Print Your Name

Student ID #

Problem	Total Points	Score
1	8	
2	7	
3	6	
4	7	
5	7	
Part 2 Total	35	
Part 1 Total	35	
Exam Total	70	

Directions

- Please check that your exam contains a total of 6 pages.
- Show all your work or you may not receive credit.
- Place a box around your $\boxed{\text{FINAL ANSWER}}$ to each question.
- You may use one 8.5×11 handwritten sheet of notes and a non-graphing calculator.
- If you use a trial and error (guess and check) or other numerical method when an algebraic method is available, you will not receive full credit.
- If you use an integral from a table other than those found on the back of this page, you will not receive full credit.

Signature. Please sign below to indicate that you have not and will not give or receive any unauthorized assistance on this exam.

Signature: _____

1. (8 total points)

   (a) (6 points) Find the general solution to the following differential equation:

   $$y' = (y + 1)\cos x.$$

   Write your answer in the form $y = f(x)$.

   (b) (2 points) Find the solution of the differential equation above that satisfies the initial condition $y(0) = 1$.

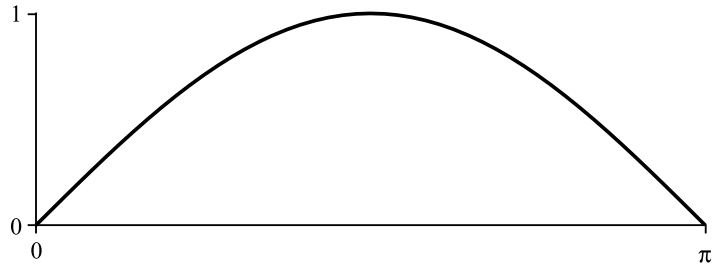
2. (7 points) A vat with 250 gallons of vinegar contains 5% acetic acid by volume. A more concentrated form of vinegar containing 8% acetic acid is poured into the vat at a rate of 5 gal/min. The mixture is stirred constantly and pours out at a rate of 5 gal/min.

   Let $V(t)$ be the volume of acetic acid in the mixture at a given time. SET UP a differential equation that describes the situation above. Include the initial condition. DO NOT SOLVE.

   Differential Equation: _____

   Initial Condition: _____

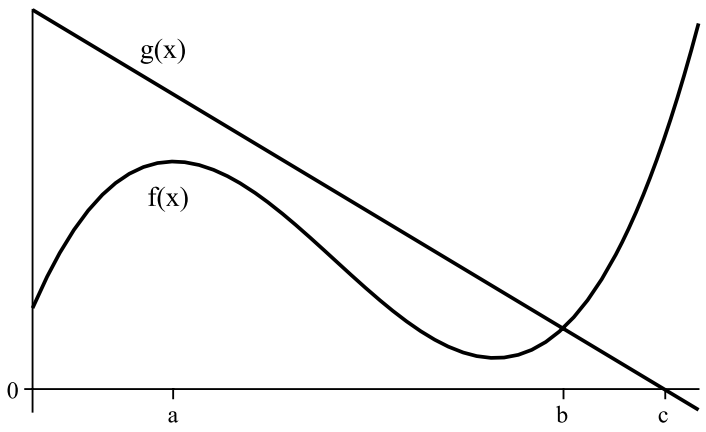
3. (6 points) Set up integrals to find the centroid $(\overline{x}, \overline{y})$ of the region bounded by $y = \sin x$, $y = 0$, $x = 0$, and $x = \pi$. The area of the region is 2. DO NOT INTEGRATE.



$\overline{x} =$ _____

$\overline{y} =$ _____

4. (7 total points) Two functions, $f(x)$, and $g(x)$ are graphed below.



Define

$$F(x) = \int_0^x f(t)\,dt \qquad G(x) = \int_0^x g(t)\,dt.$$

(a) (6 points) For each of the following, fill in the box with one of the following symbols:

$<$ less than
$=$ equal
$>$ greater than

You do not need to show work.

$F(b)$ ☐ $G(b)$

$G(c)$ ☐ $G'(c)$

$F'(b)$ ☐ $G'(b)$

$F(a)$ ☐ $F(b)$

(b) (1 point) What is $F(F''(a))$?

5. (7 total points) The speed of sound in water is affected by the water's salinity, temperature, and depth. If I assume that the salinity and temperature do not change much with depth, the speed of sound in the Atlantic Ocean at a depth of x meters is approximately

$$v(x) = 1472 + 0.0163x \quad \text{meters per second.}$$

(a) (3 points) Use the formula distance traveled = velocity $\times$ time to determine the amount of time it takes the pulse to travel from a depth of x meters to a depth of $x + \Delta x$ meters.

(b) (2 points) Use the formula you found in part (a) to write the definite integral that gives the amount of time it takes a pulse of sound to travel from the surface of the ocean to a depth of 4000 meters. DO NOT EVALUATE.

(c) (2 points) If you were to evaluate the integral in part (b), what units would your answer be in?