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 CODE: MPH602S	**COURSE NAME:** MODERN PHYSICS
SESSION: JANUARY 2019	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

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

INSTRUCTIONS
1. Answer ALL the questions. 2. Write clearly and neatly. 3. Number the answers clearly.

PERMISSIBLE MATERIALS

1. Non-programmable Calculator

THIS QUESTION PAPER CONSISTS OF 4 PAGES
(Including this front page)

Physical Constant

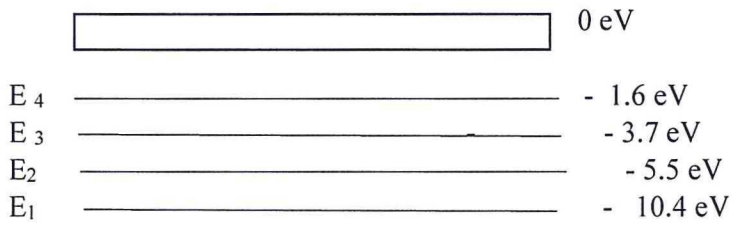
Electron mass	$m_e = 9.11x10^{-31}\,kg$
Proton mass	$m_p = 1.6736x10^{-27}\,kg$
Planck constant	h = 6.626 x 10^{-34}J
Speed of light	c = 3 x10^{8} m/s
1eV	1.6 x 10^{-19}

QUESTION 1 **[18]**

1.1 Explain the electron-cloud model and which region the cloud is being dense and more diffused. (6)

1.2 Explain the term excitation energy. (2)

1.3 The figure below gives the energy level for mercury atom:



If a bombarding electron has energy 6.7 eV,

1.3.1 To what level will the mercury atom be excited? (3)

1.4 What will be that wavelength of the light emitted if the mercury atom drops from this excited state to the second level? [Take h = 6.626 x 10^{-34} J; c = 3 x10^{8} m/s]. (3)

1.5 Show that the photon in a 1240 nm infrared beam have energies of 1.00eV. (4)

QUESTION 2 **[20]**

2.1 Define work function. (2)

2.2 The work function of sodium metal is 2.3 eV. What is the longest wavelength Light that can cause photoelectron emission from sodium? (6)

2.3 Calculate the minimum wavelength of X-rays when a voltage of 40 kV is applied to the X-ray tube. (4)

2.4 An electron falls from rest through a potential difference of 100 V. What is its de Broglie wavelength? (8)

QUESTION 3 **[21]**

3.1 Determine the de Broglie wavelength for a particle moving with a speed 2.0×10^{6} m/s if the particle is;

3.1.1 a 0.20 kg. (4)

3.1.2 an electron. (4)

3.1.3 a proton. (4)

3.2 Explain the Pauli exclusion principle. (3)

3.3 The isotope $^{14}_{6}C$ has a half-life of 5730 years. If at some time a sample contain 1.00×10^{22} carbon-14 nuclei, what is the activity of the sample? (6)

QUESTION 4 **[21]**

4.1 Explain Stern-Gerlach experiment and illustrate the experiment with a diagram. (7)

4.2 What is the value of 'l' for: - (i) s- sub shell; (ii) p- sub shell; (ii) d-sub shell; (iv) f-sub shell. (4)

4.3 Hydrogen atom has only one electron, so mutual repulsion between electrons is absent. However, in multielectron atoms mutual repulsion between the electrons is significant. How does this affect the energy of an electron in the orbitals of the same principal quantum number in multielectron atoms? (4)

4.4 Using Pauli exclusion principle write down the eight quantum states allowed for electrons in the L-shell. (6)

QUESTION 5 **[20]**

5.1 State one important idea that Plank used in other to obtain the correct spectral distribution for the blackbody radiation. Write down the Plank spectra distribution law in frequency space. (4)

5.2 Under what condition is the Plank law equivalent to Rayleigh-Jeans law? Show the equivalence mathematically. (4)

5.3 The surface temperature of the Sun is 5800 K about and measurements of the Sun's spectral distribution show that it radiates very nearly like a blackbody, deviating mainly at very short wavelengths. Assuming that the Sun radiates like an ideal blackbody, at what wavelength does the peak of the solar spectrum occur? (6)

5.4 If the accelerating potential between the cathode and anode of Thomson's e/m_e apparatus is 182.2 V, what uniform velocity v_x will the electrons acquire before entering the coexisting **E** and **B** fields? Assume accuracy to three significant figures and derive the appropriate equation. (6)

END