

Problems of Plane analytic geometry

- 1) Consider the vectors $\vec{u}(16, -13)$ and $\vec{v}(-1, 1)$. Find out a vector \vec{w} perpendicular (orthogonal) to \vec{v} and verifies $\vec{u} \cdot \vec{w} = 30$.
- 2) Consider the vectors $\vec{u}(-6, p)$ and $\vec{v}(10, 2)$. Find out the value(s) of parameter p for each of the following cases:
 - a) Magnitude of vector \vec{u} is 18. b) Vectors are parallel. c) Vectors are orthogonal (perpendicular).
- 3) Consider the vectors $\vec{u}(12, 16)$ and $\vec{v}(8, 6)$. Find out:
 - a) Magnitude of each vector. b) Scalar product (dot product). c) Angle between these vectors.
- 4) Calculate the angle between the following pairs of vectors:
 - a) $\vec{a}(3, 23)$ and $\vec{b}(1, -2)$ b) $\vec{u}(5, -6)$ and $\vec{v}(18, 21)$
- 5) Find out the unit vector of each of the following vectors:
 - a) $\vec{a}(40, 9)$ b) $\vec{b}(27, 36)$
- 6) Consider the vectors $\vec{a}(-1, 2)$, $\vec{b}(6, 9)$ and $\vec{n}(-23, -17)$.
Find out the value of x and y for which verify the following linear combination: $\vec{n} = x\vec{a} + y\vec{b}$.
- 7) Calculate magnitude and vector projection of $\vec{a}(-18, 4)$ in the direction of $\vec{b}(12, 9)$.
- 8) Determine if the following points are or are not aligned:
 - a) $A(-5, -3)$, $B(-10, -7)$, $C(-18, -15)$. b) $A(-6, 1)$, $B(-3, -2)$, $C(0, -5)$.
- 9) The points $A(-10, -1)$ and $C(8, 9)$ are opposite vertices of the square $ABCD$. Find out the other two vertices B and D .
- 10) The vertices of a right triangle are $A(-3, 9)$, $B(-17, 3)$, and $C(0, 2)$. If the right angle is at the point A , calculate the area of this triangle.
- 11) Calculate the value of parameter q for which the distance between the points $A(8, 4)$ and $B(-1, q)$ is 15.
- 12) Find out the value of parameter m for which the points $A(-3, -5)$, $B(-5, -1)$ and $C(-9, m)$ are aligned.
- 13) Calculate the midpoint M of the line segment whose end points are $A(-4, 4)$ and $B(10, -24)$.

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- 14) Consider the line segment AB , the end point $A(11, 2)$ and the midpoint $M(23, 12)$. Find out the other end point B .
- 15) Find out the general equation of the line that is parallel to the line $L: \frac{x+14}{-2} = \frac{y+5}{11}$ and passes through the point $A(4, -14)$.
- 16) Find out the general equation of the line that is perpendicular to the line $L: (x, y) = (0, 8) + \lambda(10, -1)$ and passes through the point $A(15, 4)$.
- 17) Find out the equation of the line (symmetric, general and slope–intercept forms) that passes through the points $A(17, 11)$ and $B(8, 1)$.
- 18) Calculate the distance between the point $A(15, -11)$ and the line $L: \begin{cases} x = -13 + 12\lambda \\ y = -6 - 5\lambda \end{cases}$.
- 19) Let a triangle whose vertices are $A(-3, 13)$, $B(14, 14)$ and $C(-4, 3)$, find out:
- General equation of the median that passes through vertex A .
 - General equation of the median that passes through vertex B .
 - Barycenter.
- 20) A triangle has the vertices $A(-3, 10)$, $B(12, 4)$ and $C(6, 8)$, find out the equation of the altitude that passes through vertex A and its length.
- 21) Calculate the distance between the lines $L_1: 3x + 10y + 10 = 0$ and $L_2: 3x + 10y - 52 = 0$.
- 22) Calculate the angle between the lines $L_1: (x, y) = (-14, 15) + \lambda(10, 13)$ and $L_2: y = \frac{-11x}{4} + 45$.
- 23) Find out the equation of the line (vector, parametric, symmetric, general and slope–intercept forms) that passes through the point $A(6, -3)$ and is parallel to vector $\vec{v}(-14, 0)$.
- 24) Calculate the value of parameter m for which the line $L: \begin{cases} x = 6 - 3\lambda \\ y = -14 + 7\lambda \end{cases}$ passes through the point $P(2, m)$.
- 25) Calculate the values of parameter r for which the distance between the line $L: \frac{x-13}{8} = \frac{y+11}{15}$ and the point $P(3, r)$ is 16.

