Exam 2 Problems

1. A reactant in a chemical reaction changes at a rate (g/hr) proportional to the amount of that reactant present. If $y$ represents the amount of reactant at time $t$, $\frac{dy}{dt} = -0.7y$. If there were 40 grams of reactant when the process started ($t = 0$) how many grams will remain after 5 hours.

2. A cup of coffee with temperature 145 degree Fahrenheit is place in a freezer with temperature 25 degrees. After 5 minutes the temperature of the coffee is 98 degrees. Use Newton’s law of cooling to find the coffee temperature after 15 minutes.

3. Suppose that $\sinh x = \frac{2}{3}$. Determine the values of the other hyperbolic trigonometric functions.

4. Simplify $3\sinh(\ln x)$ using its exponential form.

5. Find the derivative: a. $\frac{d}{dt} \ln(\cosh 5t)$ b. $\frac{d}{dt} \tanh(t^2 + 1)$

6. Solve the equation for $x$: $y = \frac{e^x - e^{-x}}{2}$.

7. Evaluate the integrals:
   a. $\int \frac{dt}{\sqrt{-t^2 + 6t - 5}}$  b. $\int x \cos(3x) \, dx$.  c. $\int \sin^{-1}(2x) \, dx$
   d. $\int e^x \sin(2x) \, dx$  d. $\int x \tan^2(2x) \, dx$  e. $\int \frac{1}{25 - 9x^2} \, dx$
   f. $\int \frac{x}{x^2 - x - 30} \, dx$  g. $\int \sin^3(2x) \, dx$  h. $\int \sin^2(4x) \, dx$
   i. $\int \sec(x) \, dx$  j. $\int \frac{5}{4 + 9x^2} \, dx$  k. $\int \frac{5}{\sqrt{4 + x^2}} \, dx$
   l. $\int \sqrt{9 - x^2} \, dx$  m. $\int \frac{x^2 + 2x + 16}{(x^2 + 16)^2} \, dx$  n. $\int \frac{dx}{\sqrt{x^2 + 9}}$
8. Use tables to evaluate the following:
   a. \( \int x \sqrt{15x - 4} \, dx \)
   b. \( \int \frac{dx}{x \sqrt{4x - 1}} \)
   c. \( \int \frac{x^2}{\sqrt{16 - x^2}} \, dx \)
   d. \( \int \cos(3x) \cos(5x) \, dx \)

9. The fuel tanks for airplanes are in the wings with a cross section as shown in the picture below. If the tank is to hold 5000 lbs of fuel with a density of 40 lb/ft³, Estimate the length of the tank using Simpson's rule.

   ![Fuel tank diagram]

   Horizontal spacing = 1.5 ft. y-values in feet:
   \( y_0 = 1.1, y_1 = 1.3, y_2 = 1.5, y_3 = 1.6, y_4 = 1.7, y_5 = 1.7, y_6 = 1.6 \)

10. Estimate \( \int e^{x^2} \, dx \) using the trapezoidal rule and 4 subintervals (n = 4). Round your answer to 3 decimals.

11. Evaluate the following:
   a. \( \int_0^\infty \frac{dx}{x^2 + 4} \)
   b. \( \int_0^2 \frac{2x + 3}{\sqrt{x^2 + 3x}} \, dx \)

12. Determine whether the following integrals converge or diverge. Explain.
   a. \( \int_0^\pi \frac{dx}{\sin x + \sqrt{x}} \)
   b. \( \int_0^\infty \frac{dx}{x + 4} \)