1. (24 pts) Trigonometry

   (a) A plane takes off in a straight line with an angle of inclination of $\pi/3$. How far (in the horizontal direction) will the plane have traveled when it reaches a height of 12 km?

   (b) Let $f(\theta) = 6\cos(2\theta) - 1$

      i. Sketch a graph of f on the interval $[0, 2\pi]$. (On your graph, label the coordinates of the y intercept and the coordinates of the maximum and minimum values of the function.)

      ii. What is the range of f?

      iii. Solve the inequality $6\cos(2\theta) - 1 > 2.$ for θ in the interval $[0, 2\pi]$. Write your answer in interval notation.

2. (26 pts) **Limits** Evaluate the following limits and simplify your answers.
   (Reminder: You may not use L'Hopital's Rule in your solution.)

   (a) $\lim\limits_{x\to 3} \dfrac{|x-3|}{2x^2-5x-3}$

   (b) $\lim\limits_{x\to 0} \dfrac{\tan(3x)\cos(4x)}{x}$

   (c) $\lim\limits_{x\to -\infty} \left(\sqrt{x^2+3x} - \sqrt{x^2-3x}\right)$

3. (26 pts) Consider the function $f(x) = \dfrac{3x^2+6x-9}{x^2-3x+2}$.

   (a) What is the domain of f?

   (b) Find the equation of each vertical asymptote of the function $y = f(x)$, if any exist. Support your answer by evaluating the appropriate limits.

   (c) Determine the equation of each horizontal asymptote of the function $y = f(x)$, if any exist. Support your answer by evaluating the appropriate limits.

   (d) Use the definition of continuity and your work in parts (a)-(c) to identify the values of x at which $f(x)$ is discontinuous. Describe the type of discontinuity at each value.

4. (24 pts) The following problems are not related.

   (a) Suppose f and g are both odd functions and h is an even function. Furthermore, suppose f, g, and h are all defined for all real numbers. Let $j(x) = h(f(x) + g(x))$. Determine if $j(x)$ is even, odd, or neither.

   (b) Consider $s(x) = \frac{x}{1-x}$ and $r(x) = \frac{x}{x+1}$. Determine $s \circ r$ and simplify as much as possible. Also, determine the domain of of $s \circ r$.

   (c) Use a theorem to show that $\cos x = \frac{1}{x}$ has a solution on one of the following intervals:

   - $[\frac{\pi}{2}, \pi]$
   - $[-\frac{\pi}{2}, \frac{\pi}{2}]$
   - $[-\pi, -\frac{\pi}{2}]$

   (Be sure to state the name of the theorem that is used and justify its use. Note that you only need to show a solution exists on one of the intervals, and that some of them may not work. Be sure to identify the correct interval.)