



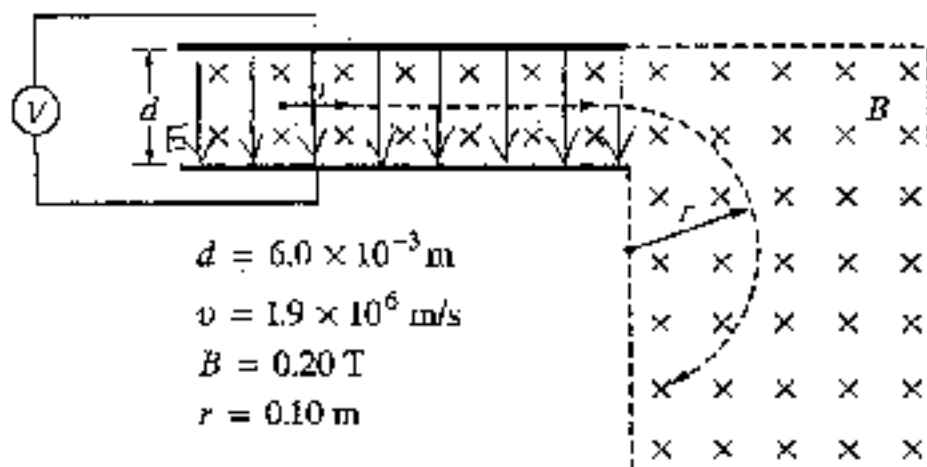
AP Physics B 2000 Student Samples

The materials included in these files are intended for non-commercial use by AP teachers for course and exam preparation; permission for any other use must be sought from the Advanced Placement Program. Teachers may reproduce them, in whole or in part, in limited quantities, for face-to-face teaching purposes but may not mass distribute the materials, electronically or otherwise. These materials and any copies made of them may not be resold, and the copyright notices must be retained as they appear here. This permission does not apply to any third-party copyrights contained herein.

These materials were produced by Educational Testing Service (ETS), which develops and administers the examinations of the Advanced Placement Program for the College Board. The College Board and Educational Testing Service (ETS) are dedicated to the principle of equal opportunity, and their programs, services, and employment policies are guided by that principle.

The College Board is a national nonprofit membership association dedicated to preparing, inspiring, and connecting students to college and opportunity. Founded in 1900, the association is composed of more than 3,900 schools, colleges, universities, and other educational organizations. Each year, the College Board serves over three million students and their parents, 22,000 high schools, and 3,500 colleges, through major programs and services in college admission, guidance, assessment, financial aid, enrollment, and teaching and learning. Among its best-known programs are the SAT[®], the PSAT/NMSQT[™], the Advanced Placement Program[®] (AP[®]), and Pacesetter[®]. The College Board is committed to the principles of equity and excellence, and that commitment is embodied in all of its programs, services, activities, and concerns.

Copyright © 2001 by College Entrance Examination Board. All rights reserved. College Board, Advanced Placement Program, AP, and the acorn logo are registered trademarks of the College Entrance Examination Board.



7. (10 points)

A particle with unknown mass and charge moves with constant speed $v = 1.9 \times 10^6 \text{ m/s}$ as it passes undeflected through a pair of parallel plates, as shown above. The plates are separated by a distance $d = 6.0 \times 10^{-3} \text{ m}$, and a constant potential difference V is maintained between them. A uniform magnetic field of magnitude $B = 0.20 \text{ T}$ directed into the page exists both between the plates and in a region to the right of them as shown. After the particle passes into the region to the right of the plates where only the magnetic field exists, its trajectory is circular with radius $r = 0.10 \text{ m}$.

(a) What is the sign of the charge of the particle? Check the appropriate space below.

☐ Positive ☒ Negative ☐ Neutral ☐ It cannot be determined from this information.

Justify your answer.

using the 2nd right hand rule

$\otimes \rightarrow v$... Force would be upward for (+) particle.
but force is downward on this particle, so, it is negative

(b) On the diagram above, clearly indicate the direction of the electric field between the plates.

(c) Determine the magnitude of the potential difference V between the plates.

$$E = \frac{V}{d} \quad V = Ed$$

$$E = \frac{F}{q} = \frac{Bqv}{q} = (0.20)(1.9 \times 10^6) = 3.8 \times 10^5$$

$$V = (3.8 \times 10^5)(6.0 \times 10^{-3})$$

$$= 2.28 \times 10^3 \text{ V}$$

GO ON TO THE NEXT PAGE.

