



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015**

COURSE NAME : MODERN PHYSICS
COURSE CODE : BWC 20403
PROGRAMME : 2 BWC
EXAMINATION DATE : DECEMBER 2014 / JANUARY 2015
DURATION : 2 1/2 HOURS
INSTRUCTION : ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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- Q1** (a) (i) Define photoelectric effect. (2 marks)
- (ii) Classify methods of electron emission in photoelectric effect. (3 marks)
- (b) Potassium is illuminated with ultraviolet light of wavelength 2500 \AA . If the work function of potassium is 2.21 eV , what is the maximum kinetic energy of the emitted electrons? If the ultraviolet light has an intensity of 2 W/m^2 , calculate the rate of electron emission per unit area. (5 marks)
- (c) (i) Determine the process of Compton effect. (4 marks)
- (ii) An X-ray of wavelength 0.300 \AA undergoes a 60° Compton scattering. Find the wavelength of the scattered photon and the energy of the electron after the scattering. (6 marks)
- Q2** (a) Write down the equation relating the energy, E of a photon to its frequency, f . Hence determine the equation relating the energy, E of a photon to its wavelength. (2 marks)
- (b) Calculate the wavelength in nm of electrons which have been accelerated from rest through a potential difference of 54 V . (3 marks)
- (c) To “observe” small objects, one measures the diffraction of particles whose de Broglie wavelength is approximately equal to the object’s size. Find the kinetic energy (in electron volts) required for electrons to resolve:
- (i) a large organic molecule of size 10 nm . (3 marks)

- (ii) a nucleus of size 10 fm. (3 marks)
- (iii) Repeat these calculations using alpha particles in place of electrons. (4 marks)
- (d) By drawing the schematic diagram, explain the failure of the classical Rayleigh–Jeans law to fit the observed spectrum of a blackbody heated to 1000 K. (5 marks)
- Q3** (a) (i) According to Bohr’s model of the atom, why do atoms emit or absorb radiation only at certain wavelengths. (2 marks)
- (ii) Provide reasons why Bohr’s model is so good and what is the disadvantage of Bohr’s model. (4 marks)
- (b) (i) Draw the spectrum series of Hydrogen atom. (4 marks)
- (ii) Calculate the wavelength for the first 3 transitions of the Lyman series and in what region of the spectrum does each of these transitions come. (3 marks)
- (c) (i) Derive De Broglie wavelength. (4 marks)
- (ii) Sommerfeld modified the Bohr’s theory. Clarify three issues argued by Sommerfeld on Bohr’s theory. (3 marks)
- Q4** (a) (i) Define the quantum number and subshell. (2 marks)

- (ii) Identify the difference between shell and subshell. Describe with suitable diagram. (4 marks)
- (b) (i) What is Pauli exclusion principle? Give example. (4 marks)
- (ii) Show the electronic configuration of the carbon atom and draw the corresponding orbital diagram. (3 marks)
- (c) (i) Describe the production of x-rays. (4 marks)
- (ii) Provide three properties of x-rays. (3 marks)

Q5 Depending on the target potential and the nature of the target element, two types of interaction occur between the incident electron beam and the target which result in the two types of x-ray spectra: Continuous spectrum and Characteristics spectrum. Compare this spectrum in terms of;

- (i) Process, (10 marks)
- (ii) Wavelength. (10 marks)

- END OF QUESTION -