Unit 3 You Tube Solved Examples

Magnetic force on a moving charged particle

An alpha particle (2 protons and 2 neutrons) is traveling with a velocity of $\vec{v} = \left(0.500\hat{\imath} + 1.00\hat{\jmath} + 1.00\hat{k}\right) \times 10^6 \frac{m}{s}$ in a magnetic field $\vec{B} = \left(-0.500\hat{\imath} + 0.300\hat{\jmath} + 0.800\hat{k}\right) \times 10^{-3} T$.

a) What is the force on the alpha particle?
b) What is the angle between the velocity and the magnetic field?
c) Briefly describe the trajectory of the alpha particle in the magnetic field.

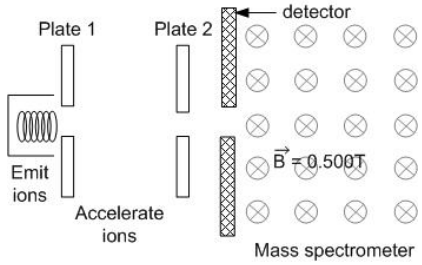
YouTube: http://youtu.be/NA9qxFbTqQA

Accelerated particles and mass spectrometer

Negative, singly ionized atoms of carbon 12 and of carbon 14 are accelerated through a potential difference of 5.74 kV. They are then deflected in a magnetic field of 0.500 T.

a) To they hit the top plate or the bottom plate of the detector?

b) How far apart are the carbon 12 and the carbon 14 ions at the detector?



YouTube: http://youtu.be/c2GdOSFMNkg

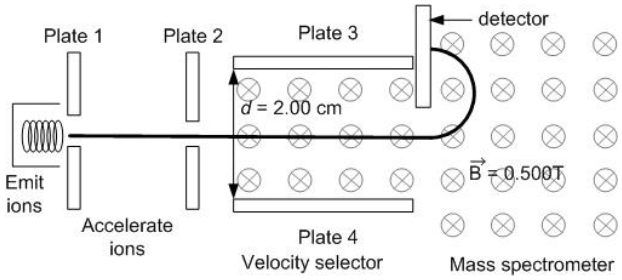
Mass spectrometer

An accelerator, velocity selector and mass spectrometer are used to analyze the carbon 12 and carbon 14 content of a sample. The carbon is positively, singly ionized.

a) You want the distance between the carbon 12 and carbon 14 at the detector to be 1 inch (2.54 cm). With what speed must the particles enter the magnetic field of the mass spectrometer?

b) What accelerating voltage is required to accelerate the carbon 12 to the correct speed, and what accelerating voltage is required to accelerate the carbon 14 to the correct speed?

c) What voltage is required across the plates of the velocity selector? Does it need to be readjusted carbon 14?



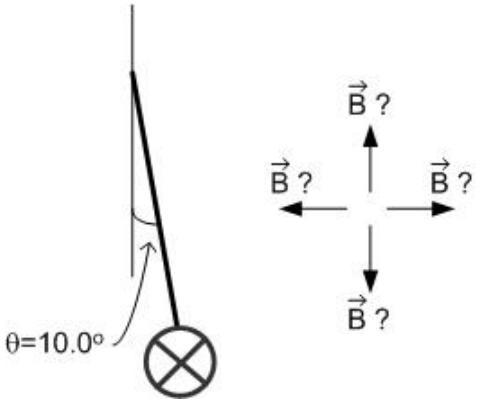
YouTube: http://youtu.be/YCNi1J2Mdso

Force on a wire in a magnetic field

A copper rod with mass per unit of length λ=0.954 kg/m carries a current of 15.0 A into the page. The rod is in a uniform magnetic field and hangs at an angle of 10.0° from the vertical.

a) What is the direction of the magnetic field? (it can only be in the 4 directions on the pictures)

b) What is the magnitude of the magnetic field?



YouTube: http://youtu.be/w3JIkTO6g2I

Magnetic field of long wires

A very long wire carries a current of 5.00 A in the +z-direction (out of the page). Another very long wire, 3.00 cm to the right of the first wire, carries a current of 10.0 A in the +z-direction. What is the net magnetic field (magnitude and direction) 2.00 cm above the first wire?

YouTube: http://youtu.be/NsIeoG_TbEI

Magnetic forces between current-carrying wires

Wire 1 carries a current of 15.0 A from the bottom to the top of the page.

Wire 2, parallel to wire 1, is placed 5.00 cm to the right of wire 1, and carries a current of 5.00 A in the opposite direction (from the top to the bottom of the page).

Wire 3 carries a current in the same direction as wire 1. The net force on wire 3 is zero. Where is it?

