

THIRD MIDTERM

3

Name: _____ Student ID #: _____

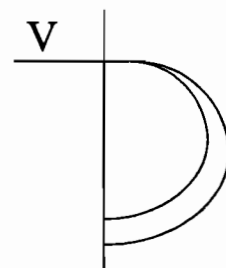
Discussion Instructor (circle): Eric Gary Jose Monica

SHOW ALL WORK!!!!

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

Use the conversion constants and data given on the front page.

A velocity selector is set up using an electric field of 10,000 V/m.



- (a) Calculate the magnetic field (in Tesla) necessary to select a velocity of 7.50×10^4 m/s.
 (b) Calculate the difference in the radii of two atoms at this velocity in a magnetic field perpendicular to their velocity of 0.912 T. The two atoms are ${}^{235}_{92}\text{U}$ and ${}^{238}_{92}\text{U}$. Each has one electron missing. (1 amu = 1.66×10^{-27} kg)

Ⓐ 10 points

$$F = F_E$$

$$qVB = qE$$

$$B = \frac{E}{c} = \frac{10^4 \text{ V/m}}{7.5 \times 10^4 \text{ m/s}} = 0.133 \frac{\text{V/s}}{\text{m}^2} = \boxed{.133 \text{ T}}$$

Ⓑ 15 points

$$\Sigma F = ma$$

$$F_B = \frac{mV^2}{R}$$

$$qVB = \frac{mV}{R}$$

$$\frac{mV}{qB} = R$$

Let $c = 1.66 \times 10^{-27} \frac{\text{kg}}{\text{amu}}$

$$m_1 = 238c$$

$$m_2 = 235c$$

$$m_1 - m_2 = 3c$$

so

$$R_1 - R_2 = \frac{m_1 V}{qB} - \frac{m_2 V}{qB} = \frac{V(m_1 - m_2)}{qB} = \frac{V(3c)}{qB} = \boxed{2.56 \times 10^{-3} \text{ m}}$$