

Pre-class Assignment for physics Complete before 1 pm on Thursday January 26

Associated reading: *Quantum*, ch. 5 - 6

1. Scattering (associated with week 13 lab exercises – many of you did not get to do this, so this replaces the lab version)
 - a) Go to http://www.kcvs.ca/site/projects/physics_files/rutherford/other_nuclei.swf Read, then close the Instructions box.
 - b) Use Auto-fire.
 - c) Under Options, choose Circle Nucleus, and then press Auto-Fire.
 - d) Under Options, explore Hour Glass Nucleus, Square Nucleus, and Plate Nucleus as above. Note that you can change the Angle Rotation of the Square Nucleus and Plate Nucleus using the slider on the bottom.
 - e) Finally, explore Unknown Nucleus (under Options). Use Fire and change the Impact Parameter to control yourself, or use Auto-Fire. To get a different Unknown Nucleus, go back to the Options menu and choose Unknown Nucleus again.

2. Wave Interference (associated with week 13 lab exercises)
 - a) Go to <http://www.walter-fendt.de/ph14e/singleslit.htm>
 - b) Change the wavelength to 670 nm.
 - c) Set the Width of slit as wide as possible (5000 nm).
 - d) Examine the pattern on the curved screen (you used a flat screen) and the flat screen version (in the yellow bordered box below). Switch between Diffraction Pattern and Intensity Profile several times until you see how they are related (you might not see this until you've looked at several different patterns, below).
 - e) Reduce the Width of slit to 2750 nm. Again examine the pattern. Switch between Diffraction Pattern and Intensity Profile as before.
 - f) Reduce the Width of slit to 500 nm (as small as this simulation will allow). Again examine the pattern. Switch between Diffraction Pattern and Intensity Profile as before.
 - g) Go to <http://www.walter-fendt.de/ph14e/doubleslit.htm>
 - h) Change the wavelength to 670 nm.
 - i) Set the Spacing between slits as close as possible (5000 nm).
 - j) Examine the pattern. Switch between Interference Pattern and Intensity Profile.
 - k) Increase the Spacing between slits to 2750 nm. Again examine the pattern. Switch between Interference Pattern and Intensity Profile as before.
 - l) Reduce the Width of slit to 500 nm (as small as this simulation will allow). Again examine the pattern. Switch between Interference Pattern and Intensity Profile as before.

3. Standing Waves (associated with week 13 lab exercises)
 - a) Go to <http://ngsir.netfirms.com/englishhtm/TwaveStatA.htm>
 - b) Switch from 5th Harmonic to Fundamental. Turn on Nodes and Antinodes. Make sure you are in Standing Wave setting.
 - c) Click Start and watch several complete oscillations of the standing wave.
 - d) Switch from Fundamental to 2nd Harmonic and observe. Repeat for 3rd Harmonic, 4th Harmonic, 5th Harmonic, 6th Harmonic.
 - e) Go to <http://www.mta.ca/faculty/science/physics/suren/Harmonics/Harmonics.html> and Run the Applet.
 - f) Press Stop (lower right corner). Make sure that Fixed at Both Ends is selected along with Particles.
 - g) Keep the Fundamental at 100% and slide the Second Overtone to 0%. (Note the second overtone is the third harmonic). Observe the pattern for two or three oscillations.
 - h) Slide the Fundamental to 0% and set the First Overtone to 100%. Observe.
 - i) Now, set the Fundamental to 100% and the First Overtone to 100%. Observe.

4. Bohr Model & Hydrogen Spectrum (associated with week 13 lab exercises)
 - a) Go to <http://www.lon-capa.org/~mmp/kap29/Bohr/app.htm> Read the instructions and follow along. You can use this to check (but not replace!) your work for the associated lab exercise

5. Compton Scattering

- a) Go to http://www.kcvs.ca/site/projects/physics_files/compton-scattering/compton-scattering.swf Read, then close the Instructions box.
- b) Click Start. Pay attention to the “shape” of the incoming x-ray and the outgoing x-ray.
- c) Try out the following angles: 45, 90, 135, 180, 225, 270, 315, 359. Pay attention to the “shape” of the incoming x-ray and the outgoing x-ray.

6. de Broglie Waves

- a) Go to <http://www.colorado.edu/physics/2000/quantumzone/debroglie.html>
- b) You may be interested to read the discussion (recommended), but the activity is at the bottom of that page.
- c) You click and drag on the circle to change its radius. Make the circle as small as possible.
- d) Now, slowly make the circle bigger until the red squiggle turns green (careful, it is easy to miss this). Sketch the green squiggle (you may prefer to take a screenshot instead).
- e) Continue to slowly expand the circle. The squiggle should turn back to red immediately, and then turn back to green. Sketch the green squiggle (or take a screenshot).
- f) Again, slowly expand the circle. Now, however, things might be large enough to notice what’s going on with the red squiggle. Watch what happens when the red squiggle turns green. Sketch/take screenshot.
- g) Continue to expand the circle, noticing how green turns to red turns to green, making sketches/taking screenshots until you have at least 8 sketches.
- h) Go to <http://phet.colorado.edu/en/simulation/hydrogen-atom> and Run Now!
- i) Turn the knob to Prediction (what the model predicts) by clicking on the knob.
- j) (You might have done this before; do it again for review) Choose the Bohr model, without the white light turned on. What do you observe?
- k) Now, turn on the white light and watch for a while. Pay close attention. What do you observe?
- l) Choose the de Broglie model, without the white light turned on. What do you observe?
- m) Now, turn on the white light and watch for a while. Pay close attention. What do you observe?
- n) Keep this going, but also click on Show electron energy level diagram. It’s difficult to look at the atom and the energy level diagram at the same time, but do your best. What do you observe?