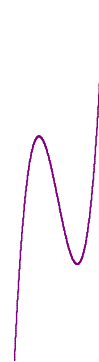**Other than problem #1, please do all problems *neatly* on a *separate sheet* of paper. Show supporting work. All problems are "NC".**

1) Add axes to fit each description:

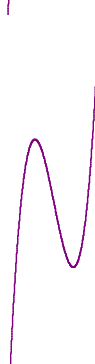   a)   1 real, 2 complex   b)   3 real
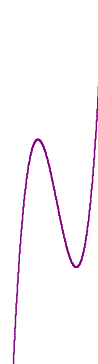
   c)   2 real   d)   2 real, 1 complex

2) Sketch the graph of a polynomial function with:

   a)   3 real, 2 complex zeros   b)   4 real zeros   c)   2 complex zeros

3) Write an equation for a polynomial function of degree 5 with 2 complex zeros, 1 non-integer zero, and 2 irrational zeros.

4) Write function with these possible rational zeros:

$$\pm 18,\ \pm 9,\ \pm 6,\ \pm 3,\ \pm 2,\ \pm 1,\ \pm\frac{9}{4},\ \pm\frac{9}{2},\ \pm\frac{3}{2},\ \pm\frac{3}{4},\ \pm\frac{1}{2},\ and\ \pm\frac{1}{4}.$$

5)   Show that $(1+i)$ is a solution of $x^2 - 2x + 2 = 0$. Find the remaining zero.

6)   Let $w = 1 + i\sqrt{3}$. Show that $w^3 + 8 = 0$.

7)   Find all solutions of the equation $x^4 + 13x^2 + 36 = 0$. Factor over the rationals, reals and complex numbers.

8)   Show that i is a solution of $p(x) = x^4 + 2x^3 + 3x^2 + 2x + 2$. Find the remaining zeros.

9)   Given that 2 is a zero of multiplicity 2 for $h(x) = x^4 - 6x^3 + 18x^2 - 32x + 24$, find the remaining zeros.

10)   One zero of the polynomial $p(x) = x^4 - 9x^3 + 50x^2 - 49x + 41$ is $4 + 5i$. Find the remaining zeros.

11)   One of the zeros of $p(x) = x^4 - 7x^2 + 4x + 20$ is $2 + i$. Find the remaining zeros.

12)   Find all zeros of $p(x) = x^4 - 6x^3 + 9x^2$.

13)   Find all zeros of $p(x) = x^4 - 5x^2 - 36$. Factor over the rationals, reals and complex numbers.

14) Given that 1 is a zero of $p(x) = x^5 - x^4 + 6x^3 - 6x^2 + 9x - 9$, find all remaining zeros.

15) a) Find a polynomial of the least degree possible that has zeros -1, 3, and $2 + 3i$.

    b) Find a polynomial with real coefficients that has zeros -1, 3, and $2 + 3i$.

16) a) Find a polynomial of the least degree possible that has zeros 4 m2 and $1 - 5i$.

    b) Find a polynomial with real coefficients that has zeros 4 m2 and $1 - 5i$.

17) Without doing any computation, explain why 3, -2, and $2i$ cannot all be zeros of the polynomial $p(x) = -3x^3 + 9x^2 - 12x + 36$.

18) Find all intercepts and graph.

    a) $f(x) = x^4 - 8x^3 + 20x^2 - 32x + 64$ b) $f(x) = 2x^3 - 7x^2 + 22x + 13$

    c) $f(x) = x^4 - 10x^3 + 29x^2 - 10x - 50$ d) $f(x) = x^4 - 8x^3 + 26x^2 - 48x + 45$