

This print-out should have 15 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering. The due time is Central time.

Please notice that for your homework to be considered towards your grade, it needs to be submitted one hour before the corresponding recitation starts. Work submitted after this time, but before the DUE DATE on top of this page, will be accepted but not graded.

PLEASE REMEMBER THAT YOU MUST CARRY OUT YOUR CALCULATIONS TO AT LEAST THREE SIGNIFICANT FIGURES. YOUR ANSWER MUST BE WITHIN ONE PERCENT OF THE CORRECT RESULT TO BE MARKED AS CORRECT BY THE SERVER.

Particle Deflection 01

29:01, trigonometry, multiple choice, > 1 min, wording-variable.

001

A positively charged particle moving parallel to the z -axis enters a magnetic field (pointing into of the page), as shown in the figure below.

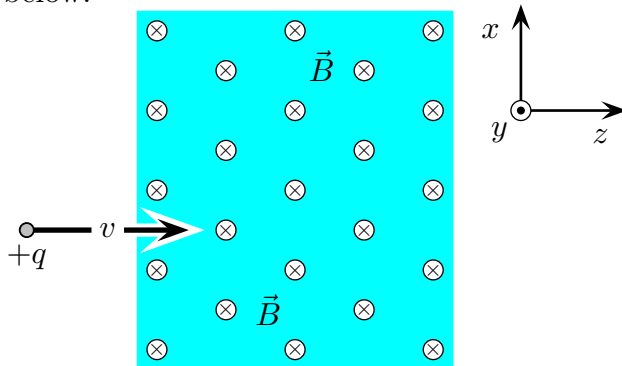


Figure: \hat{i} is in the x -direction, \hat{j} is in the y -direction, and \hat{k} is in the z -direction.

What is the initial direction of deflection?

1. $\hat{F} = +\hat{i}$
2. $\hat{F} = -\hat{i}$
3. $\hat{F} = +\hat{k}$

4. $\hat{F} = -\hat{k}$

5. $\hat{F} = +\hat{j}$

6. $\hat{F} = -\hat{j}$

7. $\vec{F} = 0$; no deflection

Particle Deflection 02

29:01, trigonometry, multiple choice, > 1 min, wording-variable.

002

A positively charged particle moving at 45° angles to both the z -axis and x -axis enters a magnetic field (pointing out of the page), as shown in the figure below.

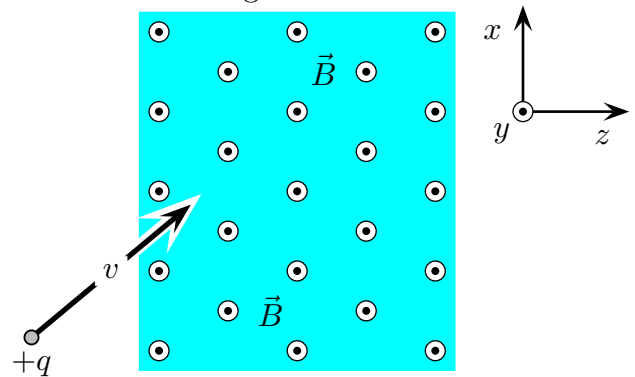


Figure: \hat{i} is in the x -direction, \hat{j} is in the y -direction, and \hat{k} is in the z -direction.

What is the initial direction of deflection?

1. $\hat{F} = \frac{1}{\sqrt{2}} (-\hat{i} + \hat{k})$
2. $\hat{F} = \frac{1}{\sqrt{2}} (+\hat{i} - \hat{k})$
3. $\hat{F} = \frac{1}{\sqrt{2}} (-\hat{i} - \hat{k})$
4. $\hat{F} = \frac{1}{\sqrt{2}} (-\hat{i} + \hat{j})$
5. $\hat{F} = \frac{1}{\sqrt{2}} (+\hat{i} - \hat{j})$
6. $\hat{F} = \frac{1}{\sqrt{2}} (-\hat{i} - \hat{j})$
7. $\hat{F} = \frac{1}{\sqrt{2}} (-\hat{j} + \hat{k})$

$$8. \hat{F} = \frac{1}{\sqrt{2}} (+\hat{j} - \hat{k})$$

$$9. \hat{F} = \frac{1}{\sqrt{2}} (-\hat{j} - \hat{k})$$

10. $\vec{F} = 0$; no deflection

Particle Deflection 03

29:01, trigonometry, multiple choice, > 1 min, wording-variable.

