1. (10 pts) Form a polynomial of *minimial degree* in *factored form* that has real coefficients (after expanding) and will have the given zeros. Do *not* expand your polynomial. Leave it factored! If you run out of room, you're doing it wrong!

x = 3, multiplicity 2; x = 3 - 7i, multiplicity 1; x = 2, multiplicity 4.

2. (10 pts) Use synthetic division to find P(3) if $P(x) = 5x^5 - 2x^3 + 3x^2 - 4x + 3$.

- 3. (5 pts) Represent the work you just did on the previous problem by writing P(x) in the form *Dividend* = *Divisor* • *Quotient* + *Remainder*.
- 4. Suppose $f(x) = (x+3)^2(x-3)(x-6) = x^4 3x^3 27x^2 + 27x + 162$. I'm showing you both factored and expanded form to help you answer the following:
 - a. (10 pts) Provide a rough sketch of *f*, using its zeros, their respective multiplicities and its end behavior. Include *x* and *y*-intercepts. Your graph should be smooth. Un-exaggerate the vertical for a better quality graph.

- b. Solve the inequalities (You've done the work. Now, INTERPRET.):
 - i) (5 pts) $f(x) = (x+3)^2(x-3)(x-6) < 0$ ii) (5 pts) $f(x) = \frac{(x+3)^2}{(x-3)(x-6)} \ge 0$

5. (10 pts) Find the *real* zeros of $f(x) = 2x^5 - 4x^4 - 11x^3 + 41x^2 - 43x + 15$. Then factor f over the set of **real numbers**. This should involve an irreducible quadratic factor.

6. (5 pts) Find the remaining (nonreal) zeros of f and factor f over the set of **complex numbers**. This step requires breaking down the quadratic piece that's irreducible over the real numbers. The fundamental theorem tells us that *nothing* is irreducible over the complex numbers.

7. (5 pts) You don't need to graph $R(x) = \frac{2x^3 + 6x^2 + 4x}{x^2 - 4}$, here, but I do want to see you graph its asymptotes.

8. (10 pts) Sketch the graph of $R(x) = \frac{3x^2 - 13x - 4}{x^2 - 3x - 10}$. Show all asymptotes and intercepts.

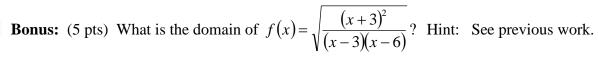
ANSWER ANY TWO (2) OF THE FOLLOWING.



Bonus: (5 pts) Form a polynomial of *minimial degree* in *factored form* that has *rational* coefficients (after expanding) and will have the given zeros. Do *not* expand your polynomial. Leave it factored! If you run out of room, you're doing it wrong!

Zeros: $x = 2 + \sqrt{3}$, multiplicity 1; x = 2 + 3i, multiplicity 2; x = -5, multiplicity 17.







Bonus: (5 pts) Sketch the graph of
$$R(x) = \frac{2x^3 + 6x^2 + 4x}{x^2 - 4}$$
. Hint: See previous work.