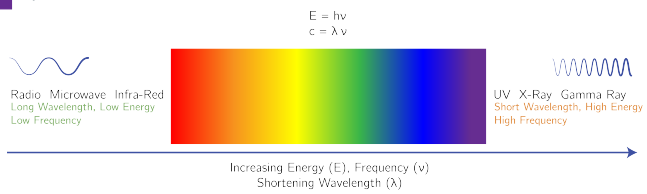
HW03 - Radiation & Atomic Theory

1 2 points

As the wavelength of a light wave gets longer, frequency and energy...

- ○ remain unchanged
- ○ increase
- ○ decrease

2 4 points



Rank the following radiation types from shortest to longest wavelength:
UV, X-Ray, Red light, Green light

- ○ Red light, Green light, UV, X-Ray
- ○ Green light, X-Ray, Red light, UV
- ○ X-Ray, Green light, Red light, UV
- ○ X-ray, UV, Green light, Red light

3 4 points

Which of the following statements is true regarding the visible spectrum:

I. Red light has the longest wavelength in the visible spectrum
II. Yellow light has a greater velocity than orange light
III. Violet light has the highest velocity in the visible spectrum
IV. Blue light has a higher frequency than green light

- ○ I only
- ○ I, III, and IV only
- ○ IV only
- ○ I, II, III, and IV
- ○ I and IV only
- ○ I, II, and IV only
- ○ II, III, and IV only

4 4 points

How would you describe the most likely effect of visible light on a molecule?

- ○ molecular ionization
- ○ molecular vibration
- ○ molecular rotation
- ○ electron excitation

5 4 points

How would you describe the most likely effect of infra-red radiation on matter?

- ○ rotation
- ○ excitation
- ○ ionization
- ○ vibration

6 4 points

DNA, generally considered a very stable organic polymer, is first damaged at which region of the electromagnetic spectrum?

- ○ UV region
- ○ IR region
- ○ Visible light
- ○ Radio waves

7 4 points

Which of the following pairs the correct definition of frequency along with the correct units shown in parenthesis?

- ○ The time it takes for a full wavelength to pass a single point (s^{-1})
- ○ The time it takes for a full wavelength to pass a single point (s)
- ○ The number of wavelengths that pass a single point per second (s^{-1})
- ○ The number of wavelengths that pass a single point per second (s)

8 4 points

What is the frequency of yellow light with a wavelength of 580 nm?

- ○ $2.39 \times 10^{-19}\ s^{-1}$
- ○ $5.17 \times 10^{5}\ s^{-1}$
- ○ $5.17 \times 10^{14}\ s^{-1}$
- ○ $1.80 \times 10^{-7}\ s^{-1}$

9 4 points

Which of the following equations directly solves for energy using wavelength?

- ○ $E = h\lambda / \nu$
- ○ $E = hc / \lambda$
- ○ $E = h\nu / \lambda$
- ○ $E = h\lambda$

10 4 points

FM radio stations correspond to the frequency of the channel in MHz. If you want to listen to a radio station that has a frequency equal to 1.015×10^{8} Hz, you should tune your radio to...

- ○ 10.15
- ○ 101.5
- ○ 1.015
- ○ 1015

11 4 points

Microwaves, such as those used for radar and to heat food in a microwave oven, have wavelengths just greater than about 3 mm. What is the corresponding frequency of radiation with a 13.4 mm wavelength?

- ○ 7.52×10^{10} Hz
- ○ 2.24×10^{10} Hz
- ○ 6.82×10^{10} Hz
- ○ 4.81×10^{10} Hz

12 4 points

It takes light with a wavelength of 212 nm to break the N-H bond in ammonia. What energy is required per photon to break this bond? What is the N-H bond strength in terms of kJ per mole?

- ○ 6.61×10^{-22} kJ/photon; 0.398 kJ/mol
- ○ 6.61×10^{-22} kJ/photon; 398 kJ/mol
- ○ 9.38×10^{-22} kJ/photon; 565 kJ/mol
- ○ 9.38×10^{-22} kJ/photon; 565,000 kJ/mol

13 4 points

Which of the following is the most energetic form of UV light?

- ○ UV-A
- ○ UV-A, UV-B, and UV-C are equally energetic
- ○ UV-C
- ○ UV-B

14 4 points

Sodium vapor lamps, used for public lighting, emit yellow light of a wavelength of 570 nm. How much energy is emitted by an excited sodium atom when it generates a photon?

