**9.1.** Determine the semi-minor and semi-major axes as well as the focal points of the ellipse $9x^2 + 25y^2 - 225 = 0$. Moreover, draw this ellipse.

**9.2.** Determine the position of the line $\ell : 2x + y - 10 = 0$ relative to the ellipse $\mathcal{E} : \frac{x^2}{9} + \frac{y^2}{4} - 1 = 0$.

**9.3.** Determine an equation of a line which is orthogonal to $\ell : 2x - 2y - 13 = 0$ and tangent to the ellipse $\mathcal{E} : x^2 + 4y^2 - 20 = 0$.

**9.4.** A *diameter* of an ellipse is the line segment determined by the intersection points of the ellipse with a line passing through the center of the ellipse. Show that the tangent lines to an ellipse at the endpoints of a diameter are parallel.

**9.5.** Consider the family of ellipses $\mathcal{E}_a : \frac{x^2}{a^2} + \frac{y^2}{16} = 1$. For what value $a \in \mathbb{R}$ is $\mathcal{E}_a$ tangent to the line $\ell : x - y + 5 = 0$?

**9.6.** Consider the family of lines $\ell_c : \sqrt{5}x - y + c = 0$. For what values $c \in \mathbb{R}$ is $\ell_c$ tangent to the ellipse $\mathcal{E} : x^2 + \frac{y^2}{4} = 1$?

**9.7.** Determine the common tangents to the ellipses

$$\frac{x^2}{45} + \frac{y^2}{9} = 1 \quad \text{and} \quad \frac{x^2}{9} + \frac{y^2}{18} = 1.$$

**9.8.** Consider the ellipse $\mathcal{E} : \frac{x^2}{4} + y^2 - 1 = 0$ with focal points $F_1$ and $F_2$. Determine the points $M$, situated on the ellipse, for which the angle $\measuredangle F_1MF_2$ is a right angle.

**9.9.** Using a rotation of the coordinate system, find the equation of an ellipse centered at the origin, with focal points on the line $x = y$ and having semi-major axes equal to 4 and the distance between the focal points equal to $2\sqrt{3}$.

**9.10.** Draw the hyperbola $9x^2 - 4y^2 = 36$, indicate the semi-major and the semi-minor axes, and write down equations for the asymptotes. Moreover, determine the relations between the coordinates $(x_P, y_P)$ of the point $P$ such that $P$ does not belong to any tangent line to the hyperbola.

**9.11.** Find an equation for the tangent lines to:

a) the hyperbola $\mathcal{H} : \frac{x^2}{20} - \frac{y^2}{5} - 1 = 0$, orthogonal to the line $\ell : 4x + 3y - 7 = 0$;

b) the parabola $\mathcal{P} : y^2 - 8x = 0$, parallel to $\ell : 2x + 2y - 3 = 0$.

**9.12.** Find an equation for the tangent lines to:

a) the hyperbola $\mathcal{H} : \frac{x^2}{3} - \frac{y^2}{5} - 1 = 0$, passing through $P(1, -5)$;

b) the paraola $\mathcal{P} : y^2 - 36x = 0$, passing through $P(2, 9)$.