Week 3 - Day 2

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# Week 3 - Day 2

Aug 31, 2016

[Quizlet on terms from this lecture](https://quizlet.com/_2gas0u)

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## Navigate using audio

# Test 1

* In this room next Wednesday at recitation time (6:30 pm - 7:50 pm)
* Covers chapter 1, 2, and however we’ve got in 3
* This evening’s recitation is a survey to get a sense of each student’s background and how it affects their performance
	+ Bring a pencil
	+ 5 bonus points
	+ Audio 0:02:42.008620

## Clicker question

* Audio 0:05:36.915010
* 4.21ft^3 to Liters
* 

## 2nd Question

* Audio 0:11:49.252666
* How many atoms are in a sample of copper with volume of 0.475 cm^3 and a density of 8.96 g / cm^3?
	+ 

## Chapter 3

* Audio 0:18:47.526137

## Properties of Waves

* Audio 0:19:09.721677
* 
* Wavelength (λ) is the distance between identical points on successive waves.
* Amplitude is the vertical distance from the midline of a wave to the peak or trough.
* Audio 0:20:20.914304
* 
* Frequency (ν) is the number of waves that pass through a particular point in 1 second (Hz = 1 cycle/s).
* Audio 0:21:32.710413
* The speed (v) of the wave = λ x ν

## Light

* Audio 0:23:42.023732
* 

## Amplitude and Wavelength

* Audio 0:24:52.722734
* Wavelength and amplitude are independent properties.
	+ The wavelength of light determines its color (intensive physical property).
* The amplitude, or intensity, determines its brightness (extensive physical property)
	+ Brightness dependent on amplitude
* 

## Color

* Audio 0:26:15.944132
* The color of light is determined by its wavelength or frequency.
* White light is a mixture of all the colors of visible light.
	+ A spectrum
	+ Red Orange Yellow Green Blue Indigo Violet
* When an object absorbs some of the wavelengths of white light and reflects others, it appears colored; the observed color is predominantly the colors reflected.

## Maxwell

* Audio 0:26:23.185612
* Maxwell (1873), proposed that visible light consists of electromagnetic waves.
* 

## Electromagnetic Spectrum

* Audio 0:29:13.853883
* 

## Example problem

* Audio 0:30:56.499318
* An electromagnetic wave has a frequency of 6.0 x 10^4 Hz. Does this frequency fall in the visible region? Convert this frequency into wavelength (nm).
	+ 

## Clicker Question

* Audio 0:34:13.178546
* What is the wave length of a wave with frequency 8.6 \* 10^13 Hz?
* 

## Einstein and the Photoelectronic Effect

* Audio 0:39:00.844561
* Hertz observed that when (some) light shines on a metal surface, electrons are produced from the surface.
	+ The electrons emitted from the metal surface are photoelectrons.
	+ This phenomenon is called the photoelectric effect.
	+ 
* Audio 0:40:20.734175
	1. Number of electrons depends upon light intensity
	2. More Kinetic energy at higher frequency of light
	3. Emission has a frequency threshold, below which there are no electrons
* 

## Explaining the Photoelectric Effect

* Audio 0:42:05.218727
* Classic theory explanation:
	+ The photoelectric effect according to classic wave theory attributed the electrons’ being emitted from the metal surface to the light energy being transferred to the electrons.
	+ Classic theory states the following:
		- If the wavelength of light is made shorter or the light wave’s intensity is made brighter, more electrons should be ejected.
		- Energy of a wave is directly proportional to its amplitude and its frequency.
			* Example: If a dim light is used there should be a lag time before electrons are emitted in order to give the electrons time to absorb enough energy.

## Explaining the Photoelectric Effect

* Audio 0:42:13.093629
* Einstein’s explanation: Quantum theory
	+ Experimental observations indicate the following:
		- A minimum frequency was needed before electrons would be emitted regardless of the intensity called the threshold frequency.
		- High-frequency light from a dim source caused electron emission without any lag time.

## Einstein’s idea: “Light Is Quantized.”

* Audio 0:43:33.274758
* Ejection of electrons from a metal surface by light:
	+ One photon at the threshold frequency gives the electron just enough energy for it to escape the atom.
	+ Binding energy, φ
	+ When irradiated with a shorter wavelength photon, the electron absorbs more energy than is necessary to escape.
	+ This excess energy becomes kinetic energy of the ejected electron.
		- 
	+ Where (hυ) is a quantized packet of energy

## Explaining the Photoelectric Effect

* Einstein’s explanation: Quantum theory
	+ Einstein proposed that the light energy was delivered to the atoms in packets called quanta or photons.
		- Energy = (hυ)
			* hυ = quanta
	+ The energy of a photon of light is directly proportional to its frequency.
		- E = hc/λ
		- Or it is inversely proportional to its wavelength.
	+ Symbols:
		- Planck’s Constant, (h) is a proportionality constant with a value of h = 6.626 × 10−34 J · s.
		- Speed of light (c) value is 3.00 × 108 m/s

## Black Body Radiation

* Audio 0:46:37.258672
* 
* If you heat something up in the dark, you can see it with infrared radiation
* “Black Body Problem” Solved by Planck in 1900 “… an act of despair … I was ready to sacrifice any of my previous convictions about physics …” Energy (light) is emitted or absorbed in discrete units (quantum).
* 

## Vocab

|  |  |
| --- | --- |
| Term | Definition |
| Wavelength | the distance between identical points on successive waves |
| amplitude | the vertical distance from the midline of a wave to the peak or trough |
| frequency | the number of waves that pass through a particular point in 1 second (Hz = 1 cycle/s) |
| photoelectric effect | describes the phenomenon in which light shines on a metal surface and electrons are produced from the surface |
| threshold frequency | minimum frequency needed before electrons are emitted |
| quanta (photons) | the packets of energy that light travels with |
| planck’s constant (h) | 6.626 \* 10^-34 J s |
| speed of light (c) | 3 \* 10^8 m/s |

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Notes and study materials for The University of Alabama's Chemistry 101 course offered Fall 2016.