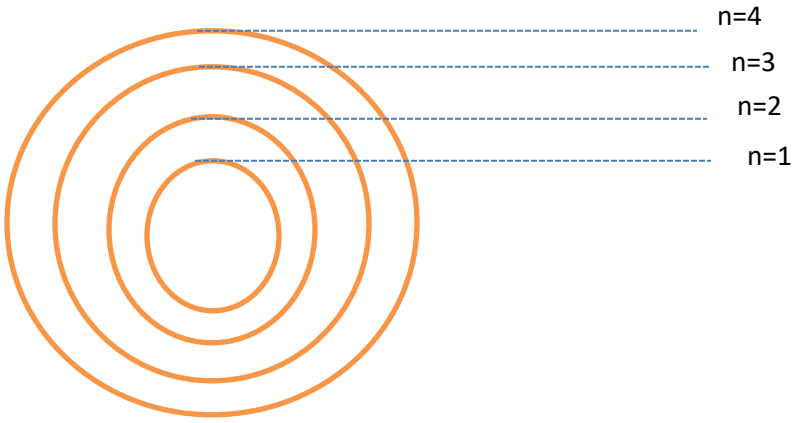
S.6 PHYSICS PAPER I REVISION QUESTIONS (13th AUG 2020

Assume where necessary;

- Speed of light, c in vacuum = 3.0 x$10^{8}$$ms^{-1}$
- Plank's constant ,h = 6.6 x 10-34Js
- Electron charge, e = 1.6 x10^{-19}C
- 1electron volt (eV) = 1.6 x 10^{-19}J
- Electron mass = 9.11 x 10^{-31}kg

1. (a) State Rutherford's model of the atom and outline the experimental evidence in support of the model.



(b) The diagram above depicts possible electron orbits in the Bohr model for the hydrogen atom. Assume the orbits are circular.

(i) Show that the total energy of an electron in an orbit of radius r is given by$E = \frac{-e^4}{8\pi\pi\varepsilon_0 r}$, where e is the electron charge.

(ii) If only the orbits are allowed for are those where by $mvr = \frac{nh}{2\pi}$,where m is the electron mass, v is the electron speed n an integer and h planck's constant. Show that the total energy in (i) above can be expressed as $E_n = \frac{-me^4}{8e^2h^2n^2}$.

(iv) Calculate the wavelength of the radiation that will be emitted when the electron makes a transition from $n = 4$ to $n = 3$.

2. The figure below shows some of the energy levels of a neon atom.

E_∞…….0.00eV

E_4…….-0.81eV

E_3…….-2.77eV

E_2…….-4.87eV

E_1…….-21.47eV

Calculate the wavelength of the electromagnetic radiation when an electron makes a transition from E_3 *to* E_2. State the region in which the radiation lies.

3. (a) (i) State Bohr's postulates of the hydrogen atom. (2 Marks)

(b)The diagram below shows possible electron orbits in the Bohr atom for hydrogen. Assuming the orbits are circular and that the total energy of the atom is

$E_n = -\frac{me^4}{8\varepsilon_0^{\,2} n^2 h}$, where m, is the Mass of an electron

e is the charge of an electron, n is the principle quantum number

h is Planck's constant, ε_o is the permittivity of free space.

Calculate the wavelength of the radiation that will be emitted when the electron

makes a Transition from n= 3 to n =2. (7 Marks)

(c) The energy levels in a mercury atom are -10.4 eV, -5.5 eV, -3.7 eV and -1.6 eV.

(i) Find the ionization energy of mercury in joules. (2 Marks)

(ii) What is likely to happen if a mercury atom in unexcited state is bombarded with an electron of energy 4.0 eV, 11.0 eV? (3 Marks)

(d) State the shortcomings of the Bohr' model.

4. (i) What is meant by photoelectric emission?

(ii) State the characteristics of photo electric emission.

(b) Describe a simple experiment to demonstrate photoelectric emission.

(c) Sodium has a work function of 2.3eV and is illuminated by light of wavelength 5.0 x 10-7m. Find the;

(i) threshold frequency of sodium. (1mark)

(ii) maximum velocity of the photoelectrons emitted. (3marks)

(iii) stopping potential with light of this wavelength. (3marks)

(d) (i) Explain any one application of photoelectric emission. (3marks)

(ii) Draw a sketch graph showing the variation of photo current with potential difference across a photocell for two different intensities but the same frequency of incident radiation. (2marks)