(d) Determine the ratio of the charge to the mass (q/m) of the particle.

$$F = Bq v = \frac{mv^2}{r}$$

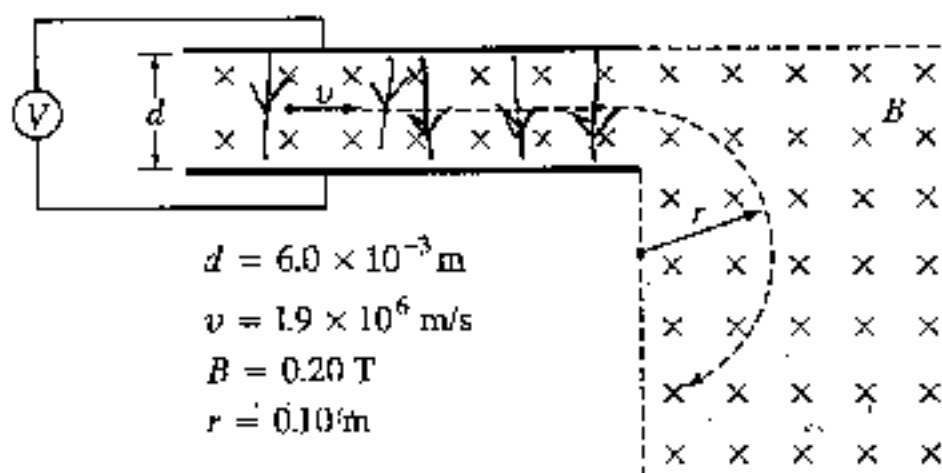
$$Bq = \frac{mv}{r}$$

$$\frac{q}{m} = \frac{v}{Br} = \frac{(1.9 \times 10^6)}{(0.20)(0.10)}$$

$$\frac{q}{m} = 9.5 \times 10^7 \text{ C/kg} //$$

END OF EXAMINATION

- MAKE SURE YOU HAVE COMPLETED THE IDENTIFICATION INFORMATION AS REQUESTED ON THE BACK COVER OF THIS BOOKLET.
- CHECK TO SEE THAT YOUR AP NUMBER APPEARS IN THE TWO BOXES ON THE BACK COVER (TOP LEFT AND RIGHT).
- MAKE SURE YOU HAVE USED THE SAME SET OF AP NUMBER LABELS ON ALL AP EXAMINATIONS YOU HAVE TAKEN THIS YEAR.



7. (10 points)

A particle with unknown mass and charge moves with constant speed $v = 1.9 \times 10^6 \text{ m/s}$ as it passes undeflected through a pair of parallel plates, as shown above. The plates are separated by a distance $d = 6.0 \times 10^{-3} \text{ m}$, and a constant potential difference V is maintained between them. A uniform magnetic field of magnitude $B = 0.20 \text{ T}$ directed into the page exists both between the plates and in a region to the right of them as shown. After the particle passes into the region to the right of the plates where only the magnetic field exists, its trajectory is circular with radius $r = 0.10 \text{ m}$.

(a) What is the sign of the charge of the particle? Check the appropriate space below.

☐ Positive ☒ Negative ☐ Neutral ☐ It cannot be determined from this information.

Justify your answer.

Using the right hand rule if the particle was positive, when it entered the field headed into the paper the force would be up, but since the particle at first moves in the opposite direction it must be negative.

(b) On the diagram above, clearly indicate the direction of the electric field between the plates.
force of Field opposes magnetic on negative particle

(c) Determine the magnitude of the potential difference V between the plates.

force due to Electric is equal to force of magnetic

$$F = E \cdot q \quad E = \frac{V}{d} \quad F = q \cdot v \cdot B$$

$$F = -\frac{Vq}{d}$$

two forces are equal $-\frac{Vq}{d} = q \cdot v \cdot B$ q cancels out

GO ON TO THE NEXT PAGE.

$$V = -2280 \text{ V} \quad -V = -6.0 \times 10^{-3} \text{ m} \cdot 1.9 \times 10^6 \text{ m/s} \cdot 0.2 \text{ T}$$

(d) Determine the ratio of the charge to the mass (q/m) of the particle.

