NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION: BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	**LEVEL:** 6
COURSE NAME: MODERN PHYSICS	**COURSE CODE:** MPH602S
SESSION: JANUARY 2020	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

SECOND OPPORTUNITY/SUPPLEMENTARY EXAMINATION QUESTION PAPER	
EXAMINER(S)	**DR ONJEFU SYLVANUS**
MODERATOR:	**PROF DIPTI SAHU**

PERMISSIBLE MATERIALS
Non-programmable Calculator

ATTACHMENT
None

THIS QUESTION PAPER CONSISTS OF 3 PAGES
(Including this front page)

QUESTION 1 [20]

1.1 Explain the Rutherford's Model of the atom and give two limitations to the model. (9)

1.2 What do you understand by photoelectric effect? (3)

1.3 What is the kinetic energy and speed of an electron ejected from a sodium surface whose work function is $W_o = 2.28$ eV when illuminated by light of wavelength (a) 410 nm, (b) 550 nm? [Take $h = 6.626 \times 10^{-34}$ J; $m_e = 9.1 \times 10^{-31}$; 1 eV = 1.6×10^{-19}]. (8)

QUESTION 2 [28]

2.1 Explain the ground state of an atom. (3)

2.2 Calculate the energy of the ground state and 1st excited state of the hydrogen atom. (6)

2.3 Calculate the frequency and wavelength of the photon emitted when an electron makes a quantum jump from the n = 3 state to the ground state of the hydrogen atom. [Take $h = 6.6 \times 10^{-34}$ Js; $c = 3.00 \times 10^{8}$]. (11)

2.4 Determine the wavelength of an electron in meters that has been accelerated through a potential difference of 100 V. (4)

2.5 Calculate the de Broglie wavelength of a 0.20 kg ball moving with a speed of 15 m/s. (4)

QUESTION 3 [20]

3.1 Explain the Heisenberg uncertainty principle. (3)

3.2 A electron moves in a straight line with a constant speed $v = 1.10 \times 10^{6}$ m/s which has been measured to a precision of 0.10%. What is the maximum precision with which its position could be simultaneously measured? [Take $\hbar = 1.06 \times 10^{-34}$]. (10)

3.3 A radioactive material has a half-life of 10 hours. What fraction of the original radioactive nuclei will remain after 30 hours? (7)

QUESTION 4 **[21]**

4.1 Using Pauli Exclusion Principle, explain and show why sodium (Z = 11) is the next univalent atom after lithium. (10)

4.2 Using Balmer series determine the wavelength of light emitted when a hydrogen atom makes a transition from the n= 6 to the n= 2 energy level according to the Bohr model. [Take Rydberg constant, R= 1.0974 X $10^7 m^{-1}$]. (6)

4.3 Explain Zeeman Effect and state what does the effect confirms. (5)

QUESTION 5 **[11]**

5.1 Show the expression of a wave function of a particle in a state of definite energy. (3)

5.2 Showed that the ratio of the number of atoms disintegrating per unit time to the number of atom in the source at that time is equal to a decay constant λ. Also show that $N = N_0 e^{-\lambda t}$ where all symbols have their usual meaning. (8)

END