1.) (a) Find the quotient and remainder when \( f(x) = x^3 - 5x^2 + 5x - 1 \) is divided by \( x - 1 \).
(b) Is \( x - 1 \) a factor of \( f(x) \)? Why?
(c) Find all of the zeros of \( f(x) \) (exactly).

2.) Given \( f(x) = 2x^2 + 6x + 8 \)
   
a) Find the \( x \) and \( y \) coordinate of the vertex of \( f(x) \) using completing the square or the formula \((-b/2a)\)

b) Find the axis of symmetry

c) Determine whether there is a maximum or minimum value and find that value

3.) Using the Rational Zeros Theorem, find (exactly) the rational zeros and then the other zeros for the function \( f(x) = 11x^4 + 8x^3 - 58x^2 - 40x + 15 \).

4.) (a) Write an equation of a polynomial that has the following zeros: 1 with multiplicity 3, -2 with multiplicity 1, and 3 with multiplicity 2. (You may leave the answer as a product of linear factors – don’t multiply it out.)
(b) Sketch a graph of a polynomial fitting the description of part a.

5.) Solve \(|6 - 4x| \geq 8\) and express the solution in interval notation.

6.) Solve \( \frac{x^2 - 6x + 8}{x - 1} < 0 \) and express the solution in interval notation.

7.) Use the Intermediate Value Theorem (showing work) to determine (if possible) whether there is a zero between -2 and 1 in the function \( f(x) = x^5 - 5x^3 + 10 \).

8.) Sketch a possible graph with a leading term of \(-x^3\) with 3 real zeros.

9.) If \(-1 + 2i\) is a zero of \( P(x) \), a polynomial with real coefficients, then which of the following is also a zero of \( P(x) \)?
   (a) \(-1 - 2i\)  (b) \(1 - 2i\)  (c) \(1 + 2i\)  (d) \(0\)

10.) If \(-3i\) is one zero of \( P(x) \), a polynomial with real coefficients, then which of the following must be a factor of \( P(x) \)?
    (a) \(x^2 - 9\)  (b) \(x^2 + 9\)  (c) \(x^2\)  (d) \(9 - x^2\)

11.) Determine algebraically if 2 is a zero of \( f(x) = 3x^2 + x + 10 \).
    Show work, not using G. C.
Answer Key

1.) (a) \( x^2 - 4x + 1 \), remainder 0
   (b) Yes, because the remainder is 0
   (c) \( 1, 2 + \sqrt{3}, 2 - \sqrt{3} \)

2.) (a) \( \frac{5}{2}, \frac{3}{2} \)
    (b) \( x = \frac{5}{2} \)
    (c) \( \text{min: } \frac{3}{2} \)

3.) \(-1, \frac{3}{11}, \sqrt{5}, -\sqrt{5}\)

4.) (a) \( P(x) = (x - 1)^3(x + 2)(x - 3)^2 \)
    (b) The graph must cross the \( x \)-axis at the points \((1, 0)\) and \((-2, 0)\) and it must just touch at \((3, 0)\). A possible graph:

5.) \((-\infty, -\frac{1}{2}] \cup [\frac{7}{2}, \infty)\)

6.) \((-\infty, 1) \cup (2, 4)\)

7.) Yes

8.) The ends of the graph must go in opposite directions of left up, right down. The graph must either cross the \( x \)-axis 3 times or touch once and cross once. A possible graph:

9.) a

10.) b

11.) No, not a zero of \( f(x) \)