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- 26) Calculate the value of parameter r for which the points $A(-5, -8)$, $B(7, -2)$ and $C(-1, r)$ are aligned and find out the general equation of the line that passes through these points.
- 27) Consider the lines $L_1: x + py + 1 = 0$ and $L_2: -5x + 6y + q = 0$, find out the values of parameters p and q for which the lines are parallel.
- 28) Consider the line $L: 7x - 3y - 11 = 0$. Find out a point of this line that is equidistant from the points $A(-3, -3)$ and $B(7, -6)$.
- 29) Find out the intersection point and the angle between the following pairs of lines: $L_1: \frac{x + 15}{14} = \frac{y + 19}{7}$ and $L_2: \frac{x + 11}{10} = \frac{y + 24}{12}$.
- 30) Calculate the value(s) of parameter r for which the distance between the line $L: 20x + ry - 44 = 0$ and the point $P(13, 2)$ is 6.
- 31) Find out the relative position of the lines $L_1: y = \frac{11x}{12}$ and $L_2: \frac{x + 6}{12} = \frac{y - 13}{11}$ and calculate the intersection point if possible.

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Answers:

- 1) $\vec{w}(10, 10)$
- 2) a) $p = \pm \sqrt{288}$ b) $p = \frac{-6}{5}$ c) $p = 30$
- 3) a) 20; 10 b) 192 c) $16^\circ 15' 36.74''$
- 4) a) $146^\circ 0' 12.75''$ b) $99^\circ 35' 35.28''$
- 5) a) $\left(\frac{40}{41}, \frac{9}{41}\right)$ b) $\left(\frac{3}{5}, \frac{4}{5}\right)$
- 6) $\vec{n} = 5\vec{a} - 3\vec{b}$
- 7) 12; $\left(\frac{-48}{5}, \frac{-36}{5}\right)$
- 8) a) Non-aligned. b) Aligned
- 9) $B(-6, 13); D(4, -5)$
- 10) $58 u^2$
- 11) $q_1 = -8; q_2 = 16$
- 12) $m = 7$
- 13) $(3, -10)$
- 14) $(35, 22)$
- 15) $11x + 2y - 16 = 0$
- 16) $10x - y - 146 = 0$
- 17) $\frac{x - 17}{-9} = \frac{y - 11}{-10}, 10x - 9y - 71 = 0, y = \frac{10x}{9} - \frac{71}{9}$
- 18) $\frac{80}{13}$
- 19) a) $9x + 16y - 181 = 0,$ b) $12x - 35y + 322 = 0,$ c) $\left(\frac{7}{3}, 10\right)$
- 20) $3x - 2y + 29 = 0, \frac{6\sqrt{52}}{13}$
- 21) $\frac{62\sqrt{109}}{109}$
- 22) $57^\circ 33' 6.11''$
- 23) $(x, y) = (6, -3) + \lambda(-14, 0), \begin{cases} x = 6 - 14\lambda \\ y = -3 \end{cases}, \frac{x - 6}{-14} = \frac{y + 3}{0}$
 $y + 3 = 0, y = -3$
- 24) $m = \frac{-14}{3}$
- 25) $r_1 = \frac{17}{4}; r_2 = \frac{-255}{4}$

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27) $p = \frac{-6}{5}; \quad q = 158$

28) $\left(\frac{15}{2}, \frac{83}{6} \right)$

29) $(-1, -12); \quad 23^\circ 37' 45.76''$

30) $r_1 = 48; \quad r_2 = -21$

31) Parallel