Physics 3034 – Spring 2024“
Due Feb 25.

Homework 04

SPN 4–01 – Brewster's Angle.

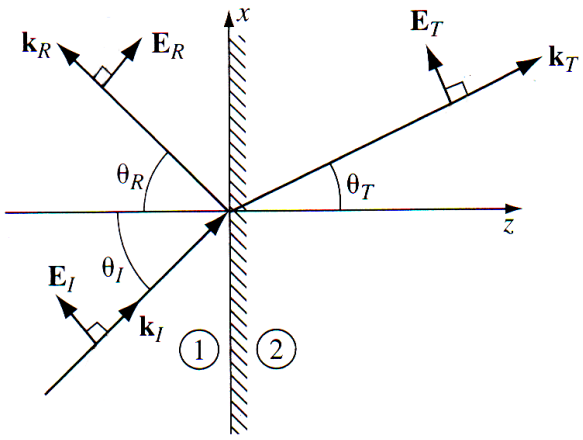
[a] Calculate Brewster's Angle for transmission from Air into glass.
[b] Calculate Brewster's angle from transmission from Water into Sapphire.

SPN 4–02 – Snell's law.
A monochromatic ray of light (e.g. a laser) is fired from glass into an unknown other substance and its angle of incidence (θ_1) and refraction (θ_2) are accurately measured. $\theta_1 = 30°$. You may assume that $n_{glass} = 1.500$ exactly. You will find the following table helpful:
`https://en.wikipedia.org/wiki/List_of_refractive_indices`

[a] If $\theta_2 = 34.35°$, what could the unknown material be?
[b] If $\theta_2 = 20.18°$, what could the unknown material be?
[c] Consider the unknown material from part "a", but now increase the incidence angle so that $\theta_1 = 65°$. What is θ_2 now? Explain briefly.

SPN 4–03 – Electric and Magnetic fields at Oblique incidence.
A ray of sunlight in air polarized as shown in the picture is incident on surface 2 (glass) at an oblique angle θ_I. The beam intensity before the light ray hits the glass is $I_I = 1000\ W/m^2$

[a] If $\theta_I = 74°$, what is the intensity of the incident ray when it hits the glass? (Hint: It's less than $1000 W/m^2$)
[b] What is the incident Electric field (magnitude)?
[c] What is the incident Magnetic field magnitude and direction?
[d] What is the reflected Magnetic field magnitude and direction?
[e] What is the transmitted Electric field vector? (Please give it in component form referring to the axes in the figure)?
[f] Use the answer to "e" to determin the transmitted intensity?
[g] Now calculate T (the transmission coefficient) from the formula in the book
[h] Do the answers to "f" and "g" agree? Should they?



Problem 2: A plane wave polarized in the x-z plane at oblique incidence.

SPN 4–04 – E_R and E_T.
Reproduce figure 9.16 for the air/glass interface. Stripped down python code is provided.
`http://kestrel.nmt.edu/~rsonnenf/phys334/python_code/` You are welcome to use any plotting tool, including Excel.

SPN 4–05 – R and T.
Reproduce figure 9.17 for the air/glass interface. Stripped down python code is provided.
`http://kestrel.nmt.edu/~rsonnenf/phys334/python_code/` You are welcome to use any plotting tool, including Excel.