MATH 140(Calculus I) Mid-Term Test
This is a mock (i.e., practice) exam!

1. Simplify the expression $\sin(\arctan x)$.

2. Let $f(x) = \dfrac{e^x + 10}{2e^x - 12}$. Now
   (i) Find the domain of $f(x)$.
   (ii) Show that $f(x)$ is a one-to-one function.
   (iii) Find the formula for $f^{-1}(x)$.
   (iv) Find the range of $f(x)$.

3. Determine whether the given function is even, or odd, or neither.

$$f(x) = e^{-x^2}\cos x, \qquad g(x) = x^4 \sin x - x, \qquad h(x) = \sin x + \cos x.$$

4. Showing all your work, find the limit or explain why it does not exist.

   (i) $\lim\limits_{x\to\infty} \cos 2x$; (ii) $\lim\limits_{x\to\pi} \dfrac{\tan x}{\sin 2x}$

   (iii) $\lim\limits_{x\to -1} \dfrac{\sqrt{x^2+1}}{x+1}$, (iv) $\lim\limits_{x\to-\infty}(2x + \sqrt{4x^2+2x})$

5. Find the asymptotes (horizontal and vertical) to the graph of the function $f(x) = \dfrac{\sqrt{x^2+1}}{2x-1}$.

6. Find all the values of the constant c that will make the function

$$f(x) = \begin{cases} -2x + c & \text{if } x < 0, \\ (x+c)^3 & \text{if } x \geq 0, \end{cases}$$

continuous everywhere.

7. (a) Evaluate the limit of the ratio $\dfrac{f(x) - f(5)}{x - 5}$ as $x \to 5$ where $f(x) = (x+10)(x-1)$.

   (b) Showing all your work, decide whether or not the function $g(x) = |x^3 - 1|$ is differentiable at $a = -1$.