Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	INTRODUCTION TO MODERN PHYSICS
COURSE CODE	:	DAU 24202
PROGRAMME CODE	:	DAU
EXAMINATION DATE	:	JANUARY / FEBRUARY 2022
DURATION	:	2 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSE BOOK**.

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 An electron with kinetic energy 2.53 MeV has been accelerated inside particle accelerator.

(i) Write Einstein's postulate in general relativity.

(5 marks)

(ii) Sketch the graph for relation between relativistic kinetic energy and velocity.

(5 marks)

(iii) Derive Lorentz factor equation determined by two observers watching a same event in two different frame reference.

(5 marks)

(iv) Find the total energy of electron according to relativistic theory.

(5 marks)

(v) Determine Lorentz factor of electron moves.

(5 marks)

Q2 An electron with a kinetic energy of 120 eV move across cathode ray.

(i) Define de Broglie relation and write the relation.

(5 marks)

(ii) Calculate the momentum of the electron.

(5 marks)

(iii) Find de Broglie wavelength of the electron.

(5 marks)

(iv) Write the expanded wave function $\Psi(x) = \Psi_0 e^{i(2\pi x - 5t)}$

(5 marks)

(v) State Heisenberg's uncertainty principle and write the relation.

(5 marks)

Q3 (a) Electron with energy 0.1 eV has been seen ejected on potassium (K) metal surface after being illuminated by certain radiation. Given the work function for potassium is 2.24 eV.

(i) Describe the concept of photon.

(3 marks)

(ii) Write relation of photoelectric effect.

(4 marks)

(iii) Calculate wavelength of incident radiation using photoelectric relation.

(5 marks)

(b) Electron in an X-ray tube accelerated so that it can produce X-rays. Given that X-ray generated at wavelength 0.100 nm.

(i) Write principle of X-ray production.

(4 mark)

(ii) Find minimum potential difference applied on the X-ray tube.

(3 marks)

(iii) State **two (2)** effects may occur by interaction of X-rays with matter.

(2 marks)

(iv) Explain the effects mentioned in **Q3 (b)(iii).**

(4 marks)

Q4 (a) Hydrogen lamp has been deployed to study spectral lines.

(i) Write Bohr postulate of atomic model.

(4 marks)

(ii) Briefly explain the maximum number of electron *f* orbital subshell.

(2 marks)

(iii) Find the shortest and longest wavelength present in Brackett series of spectral lines.

(8 marks)

(iv) Write **three (3)** main differences between classical and modern theory of light radiation.

(6 marks)

(v) Briefly explain the findings of Rutherford and Geiger Experiment.

(5 marks)

– END OF QUESTIONS –

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LIST OF FORMULAS

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$	$M = \frac{h_i}{h_o} = -\left\lvert\frac{d_i}{d_o}\right\rvert$
$E = \frac{hc}{\lambda} = hf$	$KE = (\gamma - 1)m_o c^2$
$n = \frac{c_0}{v}$	$n_1 \sin\theta_1 = n_2 \sin\theta_2$
$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$	$E^2 = m_o^2 c^4 + p^2 c^2$
$\frac{pc}{E} = \frac{v}{c}$	$E = \gamma m_o c^2$
$\lambda = \frac{h}{e}\sqrt{\frac{4\pi\varepsilon_o r}{m}}$	$v = \frac{e}{\sqrt{4\pi\varepsilon_o r}}$
$n\lambda = 2\pi r_n$	$2\pi r_n = \frac{nh}{e}\sqrt{\frac{4\pi\varepsilon_o r_n}{m}}$
$r_n = \frac{n^2 h^2 \varepsilon_o}{\pi m e^2}$	$r_n = n^2 a_o$
$E_n = -\frac{e^2}{8\pi\varepsilon_o r_n}$	$E_n = -\frac{me^4}{8\varepsilon_o^2 h^2}\left(\frac{1}{n^2}\right) = \frac{E_1}{n^2}$
$\frac{1}{\lambda} = -\frac{E_1}{hc}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$	$\Delta m = Z(m_H) + (A - Z)(m_n) - m_x$
$E_{rest\ mass} = mc^2$	$E_i - E_f = hf$

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LIST OF CONSTANTS

Avogadro's Number, $N_A = 6.023 \times 10^{23}$ atoms
Electron charge, $e = 1.6 \times 10^{19}C$
Electron mass, $m_e = 9.109 \times 10^{-31}kg$
Neutron mass, $m_n = 1.675 \times 10^{-27}kg$
Proton mass, $m_p = 1.673 \times 10^{-27}kg$
Atomic mass number, $u = 1.6605 \times 10^{-27}kg$
$= 931.5MeV$
Plank's Constant, $h = 6.626 \times 10^{-34}J$
Speed of light, $c = 3 \times 10^{8}ms^{-1}$
Electric constant permitivitty of free space, $\varepsilon = 1.6 \times 10^{-12}C^2/Nm^2$
Radius of the orbit contain wavelength, $r_n = 5.3 \times 10^{-1}$ m
Mass of electron $m_e = 9.1 \times 10^{-31}kg$