1. Write the following decimals as fractions in reduced form:
   (a) 0.36
   (b) 0.136

2. Factor \((x^2 + 4xy + 4y^2) - (3x + 6y)\) completely over the integers.

3. Solve the system
   \[
   \begin{align*}
   3x - 7y &= 13 \\
   4x + 3y &= 5
   \end{align*}
   \]

4. Find the equations in slope-intercept form of each of the following lines:
   (a) the line through \((-1, 4)\) and \((-2, 1)\).
   (b) the line through \((4, -1)\) that is perpendicular to the line \(y = -2x - 7\).

5. Determine the centre and radius of the circle \(x^2 + y^2 + 4x - 6y - 3 = 0\).

6. Simplify completely, leaving your answer free of negative exponents or radicals:
   \[
   \sqrt{b} \cdot \left(\frac{\sqrt{a^3b^2}}{\sqrt{a^6b^3}}\right)^{-1}
   \]

7. Determine the vertical and horizontal asymptotes of the rational function
   \[
   y = \frac{2x}{x^2 - x - 6}
   \]

8. Solve \(\frac{1}{x} + \frac{1}{x - 2} = \frac{4}{3}\).

9. Determine the natural domain of definition of each of the following functions. Explain your results!
   (a) \(f(x) = \frac{\sqrt{x}}{2 - \sin x}\)
   (b) \(g(x) = \frac{1}{\log_3(x + 1)}\)

10. Find all solutions of \(\log_2(3x + 2) + \log_2(x + 1) = 2\).
11. Suppose that a certain radioactive substance decays exponentially according to the formula $y = 100 \cdot (2^{-0.04t})$, where $t$ is in years. Compute its half-life. Your final answer should not contain any logarithms!

12. Suppose that $t$ is an angle with $\pi < t < 2\pi$ and $\cos t = \frac{3}{5}$. Compute
   
   (a) $\tan t$
   
   (b) $\sin(2t)$

13. Prove the trigonometric identity $\sin^2 t = \frac{1 - \cos(2t)}{2}$.

14. Richard often flies from Center City to Clear Lake and returns on the same day. On a windless day, he can average 120 miles per hour for the round trip, while on a windy day, he averaged 140 miles per hour one way and 100 miles per hour the other. It took him a quarter of an hour longer on the windy day. How far apart are Center city and Clear Lake?
McGILL UNIVERSITY

FACULTY OF SCIENCE

FINAL EXAMINATION

MATHEMATICS 189-112A

FUNDAMENTALS OF MATHEMATICS

Examiner: Dr. A. Hundemer
Associate Examiner: Professor N.G.F. Sancho

Date: Wednesday, December 16, 1998
Time: 9:00 A.M. - 12:00 Noon.

INSTRUCTIONS

Calculators are not permitted
SHOW ALL YOUR WORK!

This exam comprises the cover and 2 pages of questions.