Answer the problems on separate paper. You do not need to rewrite the problem statements on your answer sheets. Work carefully. Do your own work. **Show all relevant supporting steps!**

Directions: For each problem construct an integral which solves the given problem. Do NOT expend time evaluating the constructed integrals.

1. (10 pts) Find the area of the bounded region bounded between the curves  
   \[ y = f(x) = x^2 + 4x, \quad y = g(x) = 2x + 3 \]

2. (15 pts) Let \( R \) be the region in the first quadrant bounded between the curves  
   \[ y = f(x) = \frac{5}{1 + x}, \quad \text{x-axis, } 0 \leq x \leq 4 \]
   A. Find the volume of the solid of revolution generated by revolving \( R \) about the \( x \)-axis  
   B. Find the volume of the solid of revolution generated by revolving \( R \) about the \( y \)-axis

3. (10 pts) Find the area enclosed in one loop of the lemniscate given by  
   \[ r^2 = 5 \sin 2\theta \]

4. (10 pts) Find the length of the curve given by  
   \[ y = f(x) = xe^{-x}, \quad 0 \leq x \leq 3. \]

5. (10 pts) Find the area of the region bounded between the curves  
   \[ y = f(x) = 3x - x^2, \quad y = g(x) = x - 3, \quad -3 \leq x \leq 3 \]

6. (15 pts) Let \( R \) be the bounded region in the first quadrant bounded between the curves  
   \[ y = f(x) = \frac{x^3}{9}, \quad y = g(x) = x \]
   A. Find the volume of the solid of revolution generated by revolving \( R \) about the \( x \)-axis  
   B. Find the volume of the solid of revolution generated by revolving \( R \) about the \( y \)-axis
7. (15 pts) Find the surface area of the surface generated by revolving the arc given by
\[ y = f(x) = \tan x, \quad 0 \leq x \leq \frac{\pi}{4} \]
about
A. x-axis
B. y-axis

8. (10 pts) Find the area of the region bounded between the curves
\[ x = y - 2, \quad x = 2y - y^2 \]

9. (15 pts) Let \( R \) be the bounded region in the first quadrant bounded between the curves
\[ x^2 + y^2 = 9, \quad x + y = 3 \]
A. Find the volume of the solid of revolution generated by revolving \( R \) about the line \( y = -2 \)
B. Find the volume of the solid of revolution generated by revolving \( R \) about the line \( x = 7 \)