1. [10 pts.] Use synthetic division to perform the division:

$$\frac{x^5 - x^4 + 2x^3 + 3x + 1}{x + 3}$$

2. Consider the polynomial function f defined by $f(x) = 2x^4 + 15x^3 + 31x^2 + 20x + 4$.

   (a) [5 pts.] Applying the Rational Zeros Theorem, list the possible rational zeros of the function.

   (b) [10 pts.] Find all rational zeros of f.

   (c) [5 pts.] Fully factor the polynomial $f(x)$.

3. [10 pts.] Find a polynomial function f of degree 3 with -2, 1, and 3 as zeros, and $f(0) = 8$.

4. [10 pts.] Find a polynomial function of least degree with real coefficients and having 1 and $2 - i$ as zeros.

5. [10 pts. each] Solve each equation.

   (a) $64^{2x-1} = 4^{3x}$

   (b) $y = \log_8 \sqrt[4]{8}$

   (c) $\log_x 3 = -2$

6. [10 pts. each] Solve each equation. When solutions are irrational, give them as decimals correct to four decimal places.

   (a) $6^{x+3} = 8^x$

   (b) $\ln(3x + 8) = \ln(32)$

   (c) $\log_2 x + \log_2(x + 2) = 3$

7. [10 pts.] Find the time required for an investment of \$5000 to grow to \$8000 at an annual interest rate of 7% per year, compounded quarterly.

8. [10 pts.] Find the doubling time of an investment earning 4.2% interest if interest is compounded continuously.

9. The number of fish of a certain species is given by the formula

$$n(t) = 12e^{0.012t},$$

where t is measured in years and $n(t)$ is measured in millions.

(a) [5 pts.] What will the population of fish be after four years?

(b) [10 pts.] After how many years will the number of fish reach 35 million?

10. [10 pts. each] Solve the system of equations.

(a)
$$\begin{cases} 12x - 5y = 9 \\ 3x - 8y = -18 \end{cases}$$

(b)
$$\begin{cases} 2x + 6y - z = 6 \\ 4x - 3y + 5z = -5 \\ 6x + 9y - 2z = 11 \end{cases}$$

11. [15 pts.] Graph the ellipse

$$\frac{(x+2)^2}{16} + \frac{(y+1)^2}{9} = 1,$$

and identify the domain, range, center, vertices, and foci.

A couple formulas that should be of some use:

$$A = Pe^{rt}$$

$$A = P\left(1 + \frac{r}{m}\right)^{mt}$$