Exercise 1. Calculate $P(x)+Q(x)$, $P(x)-Q(x)$ and $P(x)\cdot Q(x)$.

a) $P(x)=4-x^2$, $Q(x)=1+2x^3$, b) $P(x)=1-x^3$, $Q(x)=-1+5x+x^2$.

Exercise 2. Revise the short multiplication formulas.

a) $(a-b)^2=\ldots$, b) $(a+b)^2=\ldots$, c) $(a-b)(a+b)=\ldots$, d) $(a+b+c)^2=\ldots$,
e) $(a+b)^3=\ldots$, e) $(a-b)^3=\ldots$, f) $a^3+b^3=\ldots$, g) $a^3-b^3=\ldots$.

Exercise 3. Find zeroes of the following functions and draw graphs.

a) $f(x)=2x+1$, draw $f(x)$ and $|f(-|x|)|$,

b) $f(x)=\frac{x}{3}+2$, draw $f(x)$, $|f(x)|$ and $f(|x|)$,

c) $f(x)=4$, draw $f(x)$ and $f(x+2)+3$.

Exercise 4. For each parabola calculate its roots (if they exist) and coordinates of the tip. Draw graphs – mark roots, coordinates of the tip and the intersection with OY axis on each graph.

a) $f(x)=3x^2+4$, draw $f(x)$,

b) $f(x)=x^2-9x+8$, draw $f(x)$ and $f(|x|)$,

c) $f(x)=-2x^2-10x+12$, draw $f(x)$ and $|f(x+2)|+3$.

Exercise 5. Calculate the canonical form and roots without computing the discriminant. Draw a graph of each parabola and mark all important points.

a) $f(x)=-2x^2-2x+24$, b) $f(x)=x^2-7x+6$, c) $f(x)=3x^2+9x-120$.

Exercise 6. Find values of parameter m for which the quadratic function $y=-x^2+(m+2)x-4$ has

a) no roots, b) exactly one root, c) two roots.

Exercise 7. Solve the following biquadratic equations.

a) $x^4-3(x^2-1)=7(x^2-3)$, b) $x^4+x^2-6=0$.

Exercise 8. Divide polynomials.

a) $(x^2-9x-10):(x+1)$, b) $(x^2+9x+14):(x+7)$, c) $(3x^3-5x^2+10x-3):(3x+1)$,
d) $(2x^4-5x^3+2x):(2x+1)$, e) $(x^{15}-1):(x^5+1)$.

Exercise 9. Find all roots of the following polynomials.

a) x^3-2x^2-5x+6, b) $2x^3-5x^2-2x-3$, c) $x^3+\frac{x^2}{6}-x+\frac{1}{3}$.

Exercise 10. Find roots of the polynomials and solve inequalities. You may not "guess" any roots in examples (a) and (c).

a) $2x^3-x^2-4x+2<0$, b) $-2x^3-2x^2+5x+2>0$, c) $-16x^6+8x^5-4x^4+2x^3\geq 0$.

Exercise 11. Sketch the following curves.

a) $y = 2 + \frac{3}{x-4}$, b) $y = \frac{-5}{x+5} - 2$, c) $y = \frac{x-1}{x+1}$, d) $y = -\frac{x-3}{x+2} + 3$.

Exercise 12. Solve the following inequalities.

a) $\frac{1}{x+2} - \frac{x+2}{x-2} \leq 2$, b) $\frac{6}{3+5x} \geq 3$, c) $\frac{-7}{9-2x} \geq \frac{5}{8x+6}$, d) $\frac{1+x}{1+2x} - \frac{1-2x}{x+1} < -1$.

Exercise 13. Set domains of the following functions.

a) $f(x) = (x+1)^{-5} + (2-x)^{-1.3}$, b) $g(x) = x(x-3)^{7/3} + x^4(7-x)^{\frac{1}{2}}$, c) $h(x) = x^2(x-2)(5-x)^{\sqrt{\pi}}$.

Exercise 14. Set domains of the following functions.

a) $f(x) = \sqrt{2x - x^2}$, b) $f(x) = \frac{1}{\sqrt[3]{x^6-1}}$, c) $f(x) = \sqrt[4]{x - \frac{1}{x}}$,
d) $f(x) = \sqrt{\frac{3}{x} - 2 - x}$, e) $f(x) = \sqrt{1 - \left(\frac{2x}{1+x^2}\right)^2}$.

Exercise 15. Solve the following equations and inequalities.

a) $\sqrt{10x+8} = 8 - x$, b) $\sqrt[5]{x-3} < -2$, c) $\sqrt{x-3} < -2$,
d) $\sqrt{6-x} > 7$, e) $\sqrt{6-x} > -7$, f) $\sqrt{12 - x^2} > 5x - 7$,
g) $(x^2+x)^{-2.5} = 0.25\sqrt{8}$, h) $\sqrt{4x - x^2} > x - 2$.