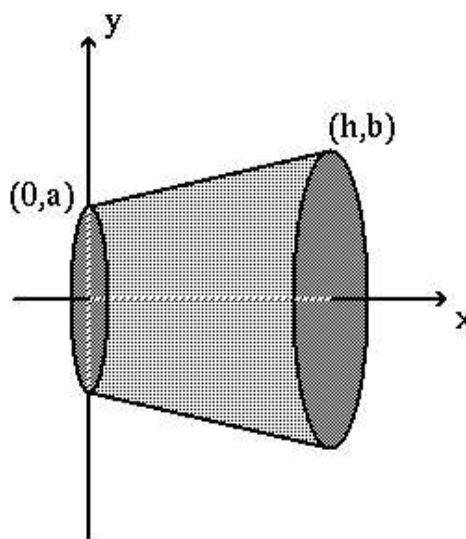
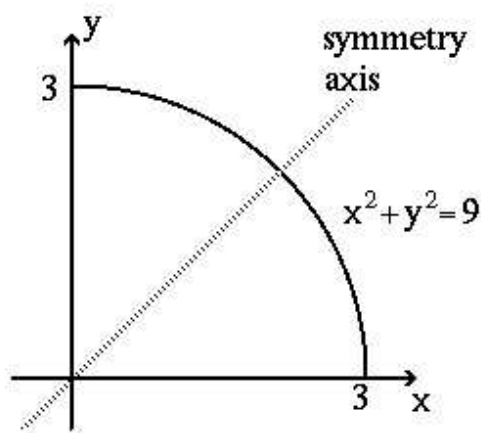


ON THE FRONT OF YOUR BLUEBOOK write: (1) your name, (2) your student ID number, (3) lecture section (4) your instructor's name, and (5) a grading table. You must work all of the problems on the exam. Show ALL of your work in your bluebook and **BOX IN YOUR FINAL ANSWERS**. A correct answer with no relevant work may receive no credit, while an incorrect answer accompanied by some correct work may receive partial credit. Text books, class notes, crib sheets, and calculators are NOT permitted.

1.
 - a. Find the equation for the line connecting the points $(0, a)$ and (h, b) .
 - b. Find the volume of the frustum generated by revolving the line from part a. about the x-axis for $x = [0, b]$. (Hint: The disk method will require the evaluation of a single integral)
 - c. What does the volume formula reduce to if $a = 0$?



2. Find the center of mass of a thin plate of constant density δ covering the region cut from the first quadrant by the circle $x^2 + y^2 = 9$.



3. Find the derivative of each function.

a. $f(x) = \begin{cases} x^2 & \text{for } x < 2 \\ 4x - 4 & \text{for } x \geq 2 \end{cases}$

b. $f(x) = |x| - x$

c. $f(x) = \frac{\cot(x)}{x^2}$

d. $f(x) = (x^3 - 3x + 4)^{-68}$

e. $f(x) = \cot^2(2\sqrt{3x+1})$

f. $f(x) = \int_0^{x^2} (1+t^2)^{1/2} dt$

g. $f(x) = \int_x^{x^2} (1+t^2)^{1/2} dt$

h. $f(x) = \frac{d}{dx} \int_0^{x^2} (1+t^2)^{1/2} dt$

4. Given that f and g are continuous functions where:

$$\lim_{x \rightarrow 3} f(x) = 2, \lim_{x \rightarrow 3} g(x) = 12, \lim_{x \rightarrow 2} g(x) = 2$$

Evaluate the following limits. If there is not enough information to evaluate the limit indicate this by: **NEI**.

a. $\lim_{x \rightarrow 3} 2f(x) - 4$

b. $\lim_{x \rightarrow 3} \frac{f(x)}{g(x)}$

c. $\lim_{x \rightarrow 3} g(f(x))$

d. $\lim_{x \rightarrow 3} f(g(x))$

5. Suppose that f is differentiable on $(-\infty, \infty)$, and for each x and y we have $f(x+y) = f(x) + f(y)$. Show that there is a fixed number c such that $f(x) = cx$ for all x . (Hint: Use the definition of a derivative, which involves limits, to find an expression for $f'(x)$ and let this expression equal c).

6. Evaluate the following integrals.

a. $\int_{-\pi/4}^0 (\sec \theta)(\tan \theta + \sec \theta) d\theta$

b. $\int_4^6 f(x) dx$ where $f(x) = \begin{cases} 2x & \text{for } 4 \leq x \leq 5 \\ 20 - 2x & \text{for } 5 < x \leq 6 \end{cases}$

c. $\int_a^{a+\pi} \sin^2 x dx$

d. $\int \frac{\tan^2 x}{x - \tan x} dx$