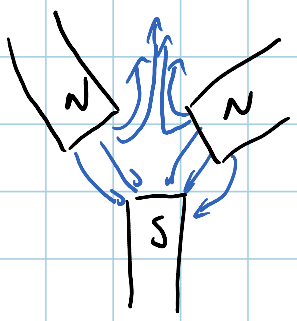
Magnetic Force

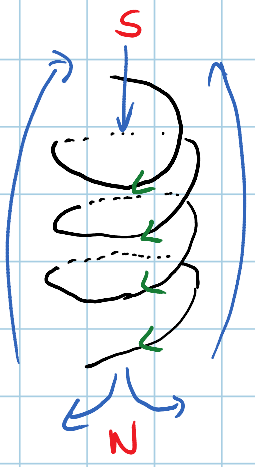
Monday, December 16, 2013
1:50 PM

Review Questions: Draw the $\bar{B}$ field for the following

a)



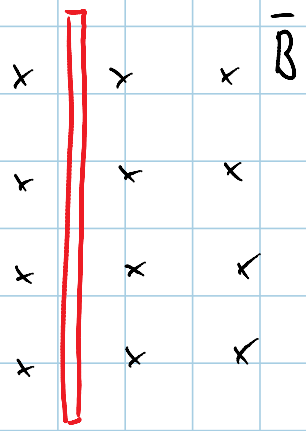
b)



Which end is North

$F_m = B \cdot I \cdot \ell$

I is like a moving charge

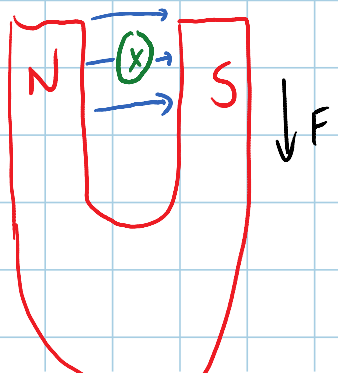


$$F_m = B\,I \cdot \ell$$
$$= B\left(\frac{Q}{t}\right)\ell$$
$$= B\,Q\,\frac{\ell}{t}$$
$$= B\,Q\,v$$
$$F_m = Q\,v\,B$$

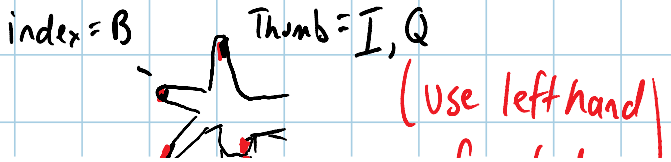
B ← mag of $\bar{B}$ field

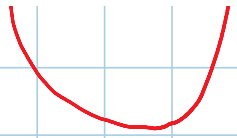
Q ← moving charge

v ← velocity of charge



The R.H.R determines the direction of force for current/positive charge





(use left hand for electron)

Magnetic Field and ...

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PHYSICS 12

NAME: _____

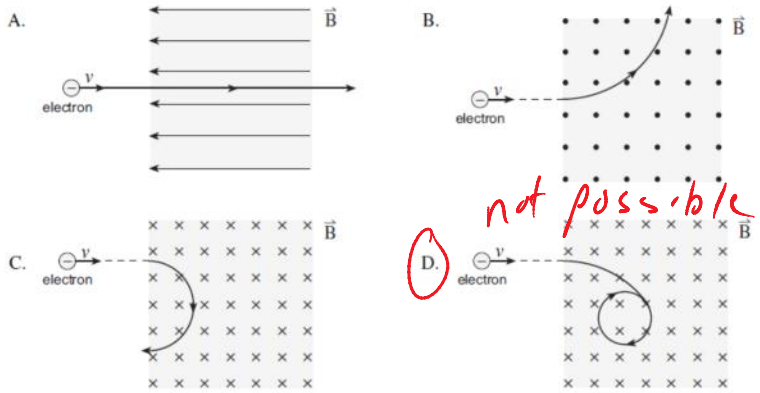
Magnetic Field and Force

1. An aircraft whose wingspan is 15 m carries a static charge of 0.60 C. It travels at 240 m/s perpendicular to a 1.5×10^{-4} T magnetic field. What magnetic force does the aircraft experience?