- ○ 2.8×10^{-19} J
- ○ 3.5×10^{-19} J
- ○ 2.8×10^{-20} J
- ○ 3.5×10^{-28} J

15 4 points

Consider the sodium vapor lamps described in the previous question. How much energy is emitted by 45.8 mg of sodium atoms emitting light at this wavelength? Assume each sodium atom emits one photon.

- ○ 2.0×10^{-3} J
- ○ 420 J
- ○ 2.0×10^{21} J
- ○ 4.2×10^{5} J

16 3 points

Which of the following statements are consistent with modern atomic theory? Multiple answers may apply.

- ☐ The vast majority of mass exists in the nucleus of an atom, but the radius of the nucleus is only about minuscule fraction of the overall atomic radius
- ☐ Electrons exist in discrete, quantifiable energy levels.
- ☐ An electron that has zero energy when it is closest to the nucleus
- ☐ The solutions to the Schrödinger Equation are wavefunctions that describe the energy and position of electrons in an atom.

17 4 points

Which of the following sets of quantum numbers is not possible?

- ○ n = 3, l = 2, m_l = 1, m_s = 1/2
- ○ n = 2, l = 0, m_l = 0, m_s = -1/2
- ○ n = 3, l = 4, m_l = -3, m_s = 1/2
- ○ n = 5, l = 3, m_l = 3, m_s = -1/2

18 4 points

Which of the following **is** a possible quantum number set for an electron in a 4d orbital?

- ○ $n = 4, \ell = 3, m_\ell = 0, m_s = ½$
- ○ $n = 4, \ell = 3, m_\ell = 3, m_s = ½$
- ○ $n = 2, \ell = 4, m_\ell = 2, m_s = -½$
- ○ $n = 4, \ell = 2, m_\ell = -1, m_s = ½$

19 4 points

An electron is found in a 6f orbital. What is the value of the angular momentum quantum number (ℓ)?

- ○ 2
- ○ 1
- ○ 4
- ○ 6
- ○ 3

20 4 points

How many unique quantum number sets are possible for a 3p electron in an argon atom?

Type your answer...

21 2 points

Which of the following is **not** a possible quantum number set?

- ○ $n = 2, \ell = 1, m_\ell = 0, m_s = ½$
- ○ $n = 4, \ell = 2, m_\ell = -1, m_s = -½$
- ○ $n = 3, \ell = 0, m_\ell = 0, m_s = ½$
- ○ $n = 3, \ell = 2, m_\ell = -3, m_s = -½$

22 2 points

An electron orbital has a round, spherical shape (s-orbital). Its n value equals 3. What is a possible quantum number set for this electron orbital?

- ☐ n = 2, l = 3, ml = 0, ms = 1/2
- ☐ n = 3, l = 1, ml = 0, ms = 1/2
- ☐ n = 5, l = 3, ml = 0, ms = 1/2
- ☐ n = 3, l = 0, ml = 0, ms = 1/2

23 3 points

The electron configuration for the Mn atom is...

- ○ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$
- ○ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
- ○ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$
- ○ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 4p^5$

24 3 points

How many total s electrons does P (atomic number 15) possess?

- ○ 4
- ○ 2
- ○ 6
- ○ 5

25 3 points

What is the electronic configuration of a selenium atom (Se)?

- $[Kr]4s^2 4p^{14} 4d^{10} 4p^4$
- $[Ar]4s^2 3d^{10} 4p^4$
- $[Kr]4s^2 4d^{10} 4p^4$
- $[Ar]4s^2 4d^{10} 4p^4$
- $[Kr]4s^2 3d^{10} 4p^4$

26 3 points

What is the electron configuration of the chloride anion, Cl^- ?

- $1s^2 2s^2 2p^6$
- $1s^2 2s^2 2p^6 3s^2 3p^4$
- $1s^2 2s^2 2p^6 3s^2 3p^5$
- $1s^2 2s^2 2p^6 3s^2 3p^6$

27 3 points

A **neutral** atom has a ground state electronic configuration designated $1s^2 2s^2 2p^2$. Select the statement that best describes this atom.

- All are true.
- The atom is carbon.
- The element has atomic number 6.
- The atom has 2 unpaired electrons.
- The atom has electrons in four different, separate orbitals.
- The atom contains 6 protons.

28 4 points

The electron configuration for the most common sodium ion is isoelectronic with...

- magnesium
- krypton
- helium
- argon
- neon