

Instructions: Show all work. Use *exact* answers unless specifically asked to round. You may check your answers in the calculator, but you must show work to receive credit.

1. Find the area of the surface of revolution if the region bounded by $y = \sin x$, the x-axis, $x = 0$, $x = \frac{\pi}{2}$ revolved around the x-axis.

$$r(x) = \sin x$$

$$f'(x) = \cos x$$

$$S = 2\pi \int_0^{\pi/2} \sin x \sqrt{1 + \cos^2 x} \, dx$$

$$= 2\pi \int_1^0 \sqrt{1+u^2} \, du = 2\pi \int_0^1 \sqrt{1+u^2} \, du$$

$$\approx 2\pi(1.14779) \approx 7.21$$



$$u = \cos x$$

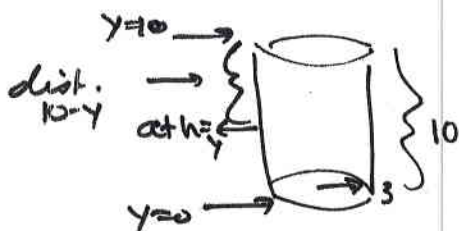
$$du = -\sin x \, dx$$

this is an $\tan \theta = u$
Sub.

which then turns
into $\sec^3 \theta$

→ to go to calc!

2. A cylindrical tank of radius 3 feet and height of 10 feet is full of water weighing 62.5 lb/ft^3 . How much work is done in emptying the tank by pumping the water over the top of the tank?



$$62.5 \text{ lb/ft}^3$$

$$\text{Volume} = \pi(3)^2 dy \text{ for each slice}$$

$$= 9\pi dy$$

$$\text{weight (force)} = 9\pi * 62.5 = \frac{1125}{2}\pi dy = F(dy)$$

distance traveled for slice at height y

$$\text{is } 10-y = d(dy)$$

$$\int_0^{10} \frac{1125}{2} \pi (10-y) dy =$$

$$\frac{1125}{2} \pi \int_0^{10} 10-y \, dy = \frac{1125}{2} \pi \left[10y - \frac{1}{2}y^2 \right]_0^{10} = \frac{1125}{2} \pi [100 - 50] = 28,125 \pi$$

$$\approx 88,357.3 \text{ foot-pounds}$$