

First Name: _____

Last Name: _____

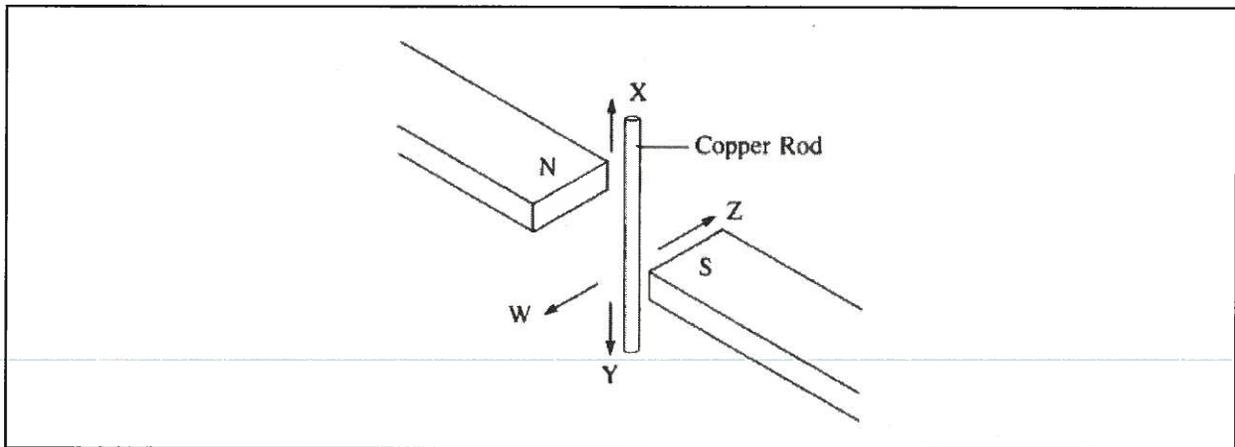
16 – Worksheet – Motor Effect, Generator Effect, and Mass Spectrometer

Textbook Questions

None

Diploma Worksheet Questions – Generator Effect

Use the following information to answer Q343:



Q343: When the rod is stationary in the magnetic field, electrons in the rod will

- a. Move in the direction of W
- b. Move in the direction of X
- c. Move in the direction of Y
- d. Not move in any direction

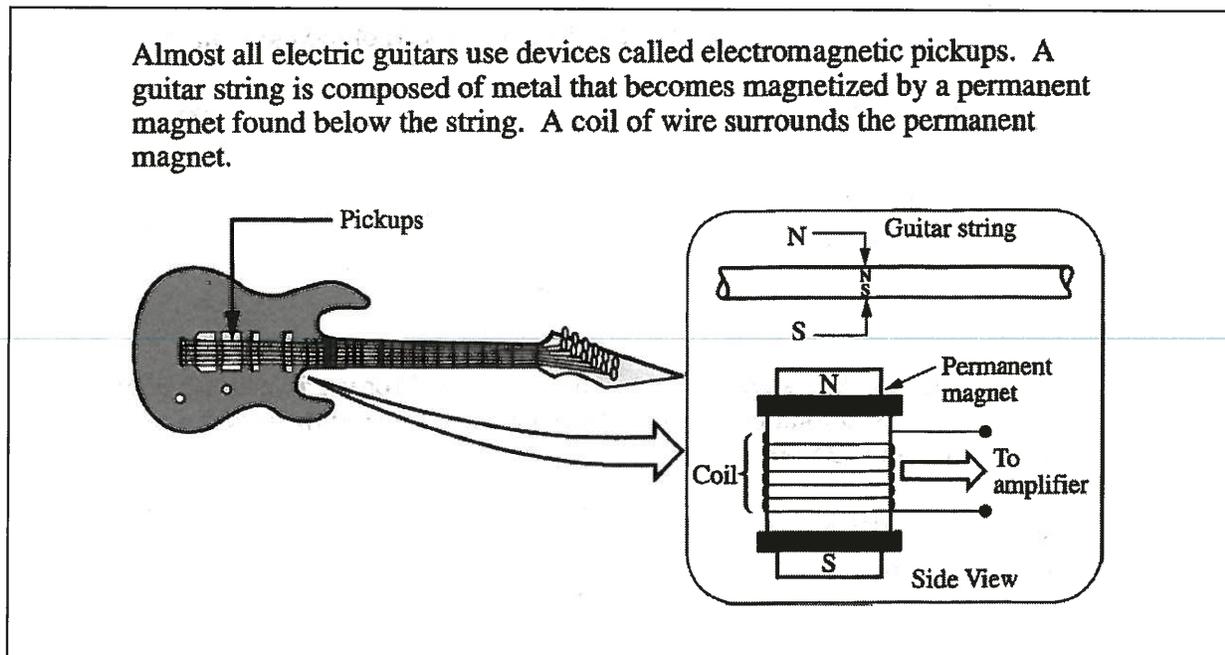
Q344: A current may be induced in a loop of wire if the loop is

