Problem 1. Find the derivative of the following polynomials:

1. $f(x) = 7x^3 - x^2 - x + 2$.
2. $f(x) = 5x^7 - 8x^6 + x^2 - 3$.
3. $f(x) = \dfrac{x^4}{4} + \dfrac{x^3}{3} - \dfrac{x^2}{2} + 4^2 - \sqrt{2}$.
4. $f(x) = \dfrac{x^{10}}{5} + 7x^9 - 5x^7 - 3x^2 - \sqrt{5}$.
5. $f(t) = \sqrt{2}\,t^3 - \sqrt{5}\,t + \sqrt{2} + \pi^2$.
6. $f(r) = \sqrt{6}\,r^4 + \sqrt{3}\,r^7 + \sqrt{6} - \pi$.

Problem 2. For the following we have the distance/displacement s of a particle moving on x-axis, given as a function of time t. Find the time instants at which the particle is at rest, the time intervals in which the particle is moving to the right and the time intervals in which the particle is moving to the left.

1. $s(t) = t^3 - 6t^2 + 9t + 1$.
2. $s(t) = -\dfrac{t^3}{3} + \dfrac{9\,t^2}{2} - 14\,t$.

Answers to problem 1.

1. $21x^2 - 2x - 1$.
2. $35x^6 - 48x^5 + 2x$.
3. $x^3 + x^2 - x$.
4. $2x^9 + 63x^8 - 35x^6 - 6x$.
5. $3\sqrt{2}\,t^2 - \sqrt{5}$.
6. $4\sqrt{6}\,r^3 + 7\sqrt{3}\,r^6$.

Answers to problem 2.

1. Time instants of rest are $t = 1$ and $t = 3$. Time intervals of moving to the right are $[0, 1) \bigcup (3, \infty)$. Here we exclude the part $(-\infty, 0)$ which lie to left of origin because time cannot be negative. Time intervals of moving to the left are $(1, 3)$.
2. Time instants of rest are $t = 2$ and $t = 7$. Time intervals of moving to the right are $(2, 7)$. Time intervals of moving to the left are $[0, 2) \bigcup (7, \infty)$. As in (1), we exclude the interval $(-\infty, 0)$ since time cannot be negative.