# Warm-Up for $\pi$-Day, 2022

Dr. Jordan Hanson - Whittier College Dept. of Physics and Astronomy

March 14, 2022

## 1 Memory Bank

1. Recall the definition of the Taylor series, in which $f^{(n)}(a)$ is the $n$-th derivative of a function $f(x)$ evaluated at $x = a$:

$$f(x) = \sum_{n=0}^{\infty} \frac{f^{(n)}(a)}{n!}(x-a)^n \tag{1}$$

2. The Law of Cosines, with sides of lengths $a$, $b$, and $c$, and with angle $\gamma$ between sides $a$ and $b$, states that

$$c^2 = a^2 + b^2 - 2ab\cos\gamma \tag{2}$$

## 2 Tools for the Multipole Expansion

1. Find the Taylor series up to $\mathcal{O}(x^2)$ for $f(x) = 1/\sqrt{1+x}$ near $x = 0$.

2. Recall that the definition of displacement between charge and observer is

$$\boldsymbol{\mathscr{r}} = \mathbf{r} - \mathbf{r}' \tag{3}$$

Find the magnitude squared of $\boldsymbol{\mathscr{r}}$ to reveal the Law of Cosines.