# Quantum (PHYS 290): Week 1

Fall 2025 v1.0

**Intro:**

*We start off studying/reviewing light as a wave, learning complex numbers and phasors. The key experiment this week is multiple slit interference. We'll have a lab on this and go into more depth than the text using phasors.*

**Reading:** ("T" stands for Townsend's text)

- T: Chapter 1 Section 1 - We discussed this material on the first day of class.
- T: Chapter 1 Section 2 - We'll discus this (and more!) on Monday
- T: Chapter 1 page 19 a bit on complex numbers as Townsend starts to discuss the principles of QM
- Looking ahead - photons and Chapter 1 sections 3 and 4

**Problems: Due Friday, September 5 at the beginning of class**

(1) Suppose you have three slits illuminated by monochromatic light.
  - (a) Sketch the phasor diagrams for the central maximum and the first minimum. Please include the relative angle $\Delta\varphi$ in your diagrams.
  - (b) The 3 slit interference pattern has two dark bands and one dim bright fringe between principal bright fringes. Using phasors diagrams see if you can explain why.

(2) 1.4 Wavey details for a radio station. But please **change** the frequency to the College's WHCL **88.7 MHz**.

(3) ($\mathbb{C}$ numbers)
  - (a) Express the complex number $\sqrt{2} + i$ in the form of $re^{i\phi}$. In your answer include a sketch of the geometry and the values of $r$ and $\phi$, which are real.
  - (b) Find $x + iy$ and $re^{i\phi}$ forms of the complex number $(1 + 3i)^2$.
  - (c) Draw the phasor $-\sqrt{3} + i$ and write in the form $re^{i\phi}$.

(4) Find the solution to the quadratic

$$z^2 - 2z + 2 = 0.$$

Write the solutions in both $z = x + iy$ and $z = re^{i\phi}$ forms.

(5) You have two phasors, $e^{i\pi/3}$ and 1. Add them and find the resulting complex number in the form $re^{i\phi}$. Include a sketch of the three phasors in your solution.

(6) T 1.1 (a) Checking a complex solution to the wave equation.

(7) (code) Labs this semester will use the Python computer language to control an experiment and there will be occasional Python problems on your Problem set, starting with this one. Find a computer with Python, install a compiler on your machine - experts in the department recommend Anaconda, or find a website that runs Python code, for instance
https://www.tutorialspoint.com/compilers/online-matplotlib-compiler.htm.

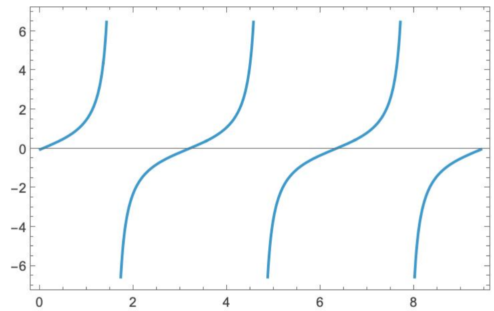
Input and read this code

```
import matplotlib.pyplot as plt
import numpy as np

x = np.arange(0, 3 * np.pi, 0.1)
y = np.tan(x)

plt.plot(x, y)
plt.show()
```

Run the code. The output, a plot, should look like this




But note that the output of the python code plot is lousy. Explain why the python plot is not a great representation of the "function". Following up on this either change the limits and rerun so that it covers only one domain of this function or make another change so that the plot improves. For your solution submit your explanation, the final plot, and the final code.