All objects considered here are in the plane $\mathbb{E}^2$.

1. Determine parametric equations for the line ℓ in the following cases:

1. ℓ contains the point $A(1,2)$ and is parallel to the vector $\mathbf{a}(3,-1)$,
2. ℓ contains the origin and is parallel to $\mathbf{b}(4,5)$,
3. ℓ contains the point $M(1,7)$ and is parallel to Oy,
4. ℓ contains the points $M(2,4)$ and $N(2,-5)$.

2. For the lines ℓ in the previous exercise

1. give a Cartesian equation for ℓ,
2. describe all direction vectors for ℓ.

3. Determine a Cartesian equations for the line ℓ in the following cases:

1. ℓ has slope -5 and contains the point $A(1,-2)$,
2. ℓ has slope 1 and is at distance 2 from the origin,
3. ℓ contains the point $A(-2,3)$ and has an angle of $60°$ with the Ox-axis,
4. ℓ contains the point $B(1,7)$ and is orthogonal to $\mathbf{n}(4,3)$.

4. For the lines ℓ in the previous exercise

1. give parametric equations for ℓ,
2. describe all normal vectors for ℓ.

5. Consider a line ℓ. Show that

1. if $\mathbf{v}(v_1,v_2)$ is a direction vector for ℓ then $\mathbf{n}(v_2,-v_1)$ is a normal vector for ℓ,
2. if $\mathbf{n}(n_1,n_2)$ is a normal vector for ℓ then $\mathbf{v}(n_2,-n_1)$ is a direction vector for ℓ.

6. Consider the points $A(1,2)$, $B(-2,3)$ and $C(4,7)$. Determine the medians of the triangle ABC.

7. Let $M_1(1,2)$, $M_2(3,4)$ and $M_3(5,-1)$ be the midpoints of the sides of a triangle. Determine Cartesian equations and parametric equations for the lines containing the sides of the triangle.

8. Let $A(1,3)$, $B(-4,3)$ and $C(2,9)$ be the vertices of a triangle. Determine

1. the length of the altitude from A,
2. the line containing the altitude from A.

9. Determine the circumcenter of the triangle with vertices $A(1,2)$, $B(3,-2)$, $C(5,6)$.

10. Determine the angle between the lines $\ell_1 : y = 2x + 1$ and $\ell_2 : y = -x + 2$.

11. Let $A(1, -2)$, $B(5, 4)$ and $C(-2, 0)$ be the vertices of a triangle. Determine the equations of the angle bisectors for the angle $\measuredangle A$.

12. Let A' be the orthogonal reflection of $A(10, 10)$ in the line $\ell : 3x + 4y - 20 = 0$. Determine the coordinates of A'.

13. Determine Cartesian equations for the lines passing through $A(-2, 5)$ which intersect the coordinate axes in congruent segments.