HW03 - Radiation & Atomic Theory

1 1 point

Frequency is...

- the distance between a peak in one wave to the trough in the next wave.
- the number of waves passing a fixed point in one second.
- the distance between successive peaks in a wave.
- one half the height of the wave.

2 1 point

Wavelength is...

- one-half of the height of a wave.
- the distance between a peak of one wave and the trough of the next.
- the number of waves passing a fixed point in one second.
- the distance between successive peaks in a wave.

3 1 point

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

- remain unchanged
- increase
- decrease

4 1 point

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

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

5 1 point

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...

- 1.015
- 1015
- 10.15
- 101.5

6 1 point

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?

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

7 1 point

If a photon's wavelength is 663 µm, what is its energy?

- 4.40×10^{-43} J
- 3.00×10^{-25} J
- 3.00×10^{-22} J
- 4.40×10^{-46} J

8 1 point

A photon has a frequency of 223 MHz. What is the energy of this photon?

- 1.48×10^{-25} J
- 8.91×10^{-28} J
- 8.91×10^{-22} J
- 1.48×10^{-31} J

9 1 point

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

- 5.80×10^{10} s^{-1}
- 1.80×10^{-7} s^{-1}
- 5.17×10^{14} s^{-1}
- 5.17×10^{5} s^{-1}
- 2.39×10^{-19} s^{-1}

10 1 point

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?

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

11 1 point

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.

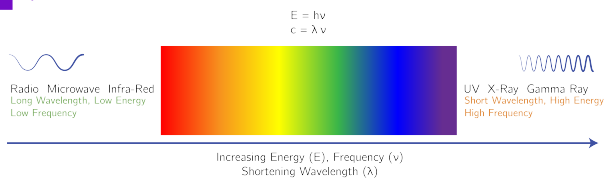
- 2.0×10^{21} J
- 420 J
- 4.2×10^{5} J
- 2.0×10^{-3} J

12 1 point

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

13 1 point



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

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

14 1 point

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

15 1 point

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

- excitation
- vibration
- rotation
- ionization

16 1 point

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

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

17 1 point

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

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

18 1 point

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

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

19 1 point

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

- 5
- 6
- 4
- 2

20 1 point

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.

21 1 point

A common reference point in atomic theory is the energy of a free electron. A "free" electron is one that is free of all positive/negative attractions and repulsions. It is effectively an infinite distance away from all things. What is the value of this reference energy level of a free electron ?

- $-\infty$ J
- $+\infty$ J
- 0 (zero) J
- 6.022×10^{23} J

22 1 point

Consider attractive forces within matter between particles (any particles really). As those attractions get stronger and stronger and the matter responds, the energy level of that matter...

- will decrease accordingly
- stay approximately the same
- will increase accordingly

23 1 point

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

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

24 1 point

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

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

25 1 point

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

- 1
- 4
- 2
- 3
- 6

26 1 point

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

27 1 point

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

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

28 1 point

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

29 1 point

The electron configuration for the Mn atom is...

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

30 1 point

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

- $[Kr]4s^24d^{10}4p^4$
- $[Ar]4s^23d^{10}4p^4$
- $[Ar]4s^24d^{10}4p^4$
- $[Kr]4s^24p^{14}4d^{10}4p^4$
- $[Kr]4s^23d^{10}4p^4$

31 1 point

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

- $1s^22s^22p^6$
- $1s^22s^22p^63s^23p^4$
- $1s^22s^22p^63s^23p^5$
- $1s^22s^22p^63s^23p^6$

32 1 point

A **neutral** atom has a ground state electronic configuration designated $1s^22s^22p^2$. Select the statement that best describes this atom.

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

33 1 point

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

- argon
- krypton
- magnesium
- neon
- helium