YouTube: http://youtu.be/epLI3u9mJqw

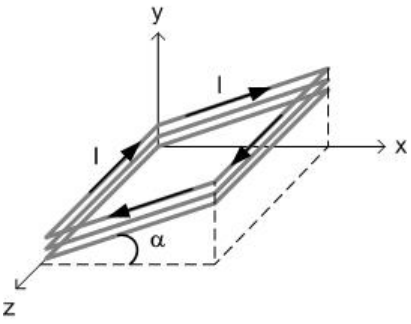
Magnetic torque on a current-carrying coil

A square coil is made of 10.0 turns with sides of 4.47 cm, and carries a current of 1.50 A in the direction indicated. The coil is placed with one side along the z-axis and inclined at 26.5° from the x- to the y- axis.

a) What are the magnitude and the direction of the magnetic moment of the coil?

b) What is the magnetic torque on the coil if it is in a uniform magnetic field of 5.00 mT that points 160° from the x- axis (the magnetic field has no z- component).

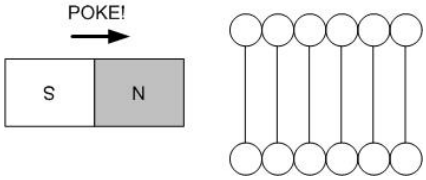
c) What is the magnetic torque on the coil if it lies in a magnetic field $\vec{B} = (5.00\hat{\imath} - 5.00\hat{\jmath} + 5.00\hat{k})$mT ?



YouTube: http://youtu.be/MosMfPI1MNA

Induced current

A magnet is poked north pole first into a solenoid. Determine the direction in which the induced current flows and whether the magnet and the solenoid attract each other or repel each other.

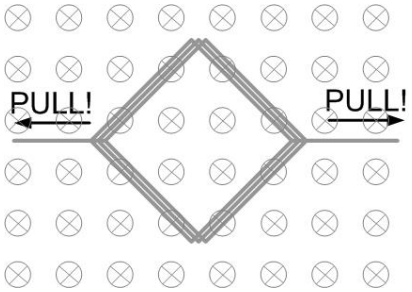


YouTube: http://youtu.be/Q_7ZjZqrN0k

Induced current

A square coil is made of 10.0 turns and has a side of length 10.0 cm. The coil lies in a 1.00T-magnetic field that points into the page. The coil is flattened by pulling the sides in 0.200 s. The coil's resistance is 10.0Ω. What is the magnitude and the direction of the induced current?

YouTube: http://youtu.be/RJZ67-aBND8

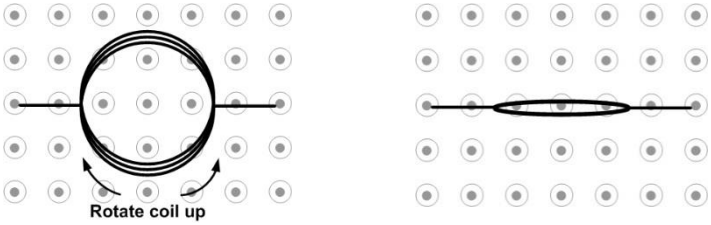


Induced emf

A circular, 20.0-turn coil has a diameter 7.50 cm. It lies in a uniform magnetic field of 0.100 T that points out of the page. The coil is rotated ¼ turn, from perpendicular until it is parallel to the field.

a) How quickly must this be done for the average emf to be 1.50V, and which way does the induced current flow?

b) You have a power supply that can deliver a maximum of 5.00 A. Design an apparatus that can produce the uniform magnetic field in this problem.

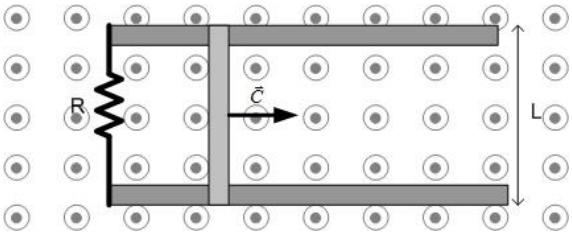


YouTube: http://youtu.be/mubvkqPjWUA

Motional emf, (slide-wire generator)

A 1.50-m long metal bar is pulled to the right at a steady 5.00 m/s perpendicular to a uniform, 0.750 T magnetic field directed out of the page. The parallel metal rails are connected through a 25.0-Ω resistor. You may ignore the resistance of the bar and of the rails.

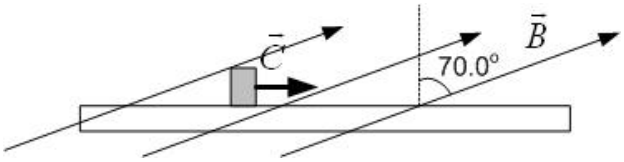
a. What is the force $\vec{C}$ required to keep the bar moving at a constant velocity of 5.00 m/s?



b. At what rate is energy dissipated in the resistor?

c. On the picture, indicate the positive and negative ends of the metal bar and the direction in which current flows in the resistor

d. What is the current in the resistor if the magnetic field is not perpendicular to the page, but at an angle of 70.0° from the vertical? (the bar is still moving at 5m/s)



YouTube: https://youtu.be/Re_sWrOvQZg