Math 220/221 Midterm 3 Review Worksheet

1) Let $R$ be the finite region bounded by the graphs of $y = 3\sin(x)$, $y = 5$, $x = 0$, and $x = \pi$. Set up but do not evaluate, definite integrals which represent the following quantities. Integrate with respect to $x$.

   a) The area of the region $R$
   b) The volume of the solid with base $R$ for which the cross-sections perpendicular to the $x$-axis are squares
   c) The volume of the solid formed when $R$ is revolved around the line $y = 8$
   d) The volume of the solid formed when $R$ is revolved around the line $x = -2$

2) At $t$ hours, a population of bacteria is growing at a rate of $21e^{\sqrt{t}}/\sqrt{t}$ bacteria per hour. Compute the change in population size between times $t = 169$ and $t = 196$. Simplify

3) Find the average value of the function $f(x) = \frac{8}{x^2 + 9}$ on the interval $[1,9]$. Simplify

4) Suppose that $f(x)$ is an even function which satisfies the following conditions

   - $\int_{3}^{36} f(x) \, dx = 900$
   - $\int_{-3}^{3} f(x) \, dx = 300$

   Evaluate the following quantities

   $$\int_{3}^{36} (f(x) + 100) \, dx$$
   $$\int_{0}^{18} x \, f(x^2) \, dx$$

6) Evaluate the Integral:

   $$\int_{0}^{\pi/4} (1 + \tan(t))^3 \sec^2(t) \, dt$$