Quiz 10

Name: _____   Student Number: _____

CALCULATORS ALLOWED.

1. (4 marks) An alpha particle travels around a circular loop at 10% of the speed of light. The circular motion is due to a uniform magnetic field of 1 kG. What is the loop radius?

$$\frac{mv^2}{r} = qvB.$$

$$r = \frac{mv}{qB}$$

$$= \frac{4 \times 1.67 \times 10^{-27} kg \times 3 \times 10^{7} m/sec}{2 \times 1.6 \times 10^{-19} Coul \times 10^{-1} Tesla}$$

$$= 6.3 \ m.$$

2. (3 marks) Derive and evaluate an expression for the radius of a single electron orbiting an alpha particle.

Centripetal Force = Coulomb Force
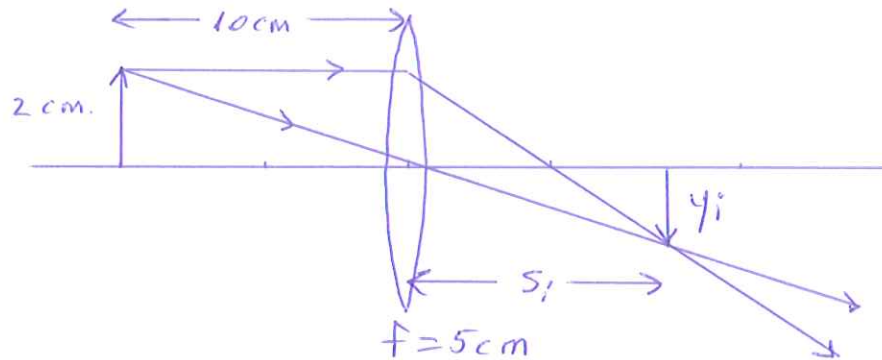
$$\frac{mv^2}{r} = \frac{k \, 2q^2}{r^2}$$

$$\frac{m^2 v^2 r^2}{mr} = 2kq^2$$

But $mvr = nh \Rightarrow r = \frac{n^2 h^2}{2mkq^2}$

For $n = 1 \Rightarrow r = \frac{(1.06 \times 10^{-34})^2}{2 \times 9.11 \times 10^{-31} \times 9 \times 10^{9} \times (1.6 \times 10^{-19})^2}$

$$= 2.68 \times 10^{-11} \ m = \frac{1}{2} \ Bohr \ Radius$$

3. (3 marks) Lens
   a) Draw the rays from the object through the lens that create the image.
   b) Find the image position.
   c) Find the image height.

$$\frac{1}{S_o} + \frac{1}{S_i} = \frac{1}{f}$$

$$\frac{1}{10} + \frac{1}{S_i} = \frac{1}{5}$$

$$\frac{1}{S_i} = \frac{1}{10}$$

$$S_i = 10 \, cm.$$

Image Height $\quad \dfrac{Y_i}{Y_o} = \dfrac{f}{S_o - f}$

$$Y_i = 2 \, cm. \quad \frac{5 \, cm}{10 - 5}$$

$$= 2 \, cm!$$