NOTE: There are six questions for chapter 4, four were covered on the midterm, two are new.

1. (§4.1) Graph a quadratic function.
   EG Sketch the graph of the quadratic function \( f(x) = -2x^2 - 4x - 3 \).
   Label the vertex and y-intercept.

2. (§4.1) Find optimal values using quadratic models.
   EG Paradise Travel Agency’s monthly profit \( P \) (in thousands of dollars) depends on the amount of money \( x \) (in thousands of dollars) spent on advertising per month according to the rule \( P(x) = 7 - 2x(x - 4) \). What is Paradise’s maximum monthly profit?

3. (§4.2) Graph polynomial functions.
   EG Sketch the graph of \( f(x) = (x - 2)^2 (x - 3)(x + 1) \)

4. (§4.3,§4.4) Graph rational functions.
   EG Sketch the graph of \( R(x) = \frac{x^2 - x - 12}{x + 1} \)

5. (§4.5) Solve rational inequality.
   EG Solve \( \frac{x}{x + 2} < \frac{1}{x} \)

6. (§4.6,§4.7) Find zeros of polynomials.
   EG Find all the roots/zeros of \( P(x) = 2x^3 - 5x^2 + 6x - 2 \)

An Old Quiz on Chapter 4

a. In each of the following statements, circle \( T \) if true, \( F \) if false.
   (In each statement, assume any function called “P” is a polynomial function.)
   T F If \( P(1) = -2 \) and \( P(2) = 7 \), then \( P(r) \) must be 0 for some number \( r \) between 1 and 2.
   T F If \( r \) is a root of \( P \), then \( (x - r) \) is a factor of \( P(x) \).
   T F If \( (x - 8) \) is a factor of \( P \), then \( P(8) \) must be 0.
   T F If \( P(x) = 5(x - 2)^2(x + 4) \), then the only roots of \( P \) are 2 and -4.
   T F If \( P(x) = (x - 3)Q(x) + 2 \), for some polynomial \( Q \), then 3 is a root of \( P \).

b. Use polynomial long division to fill in the blanks with polynomials of degree < 2:
   \[
   \frac{x^3 + x^2 + 1}{x^2 + 1} = \underline{\phantom{\frac{1}{2}}} + \frac{\phantom{\frac{1}{2}}}{x^2 + 1}
   \]

3. List all theoretically possible* rational roots of the polynomial \( 4x^4 - 8x^3 + 7x^2 + 2x - 9 \)
   * based on rational zeroes theorem.

4. \( P(x) = x^3 + 2x - 3 \)
   a. USE synthetic division to locate a rational root of \( P \).
   b. Find all the roots of \( P(x) \)
   c. Sketch the graph of \( y = P(x) \)

7. Sketch the graph of \( y = \frac{3x + 5}{x + 2} \) Label all the intercepts & asymptotes.

8. a. How can we know that \( P(x) = x^4 + 3x^2 + 1 \) has no real roots, without a lot of work?
   b. List all the theoretically possible rational roots of \( P(x) = 2x^3 - \frac{1}{2} x^2 - 32 x + 8 \).
   c. Find all the roots of the polynomial given in #2. Any surprises?
   d. List all the theoretically possible rational roots of \( P(x) = 2x^3 - 5x^2 - 3x \).
   e. Find all the roots of \( P(x) = 2x^3 - 5x^2 - 3x \).