Math 165: Final Exam — Part 1
Fall 2015

This part of the exam has 8 problems for a total of 40 possible points. Each problem is worth 5 points.

You may NOT use a calculator on this section. You must show all work, but you need not simplify your answers unless instructed to do so. This part of the exam will be collected after 50 minutes.

Question 1: ______
Question 2: ______
Question 3: ______
Question 4: ______
Question 5: ______
Question 6: ______
Question 7: ______
Question 8: ______

40 Total Points: ______
Question 1. Evaluate \( \int \left( -2x^4 - \frac{1}{4} \sqrt{x} - 7x^{-1} - \frac{\sqrt{2}}{x^{1/2}} + 2015 \right) \, dx \).

Question 2. Evaluate \( \int_1^{e^5} \frac{2}{t(4 + \ln t)^{3/2}} \, dt \). Your answer must be in simplest form.
**Question 3.** The differentiable function $f$ satisfies

\[ f(-2) = 0, \quad f'(-2) = 0, \quad f(0) = 4, \quad f'(0) = -2, \quad f(3) = 1, \quad \text{and} \quad f'(3) = -3. \]

Evaluate

\[ \int_{-2}^{3} 4(f(z) + 1)^2 f'(z) \, dz. \]

**Question 4.** Does the graph of

\[ y = \frac{e^{x^2}}{x^2} \]

have any horizontal asymptotes? If yes, provide the asymptote(s) and justify your answer. If no, justify your answer.
**Question 5.** A radioactive substance decays in such a way that the amount present at time $t \geq 0$ is given by

$$A(t) = 2015e^{-kt},$$

where $k$ is a known positive constant. How long does it take the substance to decay to one-third of its original amount? (Your answer can involve $k$.) Show all work.

**Question 6.** Let $G(z) = \int_0^z 3 \cos(t^2/2) \, dt$.

a. Find the value of $G''(0)$. (2 points.)

b. The function $H$ is defined as the composition $H(z) = G(G(z))$. Find the value of $H'(0)$. (3 points.)
**Question 7.** Find an equation for the line tangent to the graph of \( y = f(x) = \tan^{-1}(x^3) \) at the point with \( x = 1 \).

**Question 8.** Consider the graph of \( y = (x^2 - 3)e^x \) on the interval \(-4 \leq x \leq 2\). Find the coordinates of the absolute maximum point and the coordinates of the absolute minimum point. Be sure you state which is which and show all work needed to justify your answers. (Recall that \( e \approx 2.71 \).)