FORMULAS AND PROCEDURES FOR ROTATIONS OF CURVES f(x) = R ABOUT THE X-AXIS AND THE Y-AXIS.

1. The below formula is for rotating a curve f(x) = R from **a** to **b** about the x-axis:

$$\pi\int_a^b R^2dx = \pi\int_a^b f(x)^2dx$$

Sometimes, the above formula is referred as the "disk method".
If one wants to rotate about the y-axis from **c** to **d**, one has to solve for x in terms of y. Suppose that after doing this, x = g(y) = R. The above formula becomes

$$\pi\int_c^d R^2dy = \pi\int_c^d g(y)^2dy$$

2. The below formula is for rotating area between f(x) = R = "**upper curve**" and g (x) = S = "**lower curve**" from **a** to **b** about the x-axis:

$$\pi\int_a^b (R^2 - S^2)dx = \pi\int_a^b (f(x)^2 - g(x)^2)dx$$

Sometimes, the above formula is referred as the "washer method". If one wants to rotate about the y-axis from **c** to **d**, one has to solve for x in terms of y for both curves. ***Note that what may appear to be the upper curve looking at it from the x-axis may not be the upper curve looking at it from the y-axis.***
BE CAREFUL HERE! Suppose that after solving for x in terms of y for both curves, x = h(y) = R = the upper curve and x = w(y) = S = the lower curve. The above formula becomes

$$\pi\int_c^d (R^2 - S^2)dy = \pi\int_c^d (h(y)^2 - w(y)^2)dy$$

3. Sometimes, we want to rotate a piece of area about the y-axis, but we are unable to solve y = f(x) = the upper curve = **R** and y = g(x) = the lower curve = **S** for x in terms of y. We use the "cylindrical shells" method below:

$$2\pi\int_a^b x(R - S)dx = 2\pi\int_a^b x(f(x) - g(x))dx$$

Think of this method as rotating about a circle. The circumference is 2πR. Then just add an "x".