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**University Examinations 2016/2017**

FORTH YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE PHYSICS

**SPH 2400: ATOMIC PHYSICS**

**DATE: December, 2016 TIME: HOURS**

**INSTRUCTIONS:** *Answer questions* ***one*** *and any other* ***two*** *questions.*

**QUESTION ONE - (30 MARKS)**

1. State two observations of the Rutherford’s scattering experiment and their corresponding inferences. (2 Marks)
2. (i) Bohr retained which assumption of the Rutherford model? (1 Mark)

(ii) Differentiate between Russel-Saunders coupling and J-J coupling. (4 Marks)

1. State the quantum numbers of the Somerfield Relativistic model. (2 Marks)
2. Match the 4 quantum numbers of the vector model of the atom and their physical significance. (4 Marks)
3. Given that the ionization energy of the hydrogen atom is -13.6ev, calculate the range of wavelengths for the Baumer series of the hydrogen atom. (5 Marks)
4. Differentiate between Zeeman and the stack effects. (2 Marks)
5. Sketch and explain the x-ray spectrum produced by a x-ray tube. (5 Marks)
6. Write the atomic term symbol for hydrogen in ground state (H= 1) (3 Marks)

**QUESTION TWO (20 MARKS)**

1. Use the Pauli exclusion principle and the four quantum numbers of the vector model to determine the maximum number of electrons that can be accommodated in the orbit n=2.Show all values of quantum numbers in a table. (7 Marks)
2. Write the electronic configuration and hence determine the;
3. atomic term symbol for Boron (Z =5) (7 Marks)
4. What kind of microstate is Boron? Explain (2 Marks)
5. Describe how Zeeman effect occurs clearly differentiating between normal Zeeman effect and anomalous Zeeman effect. (5 Marks)

**QUESTION THREE (20 MARKS)**

1. With aid of a diagram explain the emission spectra of hydrogen clearly outlining the first 3 series of the spectrum. (9 Marks)
2. Show that the velocity of the electron in Bohr atomic model is inversely proportional to the principal quantum number. (6 Marks)
3. Briefly explain the shortcomings of the Somerfield relativistic model of the atom that were solved by the vector model of the atom. (5 Marks)

**QUESTION FOUR (20 MARKS)**

1. Briefly explain how x-rays are produced in an x-ray. (5 Marks)
2. An x-ray tube is operated by a 24.8 KV potential with a current of 4mA flowing. Calculate;
3. Number of electrons striking the target per second. (2 Marks)
4. The speed of the electrons as they hit the target. (3 Marks)
5. The cutoff wavelength for the x-ray spectrum produced. (2 Marks)
6. The mass absorption coefficient of alluminium for x-rays of wavelength $λ=3.2 x 10^{-11}m$ is $0.6cm^{2}/g$. If the density of alluminium is $2.7g/cm^{3}$ calculate;
7. Linear absorption coefficient of Alluminium for these x-rays. (3 Marks)
8. The half value layer (2 Marks)
9. The thickness of the Alluminium required to cut down the intensity of these x-rays 0.05. (3 Marks)