Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	MODERN PHYSICS
COURSE CODE	:	BWC 20403
PROGRAMME	:	2 BWC
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	2½ HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) What is photon?

(2 marks)

(b) Find the strength of the transverse magnetic field required to bend all the photoelectrons within a circle of radius 20 cm when light of wavelength 4000 Å is incident on a barium emitter. The work function of barium is 2.5 eV.

(6 marks)

(c) In the experiment of blackbody radiation, the radiation properties of the blackbody are independent of the particular material of which the container made. Show and explain the observations of the experiment.

(7 marks)

(d) Find the de Broglie wavelength of electron and proton having the same kinetic energy of 100 eV.

(5 marks)

Q2 (a) An electron traveling at 8×10^6 m/s enters that region of the Thomson e/m_e apparatus where the **E** and **B** fields coexist and are adjusted to be counter balancing. The **E** field is created by a parallel plate capacitor connected to a 91.1 V battery and having a 6.4 cm plate separation. If the **E** field is deactivated, what is the radius of the electron's circular arc through the counter balancing magnetic field?

(6 marks)

(b) In the Millikan oil-drop experiment consider a droplet having terminal velocity to fall 0.240 cm in 18 s with the **E** field deactivated. Find the radius of the droplet for $\rho_o = 891$ kg/m^3 and $\eta = 1.80 \times 10^{-5}$ kg/m • s.

(6 marks)

(c) Find the fraction of 7.7 MeV α particles that is deflected at an angle of 90° or more from a gold foil of 10^{-6} m thickness.

(8 marks)

Q3 (a) Atomic hydrogen in its lowest energy state absorbs a proton, raising the electron to an $n = 3$ state. If the life-time of the excited state is 10^{-10} s and the rudimentary assumption that the electron orbits around the proton, how many revolutions does the electron make in the excited state before returning to a lower energy state?

(7 marks)

(b) Calculate the wavelength for the $n_i = 3 \rightarrow n_f = 2$ transition (called the H_α line) for the atoms of hydrogen, deuterium and tritium.

(7 marks)

(c) Calculate the shortest wavelength that can be emitted by the Li^{++} ion.

(6 marks)

Q4 (a) What are the quantum numbers and names (for example 2s, 2p) of the orbital's in the $n = 4$ principal level?

(6 marks)

(b) Determine the wavelength of the light emitted when an electron in a hydrogen atom makes a transition from an orbital in $n = 6$ to an orbital in $n = 5$.

(8 marks)

(c) The shape of an atomic orbital is determined primarily by l, the angular momentum quantum number. Explain the probability density of finding the electron at a point in space.

(6 marks)

Q5 (a) A voltage applied to an X-ray being increased n times, the short wave limit of X-ray continuous spectrum shifts by $d\lambda = 26$ pm. If $n = 3/2$, find the initial voltage applied to the tube.

(5 marks)

(b) The K absorption edge of tungsten is 0.178 Å and the wavelength of K_α line is 0.210 Å. Determine the wavelength of L absorption edge.

(9 marks)

(c) Henry Moseley was undertaking a systematic study of the characteristic spectra of a large number of elements. Discuss the Moseley's Law.

(6 marks)

- END OF QUESTION –

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Constant Values:

Electron mass, $m_e = 9.1 \times 10^{-31} kg$

Proton mass, $m_p = 1.67 \times 10^{-27} kg$

Plank's constant, $h = 6.63 \times 10^{-34} J.s$

Dirac constant, $\hbar = 1.055 \times 10^{-34}\ J \cdot s$

Gold density, $\rho = 19.3\ \frac{g}{cm^3}$

Atomic number for gold, $Z = 79$

Atomic number for Li^{++}, $Z = 3$

Avogadro's number, $N_A = 6.02 \times 10^{23}\ \frac{molecules}{mole}$

Atomic masses for;

Hydrogen = 1.00728u,

Deuteron = 2.013553u,

Tritium = 3.015500u,

Gold = 197u