Name: ____________________ Academic Integrity Signature: ____________________

I have abided by the UNCG Academic Integrity Policy.

Note: Correct numerical answers without justification will receive little or no credit.

1. (3 points) What is $\frac{d}{dx}\left(\cos^{-1}(u)\right)$?

Solution: $\dfrac{-1}{\sqrt{1-u^2}} \cdot \dfrac{du}{dx}$, for $|u| < 1$

2. (3 points) What is $\frac{d}{dx}\left(\tan^{-1}(u)\right)$?

Solution: $\dfrac{1}{1+u^2} \cdot \dfrac{du}{dx}$

3. (4 points) A cylindrical tank of radius 10 feet and height 100 feet is filled with water. How fast is the water level changing if the tank is drained at a constant rate of 2 ft^3/min.

Solution: Let V denote the volume of water, then the height is h. The problem asks us to compute $\frac{dh}{dt}$ assuming $\frac{dV}{dt} = -2$. Note the minus sign since the volume is getting smaller.

First we relate the volume and height by $V = 100\pi h$ (since in general the volume of a cylinder of radius r and height h is $V = \pi r^2 h$.) Differentiate both sides with respect to t, then plug in the value for $\frac{dV}{dt}$ and solve for $\frac{dh}{dt}$.

$$\begin{aligned} V &= 100\pi h \\ \frac{dV}{dt} &= 100\pi \frac{dh}{dt} \\ -2 &= 100\pi \frac{dh}{dt} \\ \frac{-1}{50\pi} &= \frac{dh}{dt} \end{aligned}$$

Thus the water level is changing at $\frac{-1}{50\pi}$ ft/min. Equivalently water level is falling at $\frac{1}{50\pi}$ ft/min.

 Points earned: ______ out of 10.