MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN POPULATION HEALTH

SPH 0204: ATOMIC, NUCLEAR PHYSICS AND ELECTRONICS

DATE: **TIME:**

INSTRUCTIONS. Answer Question One and Any Other Two Questions

QUESTION 1 (30 MARKS)

a) Using a well labelled diagram explain the composition of an atom according to bohr model (3 marks)

b) What is an isotope (1 mark)

c) Boron has two naturally occurring isotopes, ^{10}B and ^{11}B. We know that 80.22% of its atoms are ^{11}B, atomic weight 11.009 u. From the natural atomic weight given on the inside front cover, calculate the atomic weight of the ^{10}B isotope. (3 marks)

d) state and explain the two main class of spectra (4 marks)

e) calculate the energy released and the wavelength of the emitted radiation when an electron falls from n = 3(-1.51eV) to n = 1(-13.60eV) (5 marks)

f) in an X-ray spectrum of copper there is a line of wavelength 0.025nm. Calculate the energy associated with this transition in electron volts (3 marks)

g) Define the term radioactivity (1 mark)

h) A piece of bone from an archaeological site is found to give a count rate of 15 counts per minute. A similar sample of fresh bone gives account rate of 19 counts per minute. Calculate the age of the spacemen (3 marks)

i) State the difference between nuclear fusion and nuclear fission (2 marks)

j) Sketch and label important sections of an IV curve characteristic of a diode (4 marks)

k) Define the term doping as used in semiconductors (1 mark)

QUESTION 2 (20 MARKS)

a) ${}^{4}_{2}He$ is the most abundant isotope of helium. Its mass is 6.6447x 10-27kg. What is

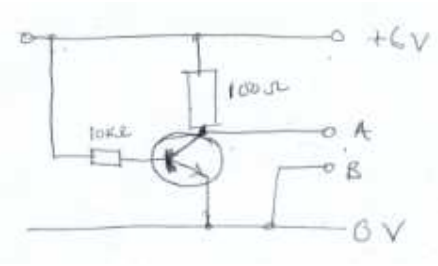
i. The mass defect? (4 marks)

ii. The binding energy of the nucleus in joules? (3 marks)

iii. The binding energy of the nucleus in electron volts? (3 marks)

b) using band gap theory explain the difference in insulators, metals and non-metals (6 marks)

c) in the circuit below assume V_{BE} =0.7V and that h_{FE} = 75.



Calculate

i. the base current (2 marks)

ii. the collector current (2 marks)

QUESTION3 (20 MARKS)

a) Calculate the mass defect and binding energy the nuclide ${}^{10}_{5}B$

a. where the mass of ${}^{10}_{5}B$ atom = 10.0129 u (6 marks)

b) using a well labelled diagram describe half wave rectification (6 marks)

c) explain how an n-type and p-type semiconductors are formed (8 marks)

QUESTION 4(20 MARKS)

a) A thorium atom of mass 232.038 u decays by the emission of an alpha particle to a

a. radium atom of mass 228.031 u. If the alpha particle has a mass of 4.003 u, how much energy in J is released in the process? (6 marks)

b) using a well labelled diagram explain how Geiger muller tube detects radioactive radiation (6 marks)

c) using a well labelled diagram explain bridge full wave rectification (8 marks)

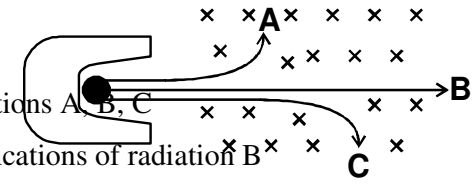
QUESTION 5(20 MARKS)

a) A radioactive element has an initial count rate of 2,400 counts per minute on a scaler. The count rate falls to 300 units per minute in 30 hours,

i. Calculate the half-life of the element (3 marks)

ii. If the initial number of atoms in another sample of the same element is 6.0 × 1020, how many atoms will have decayed in 50 hours? (3 marks)

b) The Figure below shows the three nuclear radiations labelled A, B and C under the influence of magnetic into the paper.



a) name the radiations A, B, C (3 marks)

b) name two applications of radiation B (2 marks)

c) state three properties of each of the above named radiations (9 marks)