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| **DEPARTMENT OF CHEMISTRY**  **FOURAH BAY COLLEGE**  **UNIVERSITY OF SIERRA LEONE** CHEM 213**Basic Inorganic Chemistry I****Unit 1 – Further Atomic Structure and Bonding** **CONTINUOUS ASSESSMENT**  **ASSIGNMENT**  This assignment must be submitted no later than 2 pm on Friday March 23rd 2018  You must submit this cover sheet with your assignment.  Name: ……………………………………………………  Admission No. ………………..  Note:  CHEM211 Unit 1 Continuous Assessment is worth 15% of the total marks for CHEM211  Your score will be divided into three parts:  Lecture and Tutorial Attendance 10%  Assignment 40%  Test 50% |

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| **1.** | (a) | Calculate the energy of a microwave of wavelength 2 mm |
|  | (b) | Calculate the wavelength of a photon with an energy of 9.9 x 10-19 J  [5] |
| **2.** | When radiation of frequency 9.5 x 1014 Hz is used for photoelectric emission in magnesium, the resulting electron has a speed of 2.9 x 105 ms-1. | |
|  | (a) | Calculate, in kJmol-1, the energy required to remove an electron from a piece of magnesium. |
|  | (b) | Calculate the maximum wavelength of light able to cause photoelectric emission in magnesium.  [5] |
| **3.** | (a) | A photon with wavelength 520 nm collided with an electron and as a result them electron increased its speed by 500 ms-1. Calculate the new wavelength of the photon after the collision. |
|  | (b) | Explain briefly how the Compton effect and the Photoelectric effect provide evidence that waves can behave as particles.  [5] |
| **4.** | (a) | Explain the importance of the Davisson-Germer experiment in developing the theory of wave-particle duality of matter. |
|  | (b) | State the Heisenberg uncertainty principle and explain its significance in understanding atomic structure.  [5] |
| **5.** | (a) | Calculate the de Broglie wavelength of an electron moving at 150,000 ms-1 |
|  | (b) | Explain the importance of the de Broglie wavelength in understanding atomic structure.  [5] |
| **6.** | The wavelengths of radiation emitted by a hydrogen atom can be predicted using the following equation: , where RH is the Rydberg constant (1.1 x 107 m-1) and ni and nf are the quantum numbers of the initial and final energy levels. | |
|  | (a) | State Bohr’s postulate of quantisation of angular momentum. |
|  | (b) | Hence write an expression for the energy of an electron in a hydrogen atom in terms of fundamental constants and the quantum number n. |
|  | (c) | Hence derive an expression for the Rydberg constant in terms of fundamental constants. |
|  | (d) | Give the wavelength of the radiation emitted during an electronic transition from n = 6 to n = 2 in a hydrogen atom |
|  | (e) | Suggest a value for the Rydberg constant equivalent in a He+ ion  [15] |

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| **7.** | **A classical standing wave must satisfy the following equation: 2**ψ = - ψ. | |
|  | (a) | Explain the meaning of the terms **2**ψ, ψ and in this equation. |
|  | (b) | Combine the above equation with the equations for the de Broglie wavelength of an electron, the kinetic energy of an electron and the potential energy of an electron to derive the Schrodinger equation for an electron in a hydrogen atom in terms of ψ, total energy E and distance from nucleus r. |
|  | (c) | Explain the meaning of the terms eigenfunction and eigenvalue. |
|  | (d) | State all the possible values of the quantum numbers l and ml when n = 4. Hence state how many different eigenfunctions exist with n = 4.  [15] |
| **8.** | (a) | Draw a graph to show how the potential energy of two hydrogen atoms varies with internuclear distance. Explain the shape of your graph and show how the graph can be used to give values of bond energy and bond length.  [5] |
| **9.** | (a) | Draw a diagram to show the bonding in a molecule of N2. Use your diagram to explain the difference between a π-bond and a σ-bond. |
|  | (b) | What is meant by hybridisation? Illustrate your answer by describing the hybridisation in IF5. Sketch the molecule and estimate the bond angles.  [10] |

**TOTAL 70 MARKS**