# Midterm Review – Thursday, July 16

1. Find the domain of the function
$$h(u) = \frac{\sqrt{5-u}}{\sqrt[4]{u^2 - 3u}}.$$

2. Consider the following function
$$g(x) = \begin{cases} x^2 - 2 & \text{if } x < 0; \\ -1 & \text{if } x = 0; \\ 2x - 2 & \text{if } 0 < x \leqslant 1; \\ e^{x-1} & \text{if } x > 1. \end{cases}$$

   (a) For what values $a$ does $\lim\limits_{x \to a} g(x)$ not exist?

   (b) For what values $a$ is the function $g(x)$ discontinuous at $x = a$?

   (c) Sketch the graph of $g(x)$.

3. Is there a number $a$ such that the limit
$$\lim_{x \to -2} \frac{3x^2 + ax + 2}{x^2 + x - 2}$$

   exists? If so, find the value $a$ and the value of the limit.

4. Find the limit
$$\lim_{x \to \infty} \left( \sqrt{9x^2 + x} - 3x \right).$$

5. Show that the equation
$$2^x = \sqrt{4 - x^2}$$

   has a root in the interval $[0, 1]$.

6. Use any method to differentiate the function
$$f(x) = \frac{x e^{\sin x}}{\sqrt{x+1}}.$$

7. Let
$$f(x) = \frac{1 + x}{1 - x}.$$

   (a) Use the limit definition of the derivative to calculate $f'(x)$.

   (b) Find a formula for $f^{-1}(x)$.