- a. At rest in a magnetic field
- b. Moved perpendicular to an electric field → needs to move perpendicular to a magnetic field.
- c. Moved parallel to a uniform magnetic field
- d. Rotated about an axis perpendicular to a magnetic field

Q346: A loop of wire is connected to a microammeter. When the loop is moved, the needle on the microammeter jumps. The MOST likely cause of this phenomenon is the presence of

- a. An electric field in the room
- b.** A magnetic field in the room
- c. An electric charge in the room
- d. A magnetic charge in the room → *Doesn't even make sense.*

Use the following information to answer Q349:



Q349: When the string is plucked, a small current is produced in the coil of wire because

- a. A potential difference is produced in the string
- b. There is a current in the string that can be amplified
- c. There is a charge buildup on the string
- d.** The string behaves as a magnet moving toward and away from the coil

Diploma Worksheet Questions – Combination Questions (Mass Spectrometer)

Q350: An electron passes without deflection through perpendicular electric and magnetic fields of 10.0 kN/C and 11 mT respectively. The speed of the electron is

- a. 1.1×10^{-6} m/s
- b. 2.1×10^{-5} m/s
- c.** 9.1×10^5 m/s
- d. 4.8×10^6 m/s

$$|\vec{E}| = 10.0 \times 10^3 \text{ N/C}$$

$$|\vec{B}| = 11 \times 10^{-3} \text{ T}$$

$$F_m = F_e$$

$$qvB = q|\vec{E}|$$

$$v = \frac{|\vec{E}|}{|\vec{B}|} = \frac{10.0 \times 10^3}{11 \times 10^{-3}}$$

$$v = 9.1 \times 10^5 \text{ m/s}$$

Q351: An electron travels at 2.5×10^6 m/s perpendicular to a magnetic field with a strength of 2.0×10^{-3} T. The radius of curvature of its path is

- a. 1.4×10^{-3} m
- b.** 7.1×10^{-3} m
- c. 1.4×10^2 m
- d. 7.1×10^2 m

$$F_c = F_m$$

$$\frac{mv^2}{r} = qvB$$

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

$$r = \frac{mv}{qB} = \frac{(9.11 \times 10^{-31})(2.5 \times 10^6)}{(1.60 \times 10^{-19})(2.0 \times 10^{-3})}$$

$$r = 0.0071171875 \text{ m}$$

$$r \approx 7.1 \times 10^{-3} \text{ m}$$

Q352: The radius of curvature of the path of an ion with a charge of $2e$ in a magnetic field of strength 2.00×10^{-2} T is 1.25 cm. If the speed of the ion is 3.00×10^3 m/s, its mass is

- a.** 2.67×10^{-26} kg
- b. 2.67×10^{-24} kg
- c. 3.84×10^{-14} kg
- d. 3.84×10^{-12} kg

$$F_m = F_c$$

$$qvB = \frac{mv^2}{r}$$

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

$$m = \frac{qBr}{v} = \frac{(2 \times 1.60 \times 10^{-19})(2.00 \times 10^{-2})(1.25 \times 10^{-2})}{(3.00 \times 10^3)}$$

$$m = 2.67 \times 10^{-26} \text{ kg}$$

■ KEY ■

Q357: If a charged particle travelling at 3.00×10^6 m/s at right angles to a magnetic field of 0.125 T experiences a deflecting force of 1.20×10^{-13} N, the particle could be

- a. A proton
- b. A neutron
- c. An electron
- d. An alpha particle

$$F_m = qvB$$

$$(1.20 \times 10^{-13}) = q(3.00 \times 10^6)(0.125)$$

$$q = 3.2 \times 10^{-19} \text{ C}$$

$$q = 2e$$

Q360: Alpha particles, trapped by a magnetic field, are in an orbit of radius 4.36 cm. If the velocity of the particles is exactly doubled, the new radius will be ____ cm.