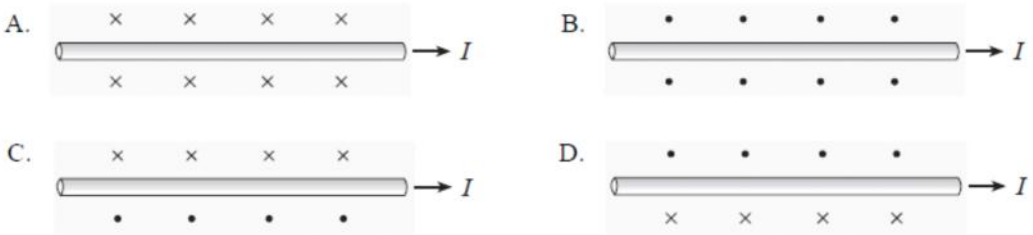
$F_m =$ $F = QvB$

B, v, Q $= (0.6\,C)(240\,m/s)(1.5 \times 10^{-4}\,T) = .0216\,N$

2. An electron, travelling with a constant velocity, enters a region of uniform magnetic field. Which of the following is **not** a possible pathway?

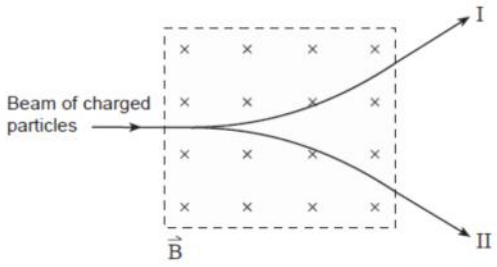


3. Which diagram shows the magnetic field created near a conductor carrying current towards the right?



4. A proton is travelling at 2.3×10^6 m/s in a circular path in a 0.75 T magnetic field. What is the magnitude of the force on the proton?

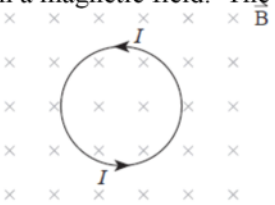
5. A beam of positively and negatively charged particles enters a magnetic field as shown. Which paths illustrate the positive and negative charges leaving the magnetic field region?



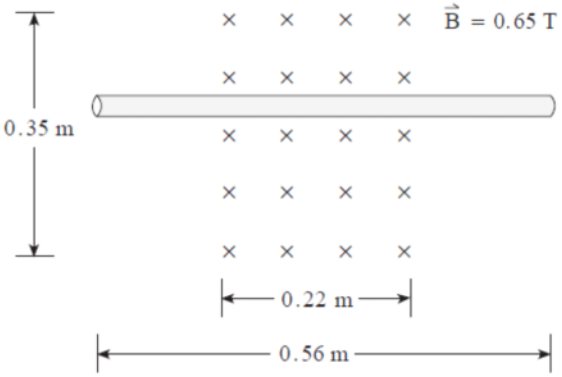
PATH OF POSITIVE CHARGES	PATH OF NEGATIVE CHARGES
I	I
I ✓	II ✓
II	I
II	II

6. The diagram shows a conductor between a pair of magnets. The current in the conductor flows out of the page. In what direction will the magnetic force act on the conductor?

7. The diagram shows current *I* flowing in a circular coil located in a magnetic field. The magnetic force acting on the coil will tend to cause it to…
   A. expand.
   B. contract.
   C. move up the page.
   D. move down the page.



8. A long conductor is placed in a 0.65 T magnetic field as shown below. What is the direction of the current that produces a 1.6 N force on the wire directed up the page?



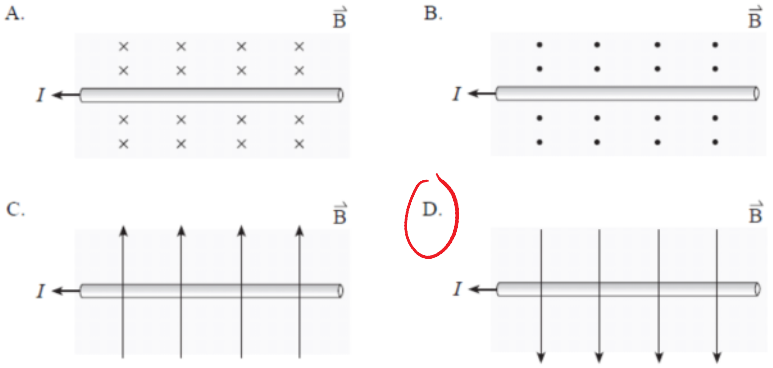
9. An electron travelling at a high speed enters a magnetic field as shown. A proton travelling at the same speed then enters the magnetic field.

mass?