$$m \frac{v^2}{r} = qvB$$

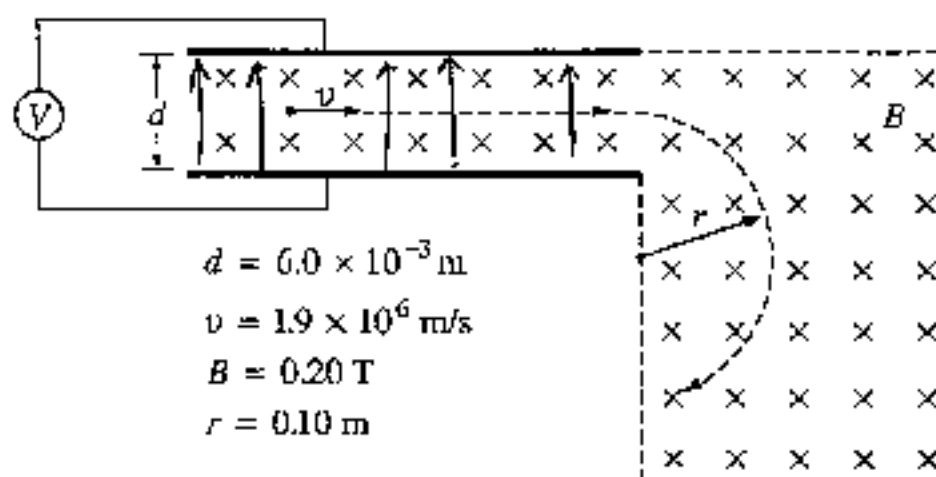
$$m \frac{(1.9 \times 10^6 \text{ m/s})^2}{.1 \text{ m}} = q \cdot 1.9 \times 10^6 \text{ m/s} \cdot .2 \text{ T}$$

$$m \cdot 3.6 \times 10^{13} = 3.8 \times 10^5 q$$

$$\frac{q}{m} = 1.0 \times 10^{-8}$$

END OF EXAMINATION

- MAKE SURE YOU HAVE COMPLETED THE IDENTIFICATION INFORMATION AS REQUESTED ON THE BACK COVER OF THIS BOOKLET.
- CHECK TO SEE THAT YOUR AP NUMBER APPEARS IN THE TWO BOXES ON THE BACK COVER (TOP LEFT AND RIGHT).
- MAKE SURE YOU HAVE USED THE SAME SET OF AP NUMBER LABELS ON ALL AP EXAMINATIONS YOU HAVE TAKEN THIS YEAR.



7. (10 points)

A particle with unknown mass and charge moves with constant speed $v = 1.9 \times 10^6 \text{ m/s}$ as it passes undeflected through a pair of parallel plates, as shown above. The plates are separated by a distance $d = 6.0 \times 10^{-3} \text{ m}$, and a constant potential difference V is maintained between them. A uniform magnetic field of magnitude $B = 0.20 \text{ T}$ directed into the page exists both between the plates and in a region to the right of them as shown. After the particle passes into the region to the right of the plates where only the magnetic field exists, its trajectory is circular with radius $r = 0.10 \text{ m}$.

(a) What is the sign of the charge of the particle? Check the appropriate space below.

☒ Positive ☒ Negative ☐ Neutral ☐ It cannot be determined from this information.

Justify your answer.

A positively charged particle would curve upward based on the right hand rule for this situation. This turns downward.

(b) On the diagram above, clearly indicate the direction of the electric field between the plates.

(c) Determine the magnitude of the potential difference V between the plates.

$$E = \frac{V}{d}$$

$$V = Ed$$

$$V = (2280 \text{ C})(6 \times 10^{-3} \text{ m})$$

$$= 13.68 \text{ V}$$

$$E = Blv$$

$$E = (0.2 \text{ T})(6 \times 10^{-3} \text{ m})(1.9 \times 10^6 \text{ m/s})$$

$$E = 2280 \text{ C}$$

- (d) Determine the ratio of the charge to the mass (q/m) of the particle.

END OF EXAMINATION

- **MAKE SURE YOU HAVE COMPLETED THE IDENTIFICATION INFORMATION AS REQUESTED ON THE BACK COVER OF THIS BOOKLET.**
- **CHECK TO SEE THAT YOUR AP NUMBER APPEARS IN THE TWO BOXES ON THE BACK COVER (TOP LEFT AND RIGHT).**
- **MAKE SURE YOU HAVE USED THE SAME SET OF AP NUMBER LABELS ON ALL AP EXAMINATIONS YOU HAVE TAKEN THIS YEAR.**