

Review Chapters 10-17

Calvin and Hobbes by Bill Watterson



Business

- Test will be available in the testing center starting tomorrow (Saturday).
 - Deadline: Wednesday at 11:00am.
 - Late Deadline: Thursday
- Vocab Quiz is available on Blackboard
 - Deadline: Tuesday at midnight
- No Class on Monday.

Chapter 10 – Waves

- Review
 - Types of waves
 - Transverse (Shear)
 - Longitudinal (Compression)
 - Surface
 - Properties of waves
 - Wavelength
 - Frequency
 - Speed
 - Amplitude
 - Wave behavior
 - Reflection
 - Refraction
 - Diffraction
 - Interference
 - Standing Waves
 - Nodes & Antinodes
 - Doppler Effect

In the picture shown here, the distance labeled 'A' is called

- A. Amplitude
- B. Frequency
- C. Wavelength
- D. Period
- E. Wave speed



Which of the following most influences the velocity of a wave

- a) Frequency of the wave
- b) Amplitude of the wave
- c) Properties of the medium
- d) Wavelength of the wave
- e) Energy carried by the wave

Chapter 11 – Properties of Light

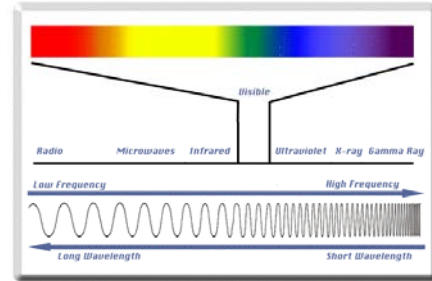
- Review
 - Speed of Light
 - How was it determined?
 - Wave Nature of Light
 - What experiments demonstrate this behavior?
 - Diffraction and Interference
 - Particle Behavior of Light
 - Low light photography
 - Photoelectric effect
 - Relationship between Light frequency and Energy

Which of these has the highest energy per photon?

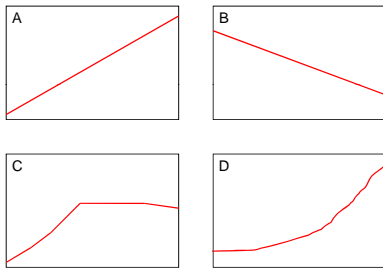
- a) Red light
- b) Green light
- c) Violet light
- d) Infrared
- e) Ultraviolet

- Which has the highest frequency?
- Where do x-rays fit? Radio Waves?
- Which has the highest speed?

Electromagnetic spectrum



Which of the following graphs best represents a plot of photon energy vs. frequency?



White light containing all of visible colors passes through a gas and the spectrum is then analyzed. The spectrum after passing through the gas could best be described as

- a) Continuous
- b) A continuous spectrum except for some black lines
- c) A continuous spectrum except for some colored lines
- d) A discrete spectrum of colored lines



Which of the following is most important in determining how the electrons behave in the photoelectric effect?

- A. Amplitude of light (brightness)
- B. Speed of the light
- C. Charge on the photons of light
- D. Frequency of the light (related to energy of photons)



Understanding the photoelectric effect

Are the following statements True or False?

- Waves transport energy from place to place.
- Light transports energy from place to place.
- Red light has more energy in each photon than ultraviolet light.
- Brighter light carries more energy than dimmer light.
- To increase the energy of a photon, one must change the color (i.e., frequency) of the light.
- Ultraviolet light will discharge an electroscope but visible light will not.
- The explanation of the photoelectric effect in terms of particles of light (photons) is taken as evidence that light behaves like a stream of particles.
- The amount of energy carried by waves is greater if the amplitude of the waves is smaller.
- Ordinary white light (containing only the visible colors) dislodges electrons from an electroscope if the light is made visibly brighter.
- Ordinary white light (containing only the visible colors) dislodges electrons from an electroscope if the light is shined on the electroscope for a long time.
- The light shined on the electroscope in the photoelectric experiment seems to behave like a wave.
- If light were particles, light carrying greater energy should consist of a greater number of particles and/or more energy per particle.

Chapter 12 – Properties of Matter

Review

- States of Matter
 - Solid, Liquid, Gas, Plasma
 - Why are boiling and melting temperatures different for different materials?
 - How does density relate to states of matter?
- Forces and Matter
 - How does temperature affect the response of matter to force?
- Be able to read a data table and see what relationships may exist

What does this table tell us?

- Boiling and freezing temperatures are *not* related
- Higher boiling temperature means higher freezing temperature.
- Higher boiling temperature means lower freezing temperature.

