1. Using long division algorithm, find the quotient and the remainder.

   a) $\frac{3x^4-5x^3-20x-5}{x^2+x+3}$ b) $\frac{9x^2-x+5}{3x^2-7x}$

   c) $\frac{2x^5-7x^4-13}{4x^2-6x+8}$ d) $\frac{x^4-x+5}{x^2-1}$

2. Express $f(x)$ in the form $f(x) = (x-k)q(x) + r$ for the given value of k.

   a) $f(x) = 2x^3 + x^2 + x - 8;\ k = -1$ b) $f(x) = -x^3 + x^2 + 3x - 2;\ k = 2$

   c) $f(x) = 2x^3 + 3x^2 - 16x + 10;\ k = -4$ d) $f(x) = 4x^4 - 3x^3 - 20x^2 - x;\ k = 3$

   e) $f(x) = x^3 + 4x^2 + 5x + 2;\ k = -2$ f) $f(x) = 2x^4 + x^3 - 15x^2 + 3x;\ k = -3$

3. For each polynomial, use the remainder theorem and synthetic division to find $f(k)$

   a) $f(x) = x^2 + 5x + 6;\quad k = -2$ b) $f(x) = 2x^2 - 3x - 3;\quad k = 2$

   c) $f(x) = -x^3 + 8x^2 + 63;\quad k = 4$ d) $f(x) = 6x^3 - 31x^2 - 15x;\quad k = -\frac{1}{2}$

   e) $f(x) = x^2 - 5x + 1;\quad k = 2 + i$ f) $f(x) = x^2 + 4;\quad k = 2i$

4. *True or false*. If *false*, tell why.

   a) Since $x - 1$ is a factor of $f(x) = x^6 - x^4 + 2x^2 - 2$, we can conclude that $f(1) = 0$.

   b) Since $f(1) = 0$ for $f(x) = x^6 - x^4 + 2x^2 - 2$, we can conclude that $x - 1$ is a factor of $f(x)$.

   c) For $f(x) = (x+2)^4(x-3)$, 2 is a zero of multiplicity 4.

   d) Since $2 + 3i$ is a zero of $f(x) = x^2 - 4x + 13$, we can conclude that $2 - 3i$ is also a zero.

5. **Impossible Division?** Suppose you were asked to solve the following two problems on a test:

   A. Find the remainder when $6x^{1000} - 17x^{562} + 12x + 26$ is divided by $x + 1$.

   B. Is $x - 1$ a factor of $x^{567} - 3x^{400} + x^9 + 2$?

6. Given that k is a zero of $f(x)$, factor $f(x)$ into linear factors.

   a) $f(x) = 2x^3 - 3x^2 - 17x + 30;\ k = 2$

   b) $f(x) = 2x^3 - 3x^2 - 5x + 6;\ k = 1$

   c) $f(x) = 6x^3 + 13x^2 - 14x + 3;\ k = -3$

   d) $f(x) = 6x^3 + 17x^2 - 63x + 10;\ k = -5$

7. For each polynomial, one zero is given. Find all zeros.

   a) $f(x) = x^3 - x^2 - 4x - 6; 3$

   b) $f(x) = x^3 - 7x^2 + 17x - 15; 2 - i$

   c) $f(x) = x^4 + 5x^2 + 4; -i$

8. Find all values of k such that $f(x)$ is divisible by the given linear polynomial.

   a) $f(x) = kx^3 + x^2 + k^2x + 3k^2 + 11; \quad x + 2$

   b) $f(x) = k^2x^3 - 4kx + 3; \quad x - 1$