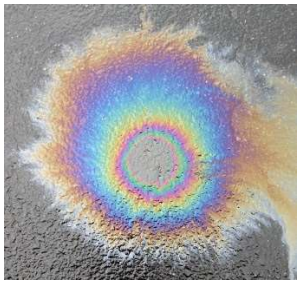
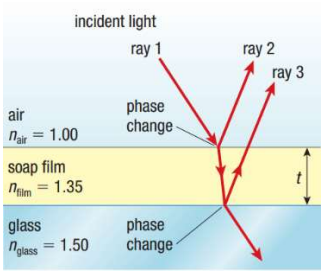
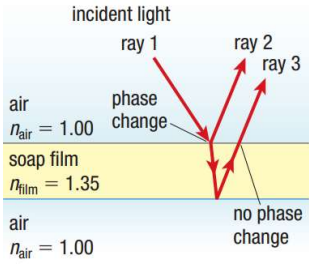
SPH4U 10.1 Interference in Thin Films

1. Thin films

Thin film:	







Reflection at a media boundary:	
Phase change at a reflection:	
$n_1 < n_2$	
$n_1 > n_2$	
importance	

Interference:	
path difference	
Same phase:	
constructive interference	
destructive interference	
Opposite phase:	

2. Determining interference effects

Consider a soap film that is the thinnest film that will produce a bright blue light when illuminated with white light. The index of refraction of the soap film is 1.35, and the blue light is monochromatic with wavelength 411 nm.

a. Calculate the thickness of the film if the soap covers a piece of crown glass with index of refraction 1.52.

b. Suppose the reflections occur instead from a soap film on water with index of refraction 1.33. Determine the thickness of the film on water that will produce the same blue colour of reflected light.

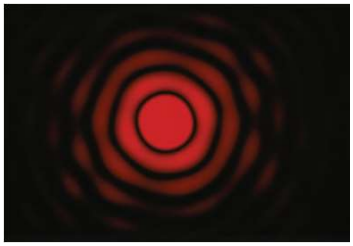
In solar cells, incoming light passes through an anti-reflective coating to increase the efficiency of the cell. The coating has $n_1 = 1.45$ and the material below has $n_2 = 3.50$. Determine the thickness of the anti-reflective coating that will minimize the reflection of light with a wavelength of 7.00×10^{-7} m.

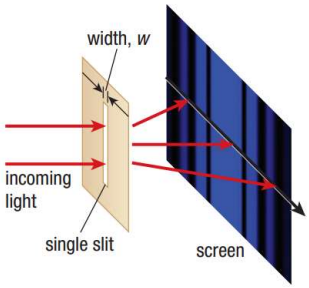
Homework: pg. 511 #1, 3-4, 7

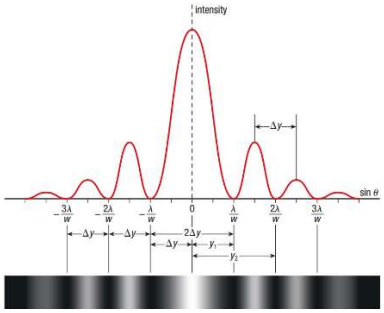
SPH4U 10.2 Single-Slit Diffraction

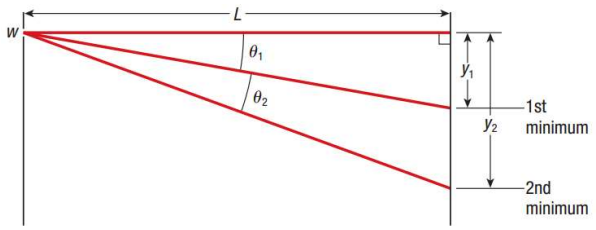
3. Single-slit diffraction

Single-slit diffraction:	
constructive interference	
destructive interference	
dark fringe location	
central maximum	









4. Analyzing single-slit interference

Light with a wavelength of 5.40 x 10^2 nm is incident on a slit of width 11 μm and produces a diffraction pattern on a screen located 80.0 cm behind the slit. Calculate the distance of the first dark fringe from the central maximum on the screen.