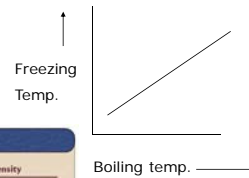


Table 12.1 – Properties of Materials

	Melting Temperature °C	Boiling Temperature °C (at 1 atm pressure)	Density		
			solid	liquid	gas
Helium	absent (see table intro)	-269	absent	0.125	0.0018
Hydrogen	-259	-253	0.078	0.071	0.001
Neon	-249	-246	0.77	1.21	0.0082
Nitrogen	-210	-196	1.09	0.81	0.013
Ethanol	-117	78.5	1.3	0.80	0.0020
Water	0	100	0.90 (at 0°)	1.00	0.0006
Table salt	801	1413	2.2	not available	not available
Copper	1083	2567	8.9	not available	not available
Gold	1063	2867	19.3	not available	not available
Magnesium Oxide	2830	3600	3.4	not available	not available

Chapter 13 – Molecular Model

Review

- What was the Continuous Model of Matter?
 - What are the 4 assumptions of the Molecular Model?
 - Matter consists of tiny particles
 - Different types of particles give different types of matter
 - The particles are in constant motion
 - Particles obey Laws of Motion, Conservation, Gravitation, & Electromagnetism
- How does the Molecular Model explain...
 - Temperature
 - Pressure

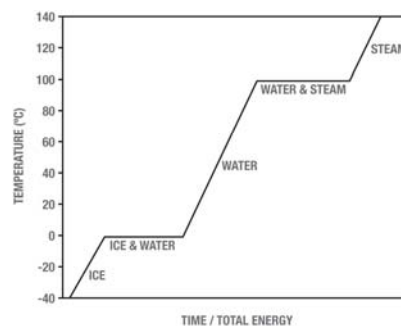
If a large bucket of water and a small glass of water have the same temperature:

- On average the molecules in the glass of water are moving faster than those in the bucket of water
- Both the glass and bucket of water have the same total internal energy
- Both have the same total molecular kinetic energy
- Both have the same total energy
- The average molecular speed is the same for both

At the same temperature, how do the speeds of molecules of different mass compare?

- More massive molecules have lower average speeds
- Less massive molecules have lower average speeds
- Mass has no effect on the average speed

Explain this graph to your neighbor.



A three-year-old's take on the molecular model and the difference between Florida and Utah.

Chapter 14 – Nuclear Atom

Review

- Key experiments
 - Gas discharge tubes
 - Oil drop
 - Gold foil
 - Light spectra
- Models & their imperfections
 - Plum pudding (Thompson)
 - Solar system (Rutherford)
 - Modified solar system (Bohr)

Chapter 15 – Duality of Matter

Review

- Experiments on Electrons
 - Particle behavior
 - Wave-like behavior
- When is the wave-like behavior important?
- What is the Heisenberg Uncertainty Principle?
- What is uncertain for small particles?
 - Position
 - Momentum

The models of matter

Are the following statements True or False?

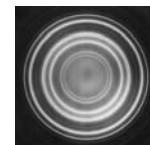
- Experiments in the 19th Century with gas discharge tubes demonstrated that matter (the atom) has charged parts.
- In Thomson's Plum Pudding Model of the Atom, the positive charge is concentrated in a tiny nucleus at the center of the atom.
- In Thomson's Plum Pudding Model, there are negatively charged electrons embedded in the positive 'stuff' of the atom like raisins in bread or plums in pudding.
- Rutherford concluded from his experiments that the atom resembled a tiny solar system, with negative electrons circling a very small, positive nucleus.
- Rutherford's Solar System Model of the Atom explained the discrete spectrum of light emitted by atoms.
- Niels Bohr's Modified Solar System Model of the Atom explained the discrete spectrum of light emitted by atoms.
- Einstein performed experiments to show that electrons behaved like waves.
- Louis De Broglie performed experiments to show that electrons behaved like waves.
- Albert Einstein explained the photoelectric effect experiments by arguing that light consisted of tiny particles (called photons).
- In the Wave Model of the Atom, electrons are described as standing waves (called orbitals).
- Ernest Rutherford's Experiment demonstrated that Thomson's Plum Pudding Model was correct by bouncing charged particles ('alpha particles') off the electrons in the 'pudding'.
- Rutherford's Experiment demonstrated the existence of the neutron.
- In the Wave Model of the Atom, electrons circle the nucleus in precise orbits.

If you are feeling stressed, watch this for a while. It will make you feel better.



The picture at the right is an interference pattern produced by passing many electrons through a thin layer of atoms and then capturing them on a screen. What would the picture look like if only one electron had been sent through the device?

