

Photoelectric Effect Activity
Pre Class Exercises

Part I. Take home calculations

In order to be able to understand the photoelectric effect: Let's do some calculations and make some predictions as a warm up! (Please finish and bring your answers to class. Also before class, please follow the instructions for installing Java and test the photoelectric effect simulation.)

Useful equations: $E = h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ Js})(2.998 \times 10^8 \frac{\text{m}}{\text{s}})}{\lambda} = \frac{1.986 \times 10^{-25} \text{ Jm}}{\lambda}$

$$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$$

$$K.E. = \frac{1}{2}mv^2$$

$$m_e = 9.11 \times 10^{-31} \text{ kg}$$

$$h\nu_{\text{photon}} = \Phi_{\text{metal}} + K.E.$$

$$\Phi_{\text{metal}} = h\nu_0$$

1. One has a red laser pointer with a wavelength (λ) of 700 nm. What is the energy (E) per photon emitted by the pointer?

2. If the light source were a UV lamp with a wavelength of 254 nm and the work function ($\Phi_{\text{metal}} = hc/\lambda_0$) for a metal gives $\lambda_0 = 298 \text{ nm}$. Would this source create photoelectrons? If so, what would be the kinetic energy (K.E.) of an electron ejected from this metal?

3. How could you increase the number of electrons ejected from the metal without changing the K.E. for individual electrons?

Please make sure that you are able to run the Photoelectric Java Applet on your computer before coming to class.

- ~~1. First, if you do not have JAVA jdk7, you will need to download the Java development kit through this link:~~

~~<http://www.oracle.com/technetwork/java/javase/downloads/jdk7-downloads-1880260.html>~~

1. This has been updated:

First, if you do not have JAVA jdk8, you will need to download the Java development kit through this link:

<http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html>

2. Scroll down the webpage and find your operating system and click on the link to download:

The screenshot shows the Oracle Java SE Development Kit 7u79 download page. A red box highlights the license agreement text: "This release will be the last Oracle JDK 7 publicly available update. For more information, and details on how to receive longer term support for Oracle JDK 7, please see the Oracle Java SE Support Roadmap." A blue arrow points from a text box "Make sure you accept license agreement here" to this red box. Another blue arrow points from a text box "Download this file for Mac" to the download link for "jdk-7u79-macosx-x64.dmg". A third blue arrow points from a text box "Download this file for PC" to the download link for "jdk-7u79-windows-x64.exe". The table below shows the download links for various operating systems.

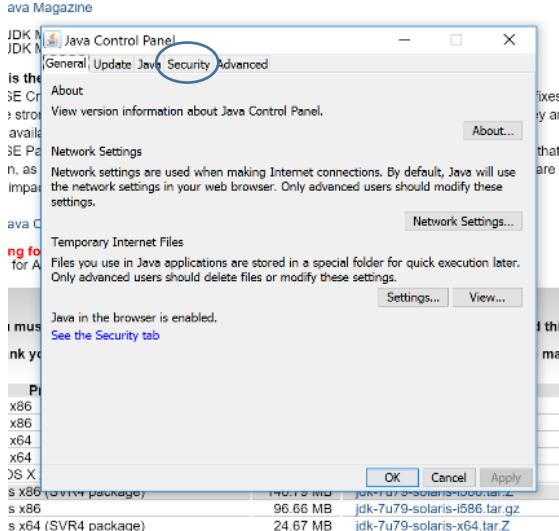
Product	File Description	File Size	Download
Linux x86		130.4 MB	jdk-7u79-linux-i586.rpm
Linux x86		147.6 MB	jdk-7u79-linux-i586.tar.gz
Linux x64		131.69 MB	jdk-7u79-linux-x64.rpm
Linux x64		146.4 MB	jdk-7u79-linux-x64.tar.gz
Mac OS X x64		196.89 MB	jdk-7u79-macosx-x64.dmg
Solaris x64 (SVR4 package)		140.79 MB	jdk-7u79-solaris-i586.rpm
Solaris x86		96.66 MB	jdk-7u79-solaris-i586.tar.gz
Solaris x64 (SVR4 package)		24.67 MB	jdk-7u79-solaris-x64.tar.Z
Solaris x64		16.38 MB	jdk-7u79-solaris-x64.tar.gz
Solaris SPARC (SVR4 package)		140 MB	jdk-7u79-solaris-sparc.tar.Z
Solaris SPARC		99.4 MB	jdk-7u79-solaris-sparc.tar.gz
Solaris SPARC 64-bit (SVR4 package)		24 MB	jdk-7u79-solaris-sparcv9.tar.Z
Solaris SPARC 64-bit		46.4 MB	jdk-7u79-solaris-sparcv9.tar.gz
Windows x86		138.31 MB	jdk-7u79-windows-i586.exe
Windows x64		140.06 MB	jdk-7u79-windows-x64.exe

3. After downloading, run through the prompts to install the program on your computer and then restart.

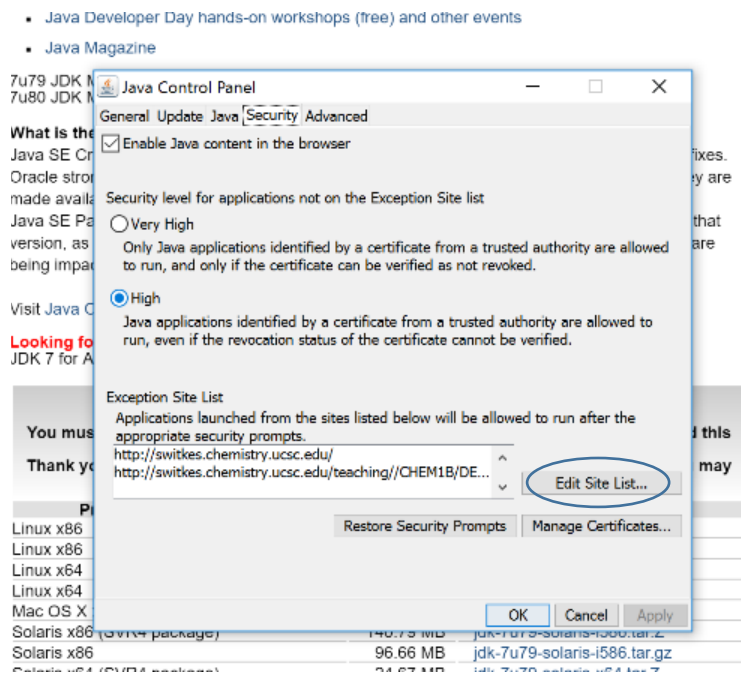
4. After restarting, open your browser and type in the following link:

http://switkes.chemistry.ucsc.edu/teaching/JAVA/TestWebStart/photel_new.jnlp

- Download the application to a location that you will remember but do not run it yet.
- Do a search on your computer for “configure Java” and open the configure Java application.



- Click on the security tab.



- Near the bottom of the window you will notice an exception list: Click on “Edit Site List...”
- When the new window opens click “Add” and then add the following:
<http://switkes.chemistry.ucsc.edu/>
- Then click OK.
- Then click “Apply” on the Java Control Panel Security tab screen.
- Click “OK” to get out of Java Control Panel.

13. Finally, open the Java Applet that you download and give it a try!