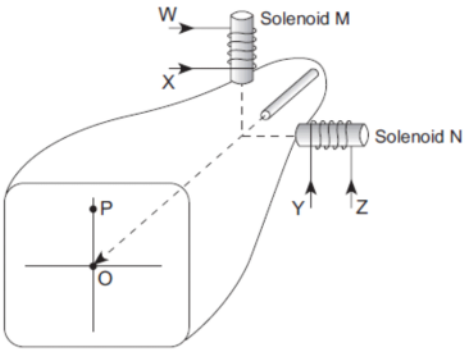
Which of the six choices best illustrates the path the proton will follow?
Using principles of physics, explain why the proton takes the path selected in a).

10. A proton has a speed of 5.0×10^6 m/s while travelling perpendicular to a 0.14 T magnetic field. What is the magnetic force on the proton?

11. In which diagram would the current-carrying conductor experience a magnetic force out of the page?



12. When there is no current in the solenoids, the electron beam in the cathode ray tube strikes the screen at the origin O. In order to move the beam to position P, which solenoid is used and what is the direction of the current applied?



	SOLENOID	CURRENT DIRECTION
A.	M	W
B.	M	X
C.	N	Y
D.	N	Z

13. Determine the magnitude and direction of the force on an electron travelling 2.84×10^5 m/s horizontally to the east in a vertically upward magnetic field strength of 1.60 T.

14. A particle with a charge of 4.0×10^{-8} C moves at a speed of 2.0×10^2 m/s through a magnetic field in the direction at which the magnetic force on the particle is maximum. If the force on the particle is 1.8×10^{-6} N, what is the magnitude of the magnetic field?

15. A positive charge of 0.25 C moves horizontal at a speed of 2.0×10^2 m/s and enters a magnetic field of 0.01 T directed vertically downward. What is the force on the charge?

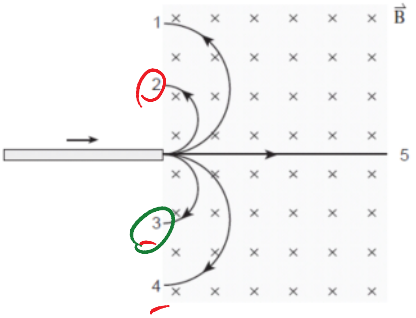
Magnetic Fields & Circular Motion

1. A charged particle travels in a circular path in a magnetic field. What changes to the magnetic field and to the velocity of the particle would both cause the radius of its path to decrease?

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

	CHANGE TO THE MAGNETIC FIELD	CHANGE TO THE VELOCITY
A.	increase ✓	increase
B.	increase ✓	decrease ✓
C.	decrease	increase
D.	decrease	decrease

2. A beam made up of ions of various charges and masses enters a uniform magnetic field as shown. One type of ion is observed to follow path 2. Which path describes the one taken by an oppositely charged ion with twice the mass and twice the charge? (Assume all ions have the same speed.)



$r = \frac{mv}{QB}$ $\frac{2m(v)}{2Q(B)}$

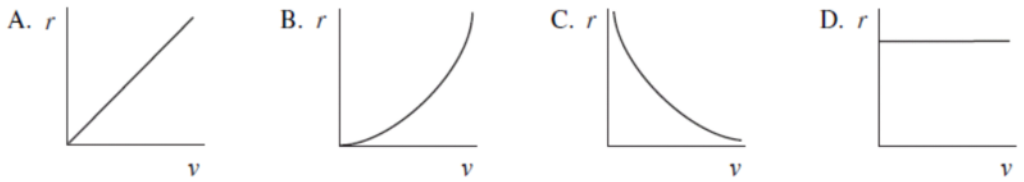
3. A proton moves with a speed of 3.6×10^5 m/s at right angles to a uniform 5.0×10^{-5} T magnetic field. What is the radius of curvature for the motion of the proton? Describe the path of the proton in the magnetic field and use principles of physics to explain the proton's motion.

m, Q

$r = \frac{mv}{QB} = \frac{(1.67\times10^{-27})(3.6\times10^{5})}{(1.6\times10^{-19})(5\times10^{-5})} = 75\,m$

4. An electron travelling at 7.7×10^6 m/s enters at right angles into a uniform magnetic field. Inside the field the path of the electron has a radius of 3.5×10^{-2} m. What is the magnitude of the magnetic field?

5. A charged mass is accelerated to various speeds and then passed through a perpendicular magnetic field. Which of the graphs below is the best representation of how the radius of its circular path through the magnetic field varies with speed?



