RH: /66 CH1: /100 CH2: /30

PHYS 252 TEST #3 03/13/19 Dr. Holmes NAME **Key**

ANSWER ALL 9 QUESTIONS. THE WORTH OF EACH PART OF EACH QUESTION IS CIRCLED NEAR THE PLACE FOR THE ANSWER. SHOW YOUR WORK ON PROBLEM TYPE QUESTIONS, AND ANSWER BRIEFLY BUT TO THE POINT ON WORD QUESTIONS.

1) The person's surface temperature is 92^{o}F (assume this is constant over the whole person's surface), and the person's surface area is 1.2 m^{2}. a) Assuming the person's "color" factor, ε, is 0.97, what is the power emitted by the person via radiation?

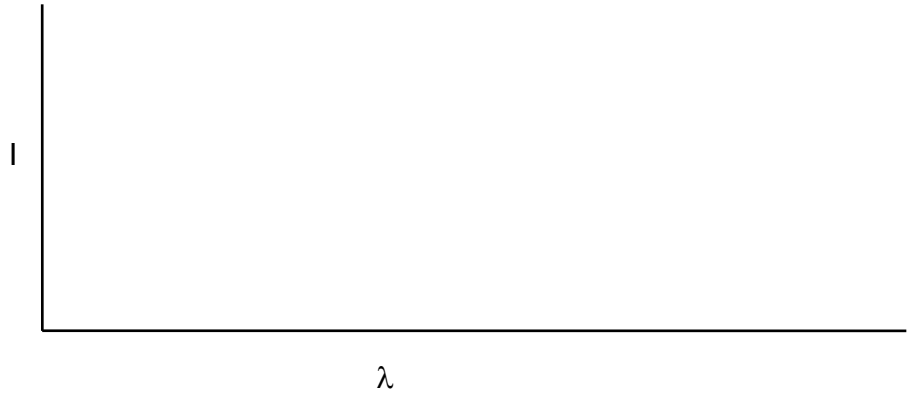
[4] **581 W**. b) If the outside temperature is 32^{o}F, what is the power absorbed by the person via radiation (assuming the person does not wear a coat).

[4] **367 W**. c) What is the wavelength for the peak power verses wavelength emitted by the person?

[4] **9.48×10^{-6} m**. d) What type of light (radio, visible, etc.) is the peak wavelength?

[1] **IR** .

2) a) Show using a graph of intensity vs wavelength what happens **experimentally** in blackbody radiation: [3]



b) Show on the above graph using a **dotted line** what the **classical (wave) theory** predicted for blackbody radiation. [4]

c) What did Planck **do differently** from the classical theory to predict the actual behavior of blackbody radiation? [3]

3) PHOTOELECTRIC EFFECT:

a) Draw a diagram showing the **experimental setup** for the photoelectric experiment: [3]

b) **Describe** one part of the experiment that **cannot** be explained by the wave theory. (A graph would be help.) [3]

c) **Describe** how the particle (photon) theory **can** explain the above part of the experiment. [3]

d) If the work function for a metal is 3.3 eV, what is the **cut-off frequency** for light to eject photo-electrons from this metal?

[3] **7.96×10^{14} Hz**. e) What is the **wavelength** for this frequency of light?

[2] **377 nm**. f) Will light of wavelength 600 nm be able to eject electrons from this metal?

[2] **No**. If so, what is the **stopping voltage** for this light; if no, then answer N.A.:

[2] **N.A.**.

g) Will light of wavelength 300 nm be able to eject electrons from the metal?

[2] **Yes**.

If so, what is the **stopping voltage** for this light; if no, then answer N.A.:

[2] **0.844 V** .

4) a) What is the evidence against the plum pudding model of the atom? (**Name** and **briefly describe** the experiment): [4]

b) What is the approximate size of an atom?

[2] **10^{-10} m**.

c) What is the approximate size of the nucleus?

[2] **10^{-14} m**.

d) What is the approximate size of the electron?

[2] **$<10^{-17}$ m**.

5) a) What is the ground state energy of the hydrogen atom?

[3] **-13.6 eV**.

b) How much energy is emitted when the electron falls from the n=5 state to the n=2 state in the hydrogen atom? **4.57×10^{-19} J**

[3] **2.86 eV**. c) What is the wavelength of a photon that has this much energy?

[2] **435 nm**. d) What type of photon is this (e.g., ultraviolet, infrared, etc. (if visible, specify the color):

[2] **blue**.

6) a) If there is such a thing as the DeBroglie wavelength, then we should be able to test it. Describe one experiment in support of the DeBroglie wavelength for matter. [4]

b) Tell how the DeBroglie wavelength "explains" the Bohr assumption that $L = n\hbar$. [4]

7) a) What does the Heisenberg Uncertainty Principle say? (use an equation and identify all terms used) [4]

b) Demonstrate this uncertainty by describing one experiment that tries to measure those quantities it relates. [4]

8) a) State the Pauli Exclusion Principle? [4]

b) Does it apply to all particles? (If NO, then indicate which it does apply to and which it does not apply to.) [2]

c) Explain how the Pauli Exclusion Principle follows from the Heisenberg Uncertainty Principle and the Schrödinger Equation. [4]

9) Explain the principles of a laser. In particular, explain what is meant by:
a) a metastable state [3]

b) a population inversion [3]

c) distinguish between stimulated and spontaneous emission: [3]