
Mentors

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Midterm 1 Review Packet

Outline of topics:

→ **Lecture 1**

- Structure of an Atom
- Shorthand Notations of Elements
- Isotopes

→ **Lecture 2**

- Understanding Atomic Mass Unit & Mass
- Calculating Average Atomic Mass

→ **Lecture 3**

- Relation between Moles, Avogadro's Number, and Molar Mass
- Calculations regarding Moles, Molar Mass, and Avogadro's Number

→ **Lecture 4**

- Wave Nature of Energy
- Properties of Waves
 - Wavelength, frequency, amplitude, and speed
 - Types of interference

→ **Lecture 5**

- Electromagnetic Waves
- Relationship between the speed of light, frequency, and wavelength as given by:
 $c = \nu\lambda$

→ **Lecture 6**

- Particulate theory vs. Wave Theory
- deBroglie's Equation
- Quantization of Energy in Photons

→ **Lecture 7**

- Bohr Model and Emission Spectra
- Energy Transfer as Electrons Move Between Orbitals

→ **Lecture 8**

- Heisenberg's Uncertainty Principle

- Define the three quantum numbers and how they relate to orbital structure (n , ℓ , and m_ℓ)

→ **Lecture 9**

- Relationship between shells, subshells, and orbitals
- Shapes of the s , p , and d orbitals

→ **Lecture 10**

- Effective nuclear charge
- Assigning quantum numbers (n , ℓ , m_ℓ , and m_s) to electrons

→ **Lecture 11**

- Build-up of Electrons in Multi-Electron Atoms
- Electron configuration
- Know how many electrons each orbital can hold

Lecture 1:

1. Write isotopic symbols in the form A_ZX for each isotope. (Tro 2nd Ed., Ch 1, #66)
 - a. the copper isotope with 34 neutrons
 - b. the copper isotope with 36 neutrons
 - c. the potassium isotope with 21 neutrons
 - d. the argon isotope with 22 neutrons
2. An element has two naturally occurring isotopes. Isotope 1 has a mass of 120.9038 amu and a relative abundance of 57.4%, and isotope 2 has a mass of 122.9042 amu. Find the atomic mass of this element and identify it. (Tro 2nd Edition Ch 1 #77)

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3. Determine the number of protons and the number of electrons in each ion. (Tro 2nd Edition Ch 1 #71)
- a. Ni^{2+}
 - b. S^{2-}
 - c. Br^-
 - d. Cr^{3+}

Lecture 2:

4. Calculate the wavelength of the light emitted when an electron in a hydrogen atom makes each transition and indicate the region of the electromagnetic spectrum (infrared, visible, ultraviolet, etc.) where the light is found. (Tro 1st Ed, Chapter 3, #69)
- a) $n = 2 \rightarrow n = 1$
 - b) $n = 3 \rightarrow n = 1$

Lecture 3:

5. What is the amount, in moles, of each elemental sample? (Tro 2nd Edition: Ch 1 #85)

- a) 11.8 g Ar
- b) 3.55 g Zn
- c) 26.1 g Ta
- d) 0.211 g Li

6. Calculate the number of atoms in each sample. (Tro 1st ed., Ch 2, Problem 53, Pg 59)

- a. 5.18g P
- b. 2.26g Hg
- c. 1.87g Bi
- d. 0.082g Sr

Lecture 4:

7.). List these types of electromagnetic radiation in order of (i) increasing frequency and (ii) decreasing energy per photon: gamma rays, radio waves, microwaves, and visible light (Tro 2nd Edition: Ch 2 #37)

Lecture 5:

8.). Calculate the frequency of each wavelength of electromagnetic radiation (Tro 2nd Edition: Ch 2 #39):

- a. 632.8 nm
- b. 503 nm
- c. 0.052 nm

Lecture 6:

9.). A laser pulse with wavelength 532 nm contains 3.85 mJ of energy. How many photons are in the laser pulse? (Tro 2nd edition #43)

Lecture 7 and 8:

10.) An electron in the $n=7$ level of the hydrogen atom relaxes to a lower energy level, emitting light of 397 nm. What is the value of n for the level to which the electron relaxed?

Lecture 9:

11.) Describe the shapes of s, p, and d orbitals. How are these orbitals related to the quantum numbers n , l , and m_l ? (Chang 6th Edition Ch. 7 #69)

Lecture 10:

12.) Which set of quantum numbers *cannot* occur together to specify an orbital? Why? (#61, textbook end of chapter problems, chapter 2)

- a. $n = 2, l = 1, m_l = -1$
- b. $n = 3, l = 2, m_l = 0$
- c. $n = 3, l = 3, m_l = 2$
- d. $n = 4, l = 3, m_l = 0$

Lecture 11:

13.) Write the electron configuration for each ion. (Tro, 1st Ed., Ch.4 #76)

- a. Cl^-
- b. P^{3-}
- c. K^+

14.) Write the full orbital diagram for each element. (Tro, 1st Ed., Ch.4 #47)

- a. N
- b. F
- c. Mg