RH = /88; CH1 = /100; CH2 = /70

PHYS 202 Test #4 4/10/19 Dr. Holmes NAME_____**Key**_____________

DO ALL THE PROBLEMS. THE WORTH OF EACH PROBLEM IS MARKED BESIDE THE SPACE FOR THE ANSWER. SHOW YOUR WORK FOR PARTIAL CREDIT.

1) A person has a surface area of 0.77 m^2 with a surface (skin) temperature of 95^oF.
What is the surface temperature in a) ^oC ? b) in Kelvin?

[1] __**35^{o}C**___ [1] _**308 K**___.

c) Assuming the person is a perfect blackbody (ε=1), at what wavelength does the radiation from the person peak?

[2] _**9.42 x 10^{-6} m**_. d) What is the total power radiated by the person?

[2] ___**393 W**____________. e) If the outside temperature is 68^oF, what is the total power absorbed by the person?

[2] _**322 W**___________. f) What is the net power lost by the person via radiation?

[2] _**71 W**_______.

2) a) Describe one aspect of the **photoelectric effect** that contradicts what the wave theory of light predicts. [3]

b) Indicate in which way it (part a) contradicts what the wave theory predicts. A graph showing what the wave theory predicts and what the experiment gives would suffice. [3]

c) Indicate how the particle (photon) theory accounts for this aspect (part a): [4]

3) a) Given that the work function of a metal is 3.0 eV, what is the cut-off frequency for the photoelectric effect with this metal?

[3] ___**7.24 x 10^{14} Hz**_. b) What wavelength is associated with this cut-off frequency?

[2] __**414 nm**_____. c) What is the stopping voltage required for ultraviolet light of wavelength 222 nm ?

[3] ____**2.6 volts**___________. d) Will green light of wavelength 555 nm be able to eject electrons from this metal?

[1] __**No**_______. e) Will UV light of wavelength 333 nm be able to eject electrons from this metal?

[1] _**Yes**____________.

4) a) List two experiments that indicate light behaves as a wave and not as a particle:

(1) [2]

(2) [2]

b) List two experiments that indicate light behaves as a particle and not as a wave:

(1) [2]

(2) [2]

5) a) What is the energy of a photon given off by a hydrogen atom in going from the n=5 state to the n=3 state?

[5] _**0.967 eV = 1.55 x 10^{-19} J**_. b) What is the wavelength of light from this transition?

[3] ____**1.28 x 10^{-6} m**_. c) What type (or if visible, what color) is this photon?

[2] ____**IR**____.

6) a) Briefly explain how the DeBroglie wavelength idea is used to explain why electrons can exist in state n=1 or state n=2 but not in a state with n=1.66 . [5]

b) Describe one experiment that supports the idea that an electron shows wave properties and has a wavelength equal to the DeBroglie wavelength. [5]

7) a) How big is an atom (length in meters)? [2] ____**10^{-10} m**______.

b) How big is the nucleus? [2] ___**10^{-14} m**______.

c) How big is the electron? [2] ___**$< 10^{-17}$ m**____.

d) How do we know the above value for part b (size of nucleus)? [4]

8) a) What is the speed of an electron accelerated through 66 volts?

[3] ___**4.82×10^{6} m/s**__.

b) What is the momentum of this electron (at the above speed)?

[3] _**4.38×10^{-24} kg*m/s**_.

c) What is the wavelength of this electron (at the above momentum)?

[3] _**1.51×10^{-10} m**__.

d) What is the wavelength of a **photon** that has an energy of 66 eV ?

[3] ___**1.88×10^{-8} m**_.

9) a) State the Heisenberg Uncertainty Principle. You can use an equation but be sure to define each symbol used: [4]

b) Design an experiment to locate an electron, and show how this principle applies when you try to locate the position of an electron: [4]

10) Explain the following terms as they are related to the operation of a laser:

a) spontaneous emission: [3]

b) stimulated emission: [3]

c) population inversion: [3]

d) light amplification: [3]