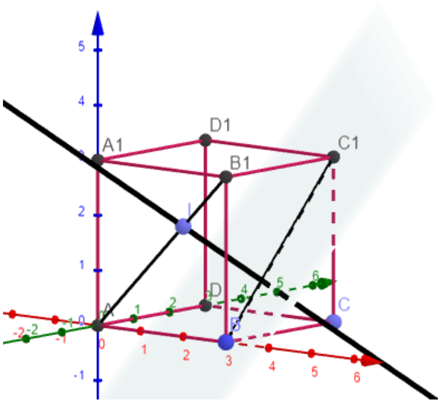


Fig. 12

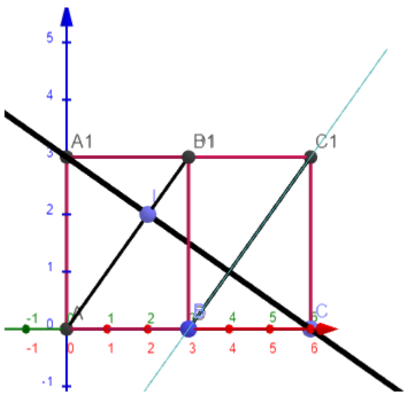


Fig. 13

1. In order to find the distance between AB_1 and BC_1 diagonals, we pass the total perpendicular of these diagonals in the above method (Figure 12).

From this we distinguish AA_1C_1C diagonal cross-sections (Figure 13). AB_1 and BC_1 lines divide the A_1C diagonal into three parts. According to the Fales theorem, AB_1 and BC_1 lines divide even equal cuts on the second side, since $\angle ACA_1$ divides $AB = BC$ passes on one side of the angle. Similar $\angle C_1A_1C$ to AB_1 and BC_1 patallel lines divide the A_1C diagonal into equal three parts. So the distance between AB_1 and BC_1 diagonals is equal to one third of the $A_1C = a\sqrt{3}$ diagonal, that is, $\frac{a\sqrt{3}}{3}$.

After the spatial representation of the issue and the formation of tasvirini in the plane, several methods of solving the issue can be used. We bring another method of solving.

We divide the AA_1C_1C diagonal cross-section of the cube (Figure 14). The diagonals of the O and O_1 Cube base will be $AO = \frac{AC}{2} = \frac{\sqrt{2}a}{2}$ if there is an intersection point. Without it $AO_1 = \sqrt{AA_1^2 + A_1O_1^2} = \sqrt{a^2 + \frac{a^2}{2}} = \frac{\sqrt{3}a}{\sqrt{2}}$. In the case of a right-angled AA_1O_1 triangle $\cos\alpha = \frac{AA_1}{AO_1} = \frac{a}{\frac{\sqrt{3}a}{\sqrt{2}}} = \frac{\sqrt{2}}{\sqrt{3}}$ and a right-angled AEO triangle

$$\mathrm{OE} = \mathrm{AO}\cdot\cos\alpha = \frac{\sqrt{2}a}{2}\cdot\frac{\sqrt{2}}{\sqrt{3}} = \frac{\sqrt{3}a}{3}.$$

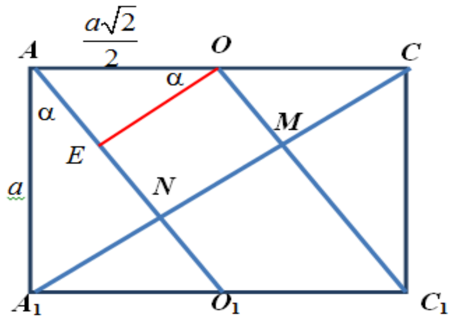


Fig. 14

2. Let the prism be AB_1 and BC_1 diagonals that do not intersect the side edges of the army, we pass the total perpendicular to these diagonals as in the 1-th issue (Figure 15).

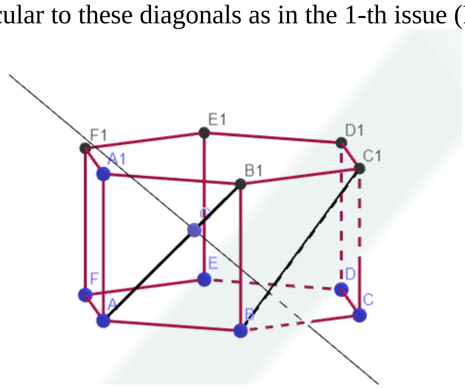


Fig. 15

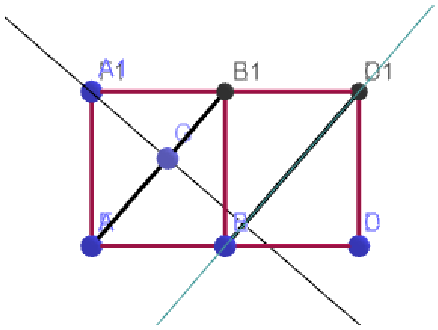


Fig. 16

From ΔA_1BB_1 to $BB_1 = a$, A_1B_1 is half the small diagonal of the Hexagon, which is the basis of the prism $\frac{\sqrt{3}}{2}a$, from the Pythagorean theorem $A_1B = \sqrt{A_1B_1^2 + BB_1^2} = \sqrt{\frac{3}{4}a^2 + a^2} = \frac{\sqrt{7}}{2}a$.

From this, the height from the right angle of ΔA_1BB_1

$$h = \frac{A_1B_1 \cdot BB_1}{A_1B} = \frac{\frac{\sqrt{3}}{2}a\cdot a}{\frac{\sqrt{7}}{2}a} = \frac{\sqrt{3}a}{\sqrt{7}}.$$

7. Results and Discussion

Stereometry is difficult in solving issueschiliklar in many respects due to the fact that the images of the spatial bodies in the plane are not sufficiently clearly understandable, and as a result, the complexity of performing additional constructions. The use of software in the creation of three-dimensional models of spatial bodies, performing various actions on them, creates convenience, which helps to develop the spatial imagination of students and solve complex issues. When students see tasvirini the issue, they develop a creative approach to the solution of the issue using the basic methods of mathematics, izlash new ideas and the ability to apply them to the given issue. The software tool “GeoGebra”, which we have already considered above, allows readers to see in every way the spatial bodies and draw tasvirini in their plane.

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