Chemistry 14A UA: Karen Leung

Quantum World (Part 2) & Quantum Numbers Worksheet

1. Calculate the de Broglie wavelength of a proton (mass=1.67 x 10^-27 kg) that is moving with a velocity 15.0% of the speed of light.

$$8.82 \times 10^{-15} m$$

2. A particle (6.644 x 10^-27 kg) and a chemistry textbook (2.18kg) are travelling at identical speeds. Considering the de Broglie equation, which object do you expect to have the shorter wavelength?

Chemistry textbook

3. If a proton and an electron have the same de Broglie wavelength, do they have the same speed? If not, how do they differ?

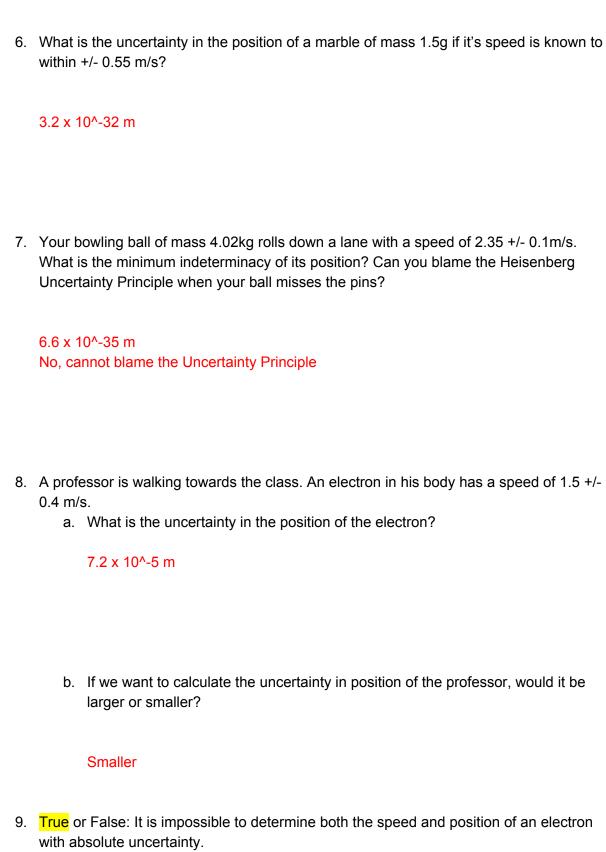
No, electron will have a higher speed

4. If a neutron and an electron have the same speed, which has the shorter de Broglie wavelength?

Neutron

- 5. Which of the following experiments most directly supports de Broglie's hypothesis of the wave nature of matter?
 - a. Black body radiation
 - b. Photoelectric effect
 - c. Alpha particle scattering by metal foil
 - d. Electron diffraction by crystal
 - e. Emission spectrum of the hydrogen atom

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REVIEW PROBLEMS (Week 2 & 3 cumulative material):

- 10. Which of the following statements regarding electromagnetic radiation is true?
 - a. Electromagnetic radiation with a wavelength of 400nm travels faster than that with a wavelength of 600nm.
 - b. Electromagnetic radiation with a wavelength of 600nm travels faster than that with a wavelength of 400nm.
 - c. The frequency of electromagnetic radiation determines how fast it travels.
 - d. Electromagnetic radiation with a wavelength of 400nm has a frequency that is smaller than that with a wavelength of 600nm.
 - e. Electromagnetic radiation with a wavelength of 600nm has a frequency that is smaller than that with a wavelength of 400nm.

11. True or false:

- a. For most metals, ultraviolet light is needed for the photoelectric effect to occur. T
- b. Because a faint light contains very little energy, it takes as few minutes before electrons are emitted from the metal it is shining upon. F
- c. A bright light always causes more electrons to be emitted than a faint light. F
- d. Higher frequency light always emits electrons with higher kinetic energies. F
- 12. Order the following types of radiation in increasing wavelength:

Gamma rays, X-rays, UV, green color, red color, infrared, microwaves

Quantum Numbers:

1. What is the maximum number of electrons that can occupy the orbitals with principal quantum number = 4?

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- 2. What does the principal quantum number tell us?
 - a. Energy
 - b. Rate of circulation
 - c. Orientation of motion
 - d. None of the above

3. If $m_1 = 3$, what are the possibilities for m_s ?

$$+\frac{1}{2}$$
, $-\frac{1}{2}$

- 4. Which of the following sets of quantum numbers is valid for an electron in a 4d orbital?
 - a. n=4, l=3, m_1 = 2, m_s = $\frac{1}{2}$
 - b. n=4, l=1, $m_l = 1$, $m_s = -\frac{1}{2}$
 - c. n=4, l=2, m_1 = 3, m_s = -½
 - d. n=4, l=2, $m_l = 1$, $m_s = -\frac{1}{2}$
- 5. Which of the following set of quantum numbers are possible?
 - a. n=4, l=3, m_1 = 3, m_s = -½
 - b. n=3, l=3, m_1 = 2, m_s = -1/2
 - c. n=2, l=0, $m_1 = 1$, $m_s = \frac{1}{2}$
 - d. n=3, l=3, $m_l = 2$, $m_s = \frac{1}{2}$
 - e. n=2, l=1, m_1 = 2, m_s = -1/2
- 6. Which of the following changes as an electron moves from a 5s to 4d orbital?
 - a. n
 - b. I
 - c. a and b
 - d. None of the above