The Surface Area Formula: If $f$ is positive and has a continuous derivative, we define the surface area of the surface obtained by rotating the curve $y = f(x)$, $a \leq x \leq b$, about the $x$-axis as

$$S = \int_a^b 2\pi f(x)\sqrt{1 + [f'(x)]^2} \, dx = \int_a^b 2\pi y\sqrt{1 + \left(\frac{dy}{dx}\right)^2} \, dx$$

1. (a) Check that this formula gives us the surface area we expect for $y = 1$, $-2 \leq x \leq 2$, which when rotated about the $x$-axis forms a cylinder.

(b) Check that this formula gives us the surface area we expect for $y = \sqrt{1 - x^2}$, $-1 \leq x \leq 1$, which when rotated about the $x$-axis gives us a sphere of radius 1.
2. Check that this formula gives us the surface area we expect for $y = 1 - x$, $0 \leq x \leq 1$, which when rotated about the $x$-axis gives us a cone of radius 1.

3. Find the area of the surface generated by rotating the curve $y = \sqrt{x}$, $1 \leq x \leq 4$ about the $x$-axis.

4. Set up an integral for the area of the surface generated by rotating the curve $y = 2 + \sin x$, $0 \leq x \leq 2\pi$ about the $x$-axis.