Examination II

Name: ______________________________ Physics 222

UIN: ________________________________ Fall 2018

Hans A. Schuessler

Time: 50 min

Each problem is worth 5 points.

Part I: Multiple Choice Questions

1. Who did first accurately measure the value for the charge of the electron?

   a. Röntgen
   b. Thomson
   c. Planck
   d. Millikan
   e. Einstein

2. The Rydberg equation is used to:

   a. determine the ratio of the electron charge to its mass
   b. calculate the wavelengths of different spectral lines of hydrogen
   c. measure the mass of the hydrogen atom
   d. calculate the wavelengths of different transitions in energy level of electrons in helium
   e. Calculate the X-ray wavelengths from Mosely plots.

3. How did Planck modify the classical theory of blackbody radiation to correctly determine his radiation law?

   a. He found that the blackbody model was incorrect for purposes of theory
   b. He accepted the Stefan-Boltzmann Law
   c. He assumed light was absorbed and emitted in quanta
   d. He realized that the charge of the electron was not quantized
   e. He proved the necessity of relativistic considerations.

4. Consider the photoelectric effect when one increases only the frequency of the incoming light onto the emitter, one measures

   a. An increased current
   b. A decrease in the necessary stopping voltage
   c. No change in either current or stopping voltage
   d. An increase in the necessary stopping voltage
   e. Either a or c. You cannot determine which from the information given.

5. Which of the following statements is correct about the experiment that first measured the charge of the electron?

a. The oil drop is suspended because there are no forces acting on the drop
b. The important result was that Coulomb attraction made all the oil drop the same mass, regardless of type of oil
c. The mass of the drop was determined by measuring its terminal velocity
d. The valve for electron charge had an experimental error of about 35%
e. Light hitting the oil drops manipulated their movement in a way to create an interference pattern.

6. How did Thomson meausre the charge to mass ratio of the electron?

a. He shot helium nuclei into gold foil to measure the nuclei scattering against electrons within.
b. He passed cathode rays through a magnetic field and measured the deflection.
c. He suspended a drop of oil between electrodes to measure the electric field from the electrons.
d. He measured very precisely a known quality of hydrogen atoms and calculated the reduced mass ration within each atom.

7. The K_β – xray comes from a transition of an electron:

a. from the L-shell to a vacancy in the K-shell
b. from the M-shell to a vacancy in the K-shell
c. from the M-shell to a vacancy in the L-shell
d. from the N-shell to a vacancy in the M-shell

8. At what wave length is the radiation emitted by a human body at its maximum? Assume a temperature of 37°C.

a. $9.35\mu m$
b. $1.16\mu m$
c. 503nm
d. $4.15\mu m$
e. 850nm

9. Indicate in which atom the electron is most strongly bound

a. H
b. He^{+}
c. Li^{++}
d. The same in all the above atoms and ions.
e. Be^{+++}

10. In the Franck-Hertz experiment the electron loses energy by

a. Ionization of a Hg atom
b. Excitation of a Hg atom to the first excited state
c. Excitation to the second excited state of a Hg atom
d. By being captured by a Hg atom
e. by causing to the Hg atom to accelerate

11. When you increase only the intensity of the light onto the emitter, you measure

a. A decrease in the necessary stopping voltage
b. An increase in the necessary stopping voltage
c. An increased current
d. No change in either current or stopping voltage
e. You cannot determine which from the information given

12. Consider building a scale model of the hydrogen atom using a Bohr's theory. You start with the proton and give it a diameter of 1cm in your setup. What is the diameter of the orbit of the electron if it is to be depicted as being in the **first excited** state?(n=2) Proton **charge radius** 0.8751(61) fm (fermi)

a. 530m
b. 1.7km
c. 2410m
d. 6.3km
e. 30m

Part II: Short problems Please show your work to get credit and circle the closest answer

13. The wavelength of maximum intensity of the sun's radiation is observed to be near 500nm. Assume the sun to be black body and calculate the sun's surface temperature

a. 4600 K
b. 3200 K
c. 5800 K
d. 6000 K
e. 5700 K

14. The power per unit area R(T) emitted from the sun's surface

a. 4.56x 10^7 W/m^2
b. 6.23x 10^7 W/m^2
c. 5.78x 10^7 W/m^2
d. 7.00x 10^7 W/m^2
e. 6.42x 10^7 W/m^2

15. A surface is irradiated with monochromatic light of variable wavelength. Above 600nm no photoelectrons are emitted from the surface. With an unknown wavelength, a stopping potential of 4 V is necessary to eliminate the photoelectric current. What is the wavelength?

a. 305 nm

b. 205 nm

c.405 nm

d. 505 nm

e.105 nm

16. A blackbody's temperature s increased from 600K to 1500K. By what factor does the total power emitted per unit area increase?

a. 4
b. 8
c. 16
d. 39
e. 2

17. Consider pair annihilation and indicate which answer is correct.

a. The two emitted photons move in the same direction.
b. Each emitted photon has an energy of about 0.511 MeV.
c. Due to conservation of momentum, the two emitted photons move at right angles to each other.
d. Four photons are emitted to conserve energy

18. Calculate the Rydberg constant for the hydrogen-like ion of uranium.

use M(uranium)=238.05078 u m(electron)=0.0005485799 u)

a. 0.9999859 $x10^7 x\ m^{-1}$
b. 0.9999991 $x10^7 x\ m^{-1}$
c. 0.9999977 $x10^7 x\ m^{-1}$
d. 0.9997633 $x10^7 x\ m^{-1}$
e. 1.0973732 $x10^7 x\ m^{-1}$

19. The Bohr radius is 0.5 x 10^{-10}m. What is the dicemeter of the stationary state with n=4?

a. 2 x 10^{-10}m
b. 4 x 10^{-10}m
c. 8 x 10^{-10}m
d. 16 x 10^{-10}m
e. 26 x 10^{-10}m

20. How much energy is required to produce a proton –antiproton pair?

a. 1877 MeV

b. 938 MeV

c. 0.511 MeV

d. 1.22 MeV