



GARISSA UNIVERSITY COLLEGE

(A Constituent College of Moi University)

**UNIVERSITY EXAMINATION 2016/2017 ACADEMIC YEAR ONE
SECOND SEMESTER EXAMINATION**

SUPPLEMENTARY/SPECIAL EXAMINATION

SCHOOL OF EDUCATION, ARTS AND SOCIAL SCIENCES

FOR THE DEGREE OF BACHELOR OF EDUCATION (ARTS)

COURSE CODE: PHY 122

COURSE TITLE: MODERN PHYSICS

EXAMINATION DURATION: 3 HOURS

DATE: 29/09/17

TIME: 09.00-12.00 PM

INSTRUCTION TO CANDIDATES

- **The examination has SIX (6) questions**
- **Question ONE (1) is COMPULSORY**
- **Choose any other THREE (3) questions from the remaining FIVE (5) questions**
- **Use sketch diagrams to illustrate your answer whenever necessary**
- **Do not carry mobile phones or any other written materials in examination room**
- **Do not write on this paper**

This paper consists of THREE (3) printed pages

please turn over



QUESTION ONE (COMPULSORY)

- (a) Define the term inertial frame of reference [1 mark]
- (b) Discuss the postulates of the special theory of relativity [4 marks]
- (c) Define Photoelectric effect [2 marks]
- (d) Describe a black body. [2 marks]
- (e) Calcium has a work function of 2.7eV, what is the maximum wavelength that will cause emission from calcium. [3 marks]
- (f) An electron which has been accelerated from rest through a p.d. of 250V. Calculate
- The speed [2 marks]
 - The de Broglie wavelength [2 marks]
- (g) What is the meaning of nuclear binding energy and how does it relate to the mass effect [2 marks]
- (h) A radioactive element has a decay constant $\lambda = 1.36 \times 10^{-11} \text{ s}^{-1}$, determine how long it takes for its mass to reduce from 2g to 1g [3 marks]
- (i) Show that the length of a 1meter stick would appear to reduce to near zero if it moves at a velocity approximately equal to that of light past a stationary observer [4 marks]

QUESTION TWO

- (a) Discuss the aspect of Rutherford's atomic model which contradicted the electromagnetic theory. [4 marks]
- (b) State the Bohr's postulate and discuss shortfalls of the Bohr's postulates [6 marks]
- (c) Show how de Broglie's wave theory predicts quantization of angular momentum of electron on any orbit of radius r. [5 marks]

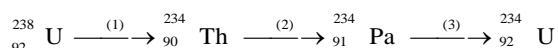
QUESTION THREE

- a) (i) Define the term Compton effect and state what does it demonstrates [3 marks]
- (ii) Calculate a shift in the wavelength of a photon scattered at an angle of 60° in the Compton Effect [4 marks]
- b) (i) Light of wavelength $5.0 \times 10^{-7} \text{ m}$ illuminates a metal whose work function is 2.0eV. Calculate the Maximum kinetic energy in joules of the emitted electrons [4 marks]
- (ii) Discuss two factors believed to be the cause of radioactivity of radioactive elements [4 marks]



QUESTION FOUR

- (a) (i) Discuss the Michelson-Morley experiment and explain the implication of its results [5 marks]
(ii) Using the inverse Lorentz transformation derive the formula for time dilation [5 marks]
- (b) (i) Differentiate between fission and fusion as used in radioactivity. [2 marks]
(ii) Part of the Uranium decay series is shown below



What particle is emitted at each decay? [3 marks]

QUESTION FIVE

- (a) Discuss the Davission –Germer experiment stating clearly what its result demonstrate [6 marks]
- (b) Describe how X-rays are produced in a modern X-ray tube, stating factors, which must be taken into consideration to generate X-rays of required quality [5 marks]
- (c) Discuss two factors believed to be the cause of radioactivity of radioactive elements [4 marks]

QUESTION SIX

- (a) Define the term nuclear mass defect [1 mark]
- (b) The solar spectrum has the approximate shape of a blackbody. The peak intensity is found at a wavelength of 4700\AA . Calculate the surface temperature of the sun [3 marks]
- (c) Show that the energy of an electron is given by $E = -\frac{me^4}{8\epsilon_0^2 n^2 h^2}$ (where $n = 1, 2, 3, \dots$) [7 marks]
- (d) Consider a sample with N undecayed nuclei. Show that for such a sample, the number of nuclei remaining after a time t is given as $N = N_0 e^{-\lambda t}$ where the symbols have their usual meaning. [4 marks]

