1) Sketch the graph of the following polynomials. Plot the x-intercepts and y-intercepts, and use the end behavior to help (4.1)

a) \( f(x) = x^2 (x+3)(x-2)^2 \)

b) \( f(x) = 2x^3 - 4x \)

c) \( f(x) = -2(x+2)^2 (x-2)^2 (x+4)^2 \)

2) Graph the following rational functions. Make sure you state any x-intercepts, y-intercepts, and the vertical and horizontal asymptotes (4.3)

a) \( f(x) = \frac{x+2}{x^2 + x - 6} \)

b) \( f(x) = \frac{x^2 - 4x + 3}{(x-1)^2} \)

3) Solve the following inequalities (3.5 and 4.4)

a) \( 3x^2 + 10x \leq 8 \)

b) \( (x+3)(x-1)(3x+1) > 0 \)

e) \( \frac{2x-1}{x-1} \leq 3 \)

4) Divide the following using synthetic division (4.5)

a) \( (2x^3 + 7x^2 + 9x - 20) \div (x+3) \)

b) \( (3x^4 - 2x^2 + 5x - 1) \div (x-2) \)

5) What is the remainder when \( f(x) = 2x^3 - x^2 + 6x - 4 \) is divided by \( x-2 \)? Use the remainder theorem. (4.5)

6) Find all the zeros of the following polynomials. Give the final answer in factored form. (4.5 and 4.6)

a) \( 2x^3 - 5x^2 - 6x + 4 = 0 \)

b) \( x^3 - 2x^2 - 7x - 4 = 0 \)

7) Find an n-th degree polynomial function with real coefficients satisfying the given conditions (4.5 and 4.6)

a) \( n = 3; -3, 2, \) and \( 1 \) are zeros

b) \( n = 3; 2 \) and \( 1+ i \) are zeros

c) \( n = 4; \sqrt{5} \) and \( 2i \) are zeros

8) Find \((f \circ g)(x)\) and give the domain of \( f \circ g \) (5.1)

a. \( f(x) = x^2 - 1; \quad g(x) = \sqrt{2x-5} \)

b. \( f(x) = \frac{3}{x-1}; \quad g(x) = x^2 \)

9) Find an equation for the inverse function, and verify that your equation is correct by taking the composite function. You must show all your work! (5.2)

a. \( f(x) = \frac{2}{x} - 1 \)

b. \( f(x) = \frac{1}{2} x - 3 \)

10) Use the following graph of \( f(x) = e^x \) to graph \( g(x) = e^{x-1} - 1 \). Make sure you plot and give the coordinates of at least three points. (5.3)

11) Evaluate without using a calculator (5.4)

a) \( \log_5 \frac{1}{\sqrt{5}} \)

b) \( \log_7 1 \)

c) \( 8^{\log_{12}} \)
d) \( \log_9 9^4 \)

12) Use the graph of \( f(x) = \log x \) to graph graph \( g(x) = 2 - \log x \). Make sure you plot and give the coordinates of at least three points. (5.4)

13) Evaluate without using a calculator (5.4)

a) \( 10^{\log 8} \)

b) \( e^{\ln 3x} \)

c) \( \ln e^{x^2} \)

d) \( 10^{\log \sqrt{7}} \)

14) Use properties of logs to expand as much as possible (5.5)

a) \( \log_5 \sqrt[4]{3x^5} \)

b) \( \log_7 \left( \frac{x^2}{49\sqrt{y+1}} \right) \)

c) \( \log_5 \sqrt[2]{\frac{xy^3}{25}} \)

15) Use properties of logs to condense into a single log with a coefficient of 1 (5.5)

a) \( \frac{1}{3} (\log_3 x - \log_3 y) \)

b) \( \frac{2}{3} \log x - 2 \log y + 4 \log z \)

c) \( 3 \ln (x + y) - 3 \ln x \)

16) Solve the following exponential equations by expressing each side as power of the same base and then equating exponents (5.6)

a) \( 4^{x+1} = 32 \)

b) \( 3^{1-x} = 27 \)

c) \( 6^{\frac{x+1}{2}} = \sqrt{6} \)

d) \( e^{2x-1} = \frac{1}{e^{x+3}} \)

17) Solve the exponential equations. Express the final solution in terms of common or natural logs. You do not need to find the decimal answer (5.6)

a) \( 4^{2x+1} = 20 \)

b) \( 7e^{x-1} = 35 \)

c) \( 2^{\frac{1}{x}} = 12 \)

18) Solve the following log equations. Be sure to state if any proposed solutions are extraneous. Give the exact answer (5.6)

a) \( \log_5 (2x - 5) = 2 \)

b) \( 5 \ln (9x) = 20 \)

c) \( \log_5 (x+5) - \log_5 (x-3) = 1 \)

d) \( \log (3 + x) - \log (x - 2) = \log 2 \)