003

A negatively charged particle moving at 45° angles to both the z -axis and x -axis enters a magnetic field (pointing out of the page), as shown in the figure below.

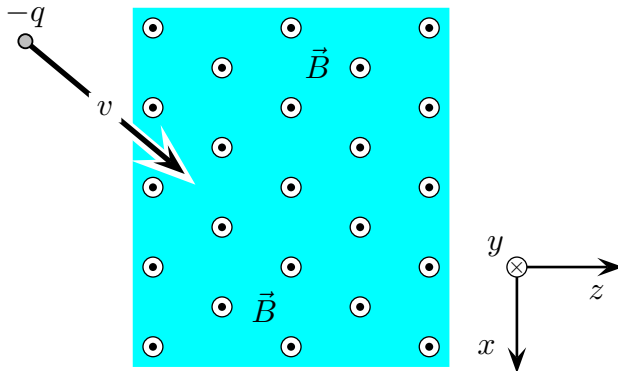


Figure: \hat{i} is in the x -direction, \hat{j} is in the y -direction, and \hat{k} is in the z -direction.

What is the initial direction of deflection?

$$1. \hat{F} = \frac{1}{\sqrt{2}} (-\hat{i} + \hat{k})$$

$$2. \hat{F} = \frac{1}{\sqrt{2}} (+\hat{i} - \hat{k})$$

$$3. \hat{F} = \frac{1}{\sqrt{2}} (+\hat{i} + \hat{k})$$

$$4. \hat{F} = \frac{1}{\sqrt{2}} (-\hat{i} + \hat{j})$$

$$5. \hat{F} = \frac{1}{\sqrt{2}} (+\hat{i} - \hat{j})$$

$$6. \hat{F} = \frac{1}{\sqrt{2}} (+\hat{i} + \hat{j})$$

$$7. \hat{F} = \frac{1}{\sqrt{2}} (-\hat{j} + \hat{k})$$

$$8. \hat{F} = \frac{1}{\sqrt{2}} (+\hat{j} - \hat{k})$$

$$9. \hat{F} = \frac{1}{\sqrt{2}} (+\hat{j} + \hat{k})$$

10. $\vec{F} = 0$; no deflection

Particle Deflection 04

29:01, trigonometry, multiple choice, > 1 min, wording-variable.

004

A negatively charged particle moving parallel to the y -axis enters a magnetic field (pointing toward the top of the page), as shown in the figure below.

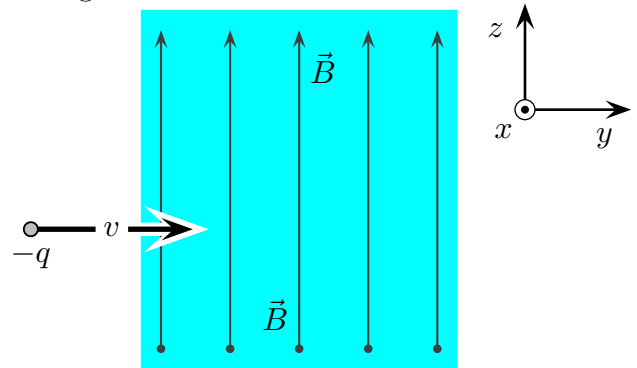


Figure: \hat{i} is in the x -direction, \hat{j} is in the y -direction, and \hat{k} is in the z -direction.

What is the initial direction of deflection?

$$1. \hat{F} = -\hat{i}$$

$$2. \hat{F} = +\hat{i}$$

$$3. \hat{F} = +\hat{j}$$

$$4. \hat{F} = -\hat{j}$$

$$5. \hat{F} = +\hat{k}$$

$$6. \hat{F} = -\hat{k}$$

7. $\vec{F} = 0$; no deflection

Electron in a Field 03

29:01, trigonometry, numeric, > 1 min, normal.

005

The magnetic field over a certain range is

given by $\vec{B} = B_x \hat{i} + B_y \hat{j}$, where $B_x = 2$ T and $B_y = 3$ T. An electron moves into the field with a velocity $\vec{v} = v_x \hat{i} + v_y \hat{j} + v_z \hat{k}$, where $v_x = 4$ m/s, $v_y = 5$ m/s and $v_z = 6$ m/s.