Light with a wavelength of 670 nm is incident on a slit of width 12 μm and produces a diffraction pattern on a screen that is 30.0 cm behind the slit.

a. Calculate the angular width and the absolute width, in centimetres, of the central maximum.

b. Calculate the distance between the first and second minima.

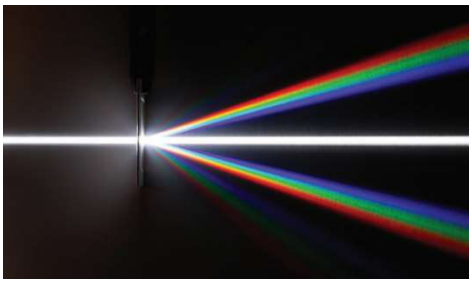
c. Determine the distance between the second and third maxima. Compare this answer to your answer in (b). Does this answer make sense? Explain why or why not.

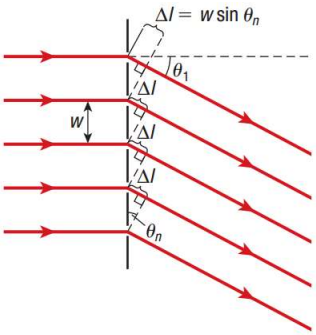
Homework: pg. 519 #1, 3, 5-8

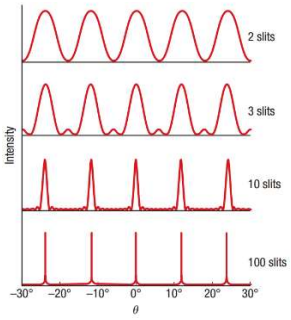
SPH4U 10.3 The Diffraction Grating

5. Diffraction gratings

Diffraction grating:	
2 slits	
more slits	
equation	







Light with a wavelength of 540 nm is incident on a diffraction grating that has 8500 lines/cm. Calculate the angles of the maxima.

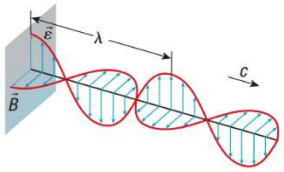
Light emitted by a particular source is incident on a diffraction grating with 9000 lines/cm and produces a first-order maximum at 32.0°. Determine the wavelength of the light.

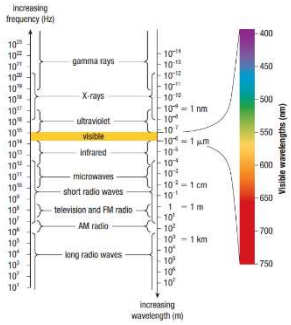
Homework: pg. 525 #2-5, 8

SPH4U 10.4 Electromagnetic Radiation

6. Electromagnetic radiation

Electromagnetic radiation:	
Electromagnetic spectrum:	
equation	





Microwaves with a wavelength of 1.5 cm carry television signals using a sequence of relay towers.

a. Determine the frequency of the microwave.

b. How much time does it take for a microwave signal to travel 5.0×10^3 km across Canada from St. John's, Newfoundland, to Victoria, British Columbia?

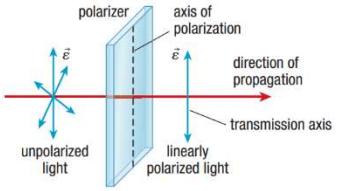
The energy of an electromagnetic wave is proportional to its frequency. An X-ray with a wavelength of 0.025 nm transfers its energy to an electron to change its state. How does the energy of the electron transition compare with that of 540 nm visible light?

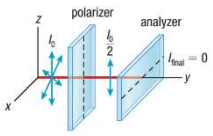
Homework: pg. 531 #1-8

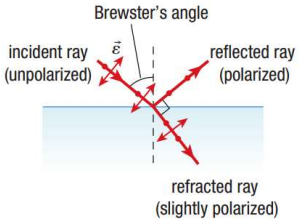
SPH4U 10.5 Polarization of Light

7. Polarized light

Polarized light:	
Polarization by selective absorption:	
Malus' Law	
unpolarised input light	
Polarization by reflection:	
Brewster's angle	
Brewster's law	







Homework: pg. 537 #2, 8-9