

1. In each of the following, form a polynomial with *real* coefficients that has the given zeros and degree. Please do not expand the polynomial.

a. (5 pts) Zeros: -4 , multiplicity 2; 2 , multiplicity 3. Degree 5.

b. (5 pts) Zeros: 2 , multiplicity 1; 5 , multiplicity 2; $7 - 8i$, multiplicity 1. Degree 5.

2. (5 pts) Expand $(x - (3 + 6i))(x - (3 - 6i))$

3. (5 pts) Use synthetic division to find $P(2)$ if $P(x) = x^4 - 5x^3 + 11x^2 - 12x + 13$.

4. (5 pts) Divide $f(x) = 2x^4 - 3x^3 + x - 3$ by $f(x) = x^2 - 1$

5. Let $f(x) = 2(x-1)^2(x+4)(x-5)^3$.

- a. (5 pts) List each real zero and its multiplicity. Determine whether the graph of $f(x)$ touches or crosses the x -axis at each x -intercept.

- b. (5 pts) Find the following limits:

i. $\lim_{x \rightarrow \infty} f(x)$

ii. $\lim_{x \rightarrow -\infty} f(x)$

- c. (5 pts) Use your work, above, to help you sketch the graph of $f(x)$, showing all intercepts (including the y -intercept).

6. Solve the inequalities (Hint: You already laid the foundations for *both* of these in the previous problem.).

a. (10 pts) $2(x-1)^2(x+4)(x-5)^3 \geq 0$

b. (5 pts) $\frac{(x+4)(x-1)^2}{(x-5)^3} \geq 0$ (Hint: This one differs only *slightly* from the previous one.)

7. (10 pts) Find *all* the zeros of $f(x) = x^4 - 5x^3 + 15x^2 - 5x - 26$. Write f in factored form, using the zeros you find.

8. (10 pts) Graph the function $R(x) = \frac{2x^3 - 3x^2 - 2x + 3}{x^3 - 4x^2 + x + 6} = \frac{(x-1)(2x-3)(x+1)}{(x+1)(x-2)(x-3)}$. Key features are asymptotes, holes (if any) and intercepts. I was kind enough to factor it for you.

9. (10 pts) Sketch the graph of $f(x) = \frac{(x+2)(x^2-1)}{(x+1)(x-3)}$. Show all intercepts, asymptotes and holes it has, if any.

Bonus (5 pts) What is the domain of $\sqrt{\frac{(x-1)^2}{(x+4)(x-5)^3}}$?

(Hint: See previous work.)