The charge on the electron is -1.602×10^{-19} C.

What is the \hat{i} component of the force exerted on the electron by the magnetic field? Answer in units of N.

006

What is the \hat{j} component of the force? Answer in units of N.

007

What is the \hat{k} component of the force? Answer in units of N.

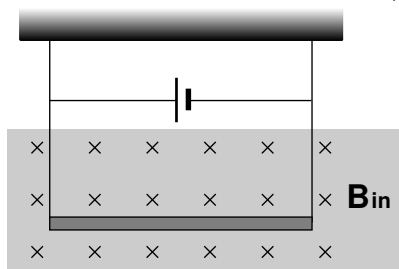
Suspended Conductor

29:03, trigonometry, numeric, > 1 min, normal.

008

A conductor suspended by two flexible wires as in the figure has a mass per unit length of 0.4 kg/m.

The acceleration of gravity is 9.8 m/s².



What current must exist in the conductor in order for the tension in the supporting wires to be zero when the magnetic field is 3.6 T into the page? Answer in units of A.

Electron in a Circular Path

29:10, trigonometry, numeric, > 1 min, normal.

009

An electron enters a region of uniform magnetic field and is observed to execute circular motion, completing 100 revolutions in $\Delta T = 0.5$ μ s.

The mass of the electron is 9.10939×10^{-31} kg and its charge is 1.60218×10^{-19} C.

Calculate the magnitude of the magnetic field in this region. Answer in units of mT.

AP EM 1993 FR 3

29:11, trigonometry, numeric, > 1 min, normal.

010

A mass spectrometer, constructed as shown in the diagram, is to be used for determining the mass of singly ionized positively charged ions.

There is a uniform magnetic field 0.2 T perpendicular to the page \hat{k} throughout the diagram. A potential difference 1500 V is applied across the parallel plates L and K , which are separated by a distance 1.2 cm and which act as a velocity selector.

The proton charge is 1.60217×10^{-19} C.

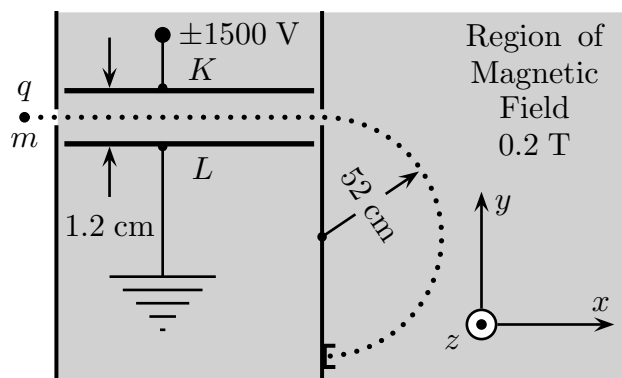


Figure: \hat{i} is in the direction $+x$ (to the right), \hat{j} is in the direction $+y$ (up the page), and \hat{k} is in the direction $+z$ (out of the page).

In which direction (relative to the coordinate system shown above) should the magnetic field point in order for positive ions to move along the path shown by the dotted line in the diagram above?

1. $\frac{\vec{B}}{\|\vec{B}\|} = +\hat{k}$
2. $\frac{\vec{B}}{\|\vec{B}\|} = +\hat{i}$
3. $\frac{\vec{B}}{\|\vec{B}\|} = -\hat{i}$

$$4. \frac{\vec{B}}{\|\vec{B}\|} = +\hat{j}$$

$$5. \frac{\vec{B}}{\|\vec{B}\|} = -\hat{j}$$

$$6. \frac{\vec{B}}{\|\vec{B}\|} = -\hat{k}$$

011

Should plate K have a positive or negative voltage polarity with respect to grounded plate L ?

1. Negative
2. Positive
3. Voltage should be zero.

012

Calculate the magnitude of the electrical field between the plates. Answer in units of V/m.

013

Calculate the speed of a particle that can pass between the parallel plates without being deflected. Answer in units of m/s.

014

Calculate the mass of a hypothetical singly charged ion that travels in a semicircle of radius $R = 52$ cm. Answer in units of kg.

015

A doubly ionized positive ion of the same mass and velocity as the singly charged ion enters the mass spectrometer.

What is the radius of its path? Answer in units of m.