NAME:

This homework is worth 35 points (23 “regular” points and 12 points of extra-credit). It is due on Monday, December 22, at the beginning of class. **No late homework will be accepted.**

**Instructions:** Attach this question sheet to your work, making it the cover page. The answers should be on 8 1/2 × 11 sheets with the question number clearly indicated. The solutions should be in order of the question number. For credit, show all steps and label answers. **Papers will be graded on clarity, neatness and organization as well as correctness.**

1. a) Solve the inequality \( x^2 - 25 \geq 0 \) and express your answer in interval notation.
   b) Find the domain and range of the function \( f(x) = \sqrt{x^2 - 25} \).

2. a) Write an equation of the line that is parallel to \( 4x - 3y = 1 \) and passes through the point \( (2, -1) \).
   b) Write an equation of the line that is perpendicular to \( 4x - 3y = 1 \) and passes through the point \( (2, -1) \).

3. Let \( f(x) = -5x^2 + 4x \). Compute and simplify \( f(x + h) - f(x) \frac{h}{h} \) (assume \( h \neq 0 \)).

4. Given the polynomial \( f(x) = 3x^3 - 5x^2 - 5x - 1 \),
   a) Find all roots. Express the answers in radical form, where appropriate.
   b) Sketch a complete graph and label all roots clearly.

5. a) Given \( \mathbf{v} = <-5\sqrt{3}, -5> \), find the magnitude and the direction angle of the vector \( \mathbf{v} \).
   b) Find the product and write the result in standard form \( a + ib \):
      \[ 3(\cos 15^\circ + i \sin 15^\circ)][4(\cos 255^\circ + i \sin 255^\circ)] \].

6. Use DeMoivre’s Theorem to find the three cube roots of \(-8\). Express your answer in standard form.

7. For the function \( y = 4 \cos 2(x + \pi/2) \), find the amplitude, period, and phase shift and draw the graph over a one-period interval.

8. The initial amount of a radioactive substance is 100 grams and is decaying at a continuous yearly rate of 3%. How long will it take for there to be a quarter as much of the radioactive substance? Express your answer to the nearest tenth.

9. Identify the conic section and draw the graph. If it is a circle find its center and radius; if it is an ellipse find its center, vertices, and foci; if it is a hyperbola find its center, vertices, foci and asymptotes; if it is a parabola find its vertex, focus and directrix: \( y^2 - 4y - 3x + 8 = 0 \).

10. a) Using the binomial theorem, write in simplest form the fourth term of the expansion of \((2x - y/3)^7\).
    b) Find the sum of the infinite geometric sequence \( 48 + (-12) + 3 + \ldots \).

**Answers.**

1. a) \((-\infty, -5]\) or \([5, \infty)\); b) domain \((-\infty, -5]\) or \([5, \infty)\), range \([0, \infty)\).
2. a) \( y = \frac{4}{3}x - \frac{11}{3} \); b) \( y = -\frac{3}{4}x + \frac{1}{2} \).
3. \(-10x - 5h + 4 \).
4. a) \( x = -1/3 \); \( x = 1 \pm \sqrt{2} \).
5. a) 10, 210\(^\circ\); b) -12\(^\circ\).
6. \(-2, 1 \pm i\sqrt{3} \).
7. 4, \pi, -\pi/2.
8. 46.2 years.
9. parabola with vertex \((4/3, 2)\), focus \((25/12, 2)\), directrix \( x = 7/12 \).
10. a) \(-\frac{560}{27}x^4y^3 \); b) 192/5.