

PHY385H1F – “Introductory Optics”

Problem Set 0

No real due date... but please hand it to me soon!

Instructions: Please fill in the blanks below to the best of your ability. If you wish to write down any comments or questions, please include your email address and I will get back to you as soon as I can. Filling in the blanks in the “History of Light” part is worth 10 marks; some of the blanks will have more than one correct answer; in these cases either answer is fine.

Name (as it appears on ROSI):_____.

Name that you’d like me to call you:_____.

What’s your major and/or year at U of T?

Have you taken PHY250 “Electricity and Magnetism” at this department recently? If no, please let me know a bit about your background in E&M.

Have you taken PHY254 “Mechanics” at this department recently? If no, please let me know a bit about your background in classical mechanics, in particular oscillations and waves.

What’s your favourite optical phenomenon or application?

A Really *Really* Brief History of Light:

Fill in the blanks!!

Based on Chapter 1 of Hecht

In the Beginning (whoah – good opening!)

People in Egypt have been using mirrors to look at themselves for at least 3900 years. In 300 B.C. Euclid wrote down the Law of _____. Hero of Alexandria tried to explain this by proposing that light always takes the shortest path between two points.

During the Dark Ages in Europe there was very little scientific progress. From about 500-1200A.D. the centre of scholarship shifted to the Arab world. Around 1000 A.D., _____ of Basra considered the law of reflection in 3-D, studied spherical and parabolic mirrors, and gave a detailed description of the human eye. His pinhole camera was later copied and further developed by Leonardo da Vinci around 1400.

From the Seventeenth Century

In 1621, Willebrord Snel empirically discovered the Law of _____. Johannes Kepler was also working on this around this time and he discovered Total _____ Reflection. In 1657 Pierre de Fermat rederived the Law of Reflection using his Principle of Least Time.

In 1665 Isaac _____ used a prism to disperse white light into a rainbow of colours. He advocated the idea that light was a stream of particles that travelled very quickly along straight lines. Around the same time, Christiaan _____ was advocating a wave theory of light, which also could explain why light travelled in straight lines. But he had no idea what was “waving”; this was just referred to as the *luminiferous aether*. Very few people could accept the wave theory at this time due to lack of experimental evidence, and so the theory of light did not develop.

The Nineteenth Century

In 1801-1803, Thomas Young of England wrote down the Principle of _____, and used it along with new experimental evidence to advocate a wave theory of light. Very few people took him seriously at first. Meanwhile in France, Jean Fresnel revived the idea of Huygens’s wavelets and was able to calculate the wavelength of light based on diffraction patterns. Fresnel and Young eventually became friends and allies in the fight to advocate the wave theory of light.

In 1864 James Clerk Maxwell discovered that light was actually an _____ wave. This explained a great deal, and also lead him to predict the speed of light in a vacuum based on totally unrelated measurements.

Twentieth-Century Optics

In 1905 Albert Einstein proposed that light was actually composed of _____. In the same year, Einstein proposed that space and time were related fundamentally by the speed of light, and that in fact there was no need for the luminiferous aether. The speed of light is a constant in all inertial reference frames.

The science of Spectroscopy actually started in 1802 but developed significantly through the early 20th century as scientists realized the connection between atomic orbitals and emission and absorption of light. In 1913 Niels Bohr was able to theoretically predict the spectrum of _____ based on quantum mechanical principles. Based on understanding of absorption and emission, the first _____ was built in 1960.