- A. A single bright dot with totally random position
- B. A single bright dot, more likely to be found in the bright areas than the dim areas
- C. More bands of light and dark
- D. No change. The picture would look the same



Chapter 16 – Quantum Model of Atom

Review

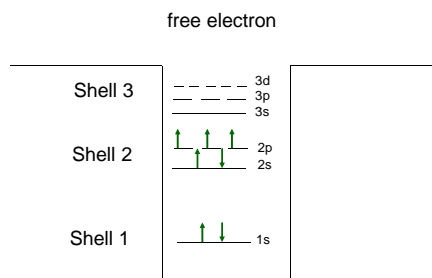
- There are no ORBITS!
- What is the quantum model
 - Electrons are in orbitals
 - Orbitals come in several types (s, p, d, f, ...)
 - Orbitals differ in energy; electrons have more E.P.E. in higher orbitals
 - Each orbital can only have 2 electrons (Exclusion Principle)
 - If 2 electrons are in an orbital, they differ in "spin."
 - Orbitals are grouped into shells

What are 'orbitals' and why are only certain orbitals possible in an atom?

Are the following statements True or False?

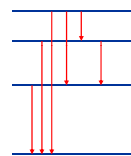
- Electrons exhibit a wave-particle duality in their nature.
- The wave nature of electrons tells us that electrons in atoms only have probabilities of precise positions and speeds rather than actually having a precise position and speed at any time.
- Probability waves are unlike tangible waves because they cannot diffract or interfere.
- Probability waves are mathematical descriptions of probability that move and change in space and time like waves.
- The regions of constructive interference in the orbital are places of low probability for finding an electron.
- The amplitude of an electron probability wave at a particular place is a measure of the probability of finding an electron at that place if you did an experiment to look.
- Electron probability waves can move around the nucleus of an atom.
- An orbital is a standing probability wave pattern.
- The law of nature that governs the behavior of electron waves near a nucleus (Schrödinger's Equation) only permits certain discrete standing wave patterns.
- Electrons are tiny particles with precise position and speed that move along well defined paths in an atom (called orbits).
- Probability waves are vibrations (disturbances) of a tangible medium.
- An orbit and an orbital are the same thing.

Which element does this represent?



An atom has only the following possible energy levels. How Many discrete colors can it emit?

- 1
- 2
- 3
- 4
- 5
- 6
- 7 or more



Chapter 17 – Periodic Table

Review

- Things that are PERIODIC
 - Size
 - Ionization Energy
 - Formulae of Compounds
- Know why elements are arranged in
 - Periods
 - Groups

Which of the following would tell me that an atom has 3 electrons in s and p orbitals in its outermost shell?

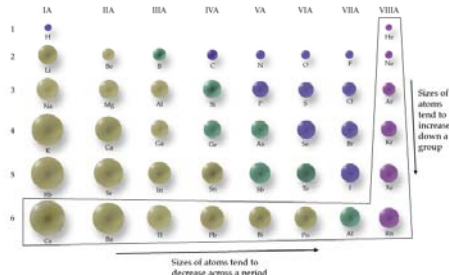
- Its row number in the periodic table
- Its mass number
- Its atomic number
- Its ionization energy
- Its group number (column)

Which of the following do you expect to have the largest ionization energy?

- a) Neon
- b) Sodium
- c) Oxygen
- d) Nitrogen

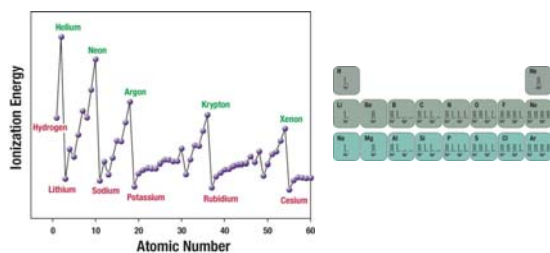
Atomic Volume

- Atomic size suddenly increase at the beginning of each row then generally *decrease* across the row.



Ionization Energies and the wave model

- Noble gasses have largest ionization energies.
- Alkali metals have the least.



Use the periodic table to predict the nature and chemical behavior of the elements.

Are the following statements True or False?

- Carbon and silicon belong to the same chemical group or family.
- We expect carbon and silicon to have the same kind of chemical formula (dioxide) when combined with oxygen.
- Neon (Ne) and krypton (Kr) react readily with metals.
- Neon (Ne) and krypton (Kr) do not react with metals but they do react with each other because they are in the same family.
- Noble gases generally have larger ionization energies than metals.
- As one progresses along a row of the Periodic Table from left to right, atoms tend to become smaller in size.
- Atoms get smaller as one progresses along a row of the Periodic Table from left to right because the number of protons in the nucleus is increasing from left to right.
- Atoms get larger as one moves downward in a column of the Periodic Table because of the Exclusion Principle.
- Beryllium (Be) has three valence electrons.
- Silicon has four valence electrons.