6. Charged particles having momentum p_1, pass perpendicularly through a magnetic field and their circular path has a radius of r. What would the radius be for particles with the same charge having momentum $p_2 = 2p_1$

   A. $2r$

   B. $\frac{1}{2}r$

   C. $\sqrt{2}r$

   D. $\frac{r}{\sqrt{2}}$

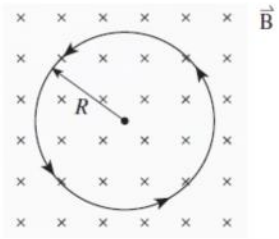
7. The path of a charged particle in a uniform magnetic field is circular when the initial velocity is perpendicular to the field. Which of the following is a valid expression for the radius of this orbit in terms of the magnetic field strength, and the particle's momentum and charge?

   A. Bqp

   B. $\frac{Bp}{q}$

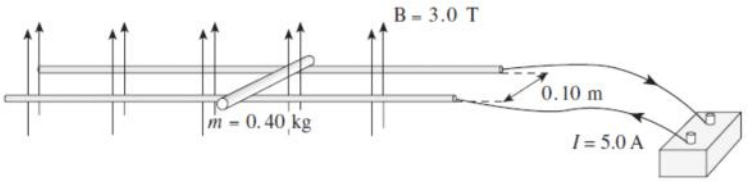
   C. $\frac{Bq}{p}$

   D. $\frac{p}{Bq}$



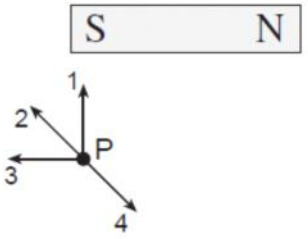
8. A positively charged object $\left(q = 1.6 \times 10^{-19}\ \text{C}\right)$ is travelling at 1.9×10^{4} m/s perpendicular to a 1.0×10^{-3} T magnetic field. If the radius of the resulting path is 0.40 m, what is the object's mass?

9. A 0.40 kg metal slider is sitting on smooth conducting rails as shown below. What is the magnitude and direction of the acceleration of the slider? (Ignore friction.)



	MAGNITUDE	DIRECTION
A.	0.42 m/s^2	left
B.	0.42 m/s^2	right
C.	3.8 m/s^2	left
D.	3.8 m/s^2	right

10. What is the direction of the magnetic field at point P due to the bar magnet?



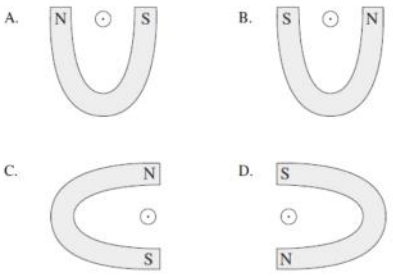
11. The diagrams below each illustrate a magnet and a conductor. In each case, the current in the conductor is out of the page. For each of these situations determine the direction of force on the conductor.

A. _____

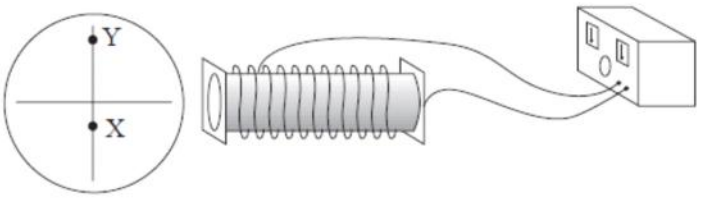
B. _____

C. _____

D. _____



12. An undeflected electron beam strikes the centre of a cathode ray tube. A solenoid placed beside a cathode ray tube causes the electron beam to strike the screen at position X.



What changes to the magnitude and direction of the current in the solenoid would cause the electron beam to strike the screen at Y?

	CHANGE TO CURRENT MAGNITUDE	CHANGE TO CURRENT DIRECTION
A.	Increases	Remains the same
B.	Increases	Reverses
C.	Decreases	Remains the same
D.	Decreases	Reverses

M. F. & F. Answers: 1) 0.022 N, 2) D, 3) D, 4) 2.8×10^{-13} N, 5) B, 6) left, 7) B, 8) right, 9) T, 10) 1.12×10^{-13} N, 11) D, 12) C, 13) 7.2×10^{-14} N, 14) 0.23 T, 15) 0.5 N

M. F. & C. M. Answers: 1) B, 2) 3, 3) 75.2 m, 4) 1.25×10^{-3} T, 5) A, 6) A, 7) D, 8) 3.37×10^{-27} kg, 9) D, 10) 2
11) A:Up, B: Down, C:right, D:Left, 12) B