Group Exam 1 YOUR NAME: _____
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Problem 1: Consider the region R bounded by the two curves

$$y = -x^2 + 10 \text{ and } y = -x + 4.$$

(a): Sketch the curves given above, label the points of intersection, and find the area of the region.

(b): Set up but DO NOT EVALUATE an integral which calculates the volume of the solid with base R and cross sections perpendicular to the to the x-axis are semi-circles.

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Problem 2: Answer the following two questions. You may assume the first in order to answer the second.

(a): Use the substitution $u = x/a$ to show that the hyperbola $y = 1/x$ has the following special property: If $a, b > 0$ then $\int_a^b \frac{1}{x}\, dx = \int_1^{b/a} \frac{1}{x}\, dx$. You may find it helpful to draw a picture.

(b): Show that the areas under the hyperbola over the intervals $[1, 2]$, $[2, 4]$, $[4, 8] \ldots$ are all the same.

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Problem 3: Show all steps and use correct mathematical grammar for full credit. You may assume the first in order to answer the second.

(a): Prove that the following equation is true:

$$\int \tan^2(x)\ dx = \tan(x) - x + C$$

(b): Give the **exact** value of

$$\int_0^{\pi/6} \tan^2(2x)\ dx.$$

Evaluate all trig functions in your answer.