ASSIGNMENT 16

52 Marks Total

Part One: Cathode Rays and Thomson's Experiment

Part One of this assignment is worth 25 marks. The value of each question is noted in the left margin in parenthesis. Note: The answer areas will expand to fit the length of your response.

(2) **1.** What was the evidence that the cathode rays were particles with charge and mass?

Answer:

(3) **2.** What is the charge to mass ratio of a particle travelling 3.60×10^6 m/s that is deflected in an arc or radius 7.40 cm as it travels through a magnetic field of 0.610 T?

Answer:

(3) **3.** Some positively charged particles passed un-deflected through perpendicular magnetic and electric fields. If the magnetic field strength was 0.650 T and the electric field strength was 2.10×10^5 N/C, what was the speed of the particles?

Answer:

(3) **4.** Alpha particles travel through a magnetic field of 0.360 T and are deflected in an arc of 0.0820 m. Assuming the alpha particles are travelling perpendicular to the field, what is the kinetic energy of an individual alpha particle?

Answer:

(3) **5.** Using the charge of an electron (determined by Millikan in another experiment to be 1.60×10^{-19} C) and the charge to mass ratio of the electron (determined by Thomson to be 1.76×10^{11} C/kg), calculate the mass of an electron.

Answer:

6. A particle accelerated by a potential difference enters a velocity selector which consists of perpendicular magnetic and electric fields. The particle travels straight when the magnetic field is 0.400 T and the electric field is 6.30×10^5 V/m. Once the electric field is turned off, a sensor determines that the radius or the particle's path is 4.11 cm.

(3) a. What is the charge-to-mass ratio of this particle?

Answer:

(4) b. Calculate the charge-to-mass ratio of an alpha particle, electron and proton. Identify the particles used in the experiment from the calculations. Hint: check your data booklet for the charges and masses.

Answer:

(1) **7.** If you have not already done so, review the "*Then, Now, and the Future: The Mass Spectrometer*" section on page 759 of your physics textbook. Based on your understanding of mass spectrometers, answer the three following questions.

a. A uniform magnetic field in the detection chamber of a mass spectrometer causes ions to travel in a circular path. Create an equation for the radius of the path.

Answer:

(1) b. How is the radius of the path an ion makes in a detection chamber affected by the ion's mass?

Answer:

(2) c. Detail how you could use a mass spectrometer to determine if a professional baseball player used an illegal performance-boosting substance.

Answer:

STOP!

When you have completed all of the questions in Part One, save your work to your desktop. You will return to this assignment to complete Part Two after you have completed the remainder of the content in the next section.

Part Two: The Millikan Experiment

Part Two of this assignment is worth 27 marks. The value of each question is noted in the left margin in parenthesis. Note: The answer areas will expand to fit the length of your response.

(1) **1.** In his experiment, why was Millikan unable to use water to make the droplets?

Answer:

(2) **2.** Millikan's oil drop experiment resulted in the determination of the charge on the electron. Describe two other quantities determined for subatomic particles using the results of the experiment.

Answer:

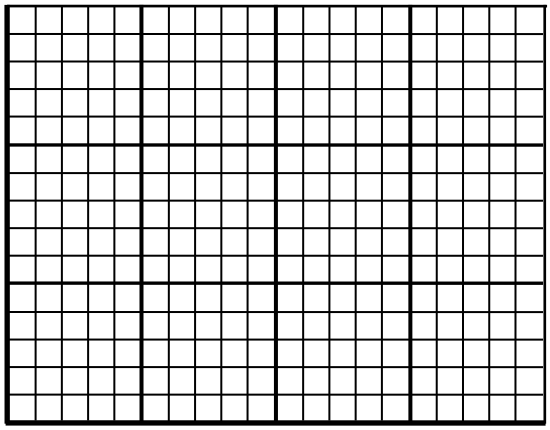
3. During a Millikan oil-drop experiment a student recorded the weight of five different droplets. She also recorded the electric field intensity needed to hold each droplet stationary between the horizontal charged plates.

Droplet Weight ($\times 10^{-14}$ N)	Electric Field Strength ($\times 10^{5}$ N/C)
1.70	1.10
5.60	3.50
6.10	3.80
2.90	1.80
4.00	2.50

(2)

a. Graph the recorded data.

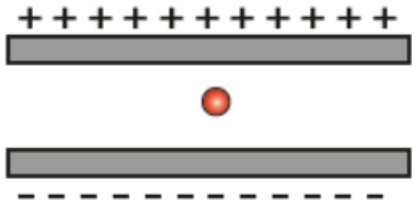
Answer:



(4) b. Using only the graph, determine elementary charge.

Answer:

4. In a Millikan-type experiment, two horizontal charged plates are 2.5 cm apart. A latex sphere of 1.3 x 10^{-15} kg remains stationary between the plates when the potential difference between the plates is 400 V. The upper plate is charged positive.



(1) a. What is the type of charge on the sphere?

Answer:

(2) b. What is the electric field intensity between the plates?

Answer:

(3) c. What is the charge on the sphere?

Answer:

(2) d. How many excess elementary charges are on the sphere?

Answer:

5. Two large, horizontal charged plates are separated by 0.050 m. A small plastic sphere is stationary and suspended between them. The sphere is experiencing an electric force of 4.5×10^{-15} N.

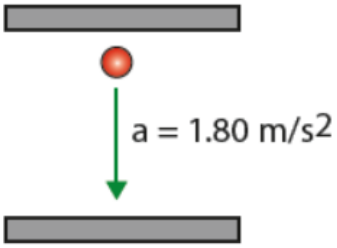
(2) a. What is the mass of the sphere?

Answer:

(3) b. If the sphere has four excess electrons, what is the potential difference between the plates?

Answer:

(5) **6.** A 1.50×10^{-14} kg oil drop accelerates downwards at a rate of 1.80 m/s^2 when placed between two horizontal plates that are 9.40 cm apart. The potential difference between the two plates is 980 V. Determine the magnitude of the charge on the oil drop. Show all work.



Answer:

When you have completed all of the questions in this assignment, submit your work.