(Record your **three digit** answer in the Numerical Response boxes below)

8	.	7	2
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$$F_c = F_m$$

$$\frac{mv^2}{r} = qvB$$

$$\frac{mv}{r} = 2B$$

$$r = \frac{mv}{2B} = 4.36 \text{ cm}$$

$$\frac{\text{NEW}}{r_{\text{new}}} = \frac{m(2v)}{2B}$$

$$= 2 \left(\frac{mv}{2B} \right)$$

$$= 2(4.36)$$

$$= 8.72 \text{ cm}$$

■ KEY ■

Use the following information to answer Q369 – Q371:

An experiment is designed to study the charge to mass ratio of hydrogen ions. Hydrogen ions, all moving in the same direction and with the same speed, v , are injected into a mass spectrometer. The magnitude of the magnetic field is varied, and the resulting radii of the path of the hydrogen ions are measured.

Q369: The equation that describes the radius of curvature of an ion's path is

- a. $r = \frac{qB}{mv}$
- b. $r = \frac{mv}{qB}$
- c. $r = \frac{qv}{mB}$
- d. $r = \frac{mB}{qv}$

$$F_c = F_m$$

$$\frac{mv^2}{r} = qvB$$

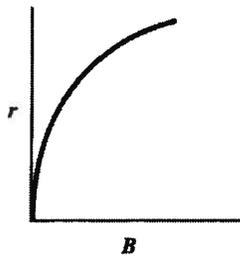
$$\frac{mv}{r} = qB$$

$$mv = qBr$$

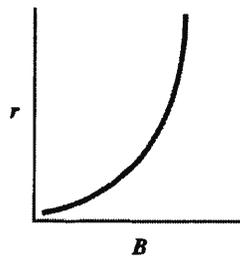
$$\frac{mv}{qB} = r$$

Q370: A graph that shows the relationship between the radius of curvature of a hydrogen ion's path and the strength of the magnetic field is graph

A.



B.

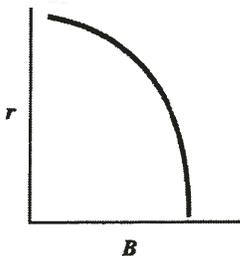


$$r = \frac{mv}{qB} =$$

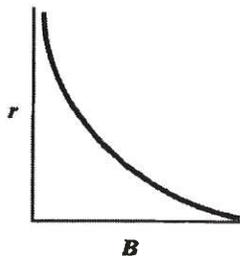
$$r = \left(\frac{mv}{q}\right) \frac{1}{B}$$

$$\text{So } r \propto \frac{1}{B}$$

C.

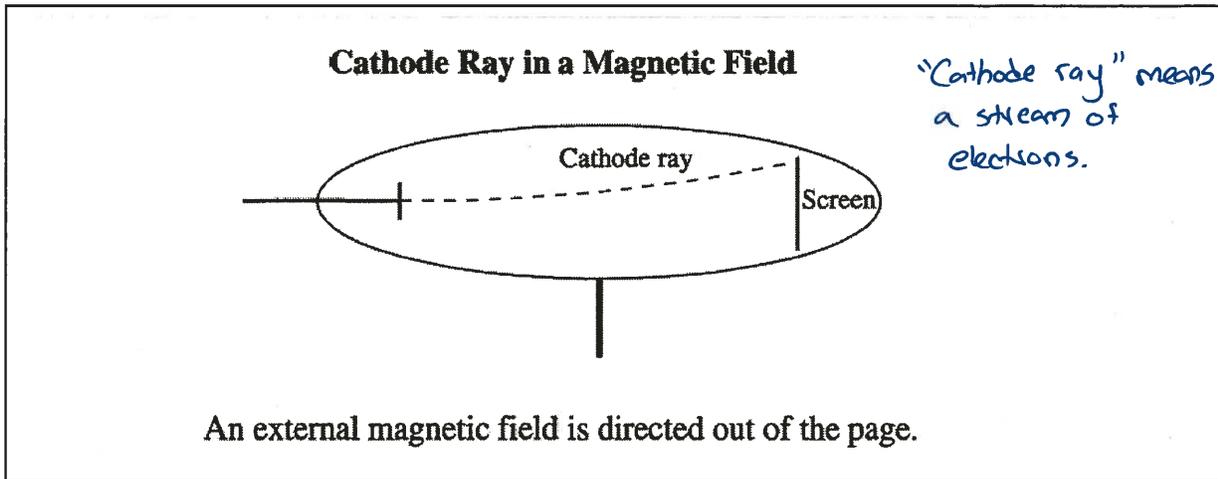


D.

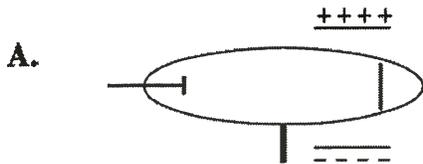


Diploma Worksheet Questions – Combination Questions (Cathode Ray Tube)

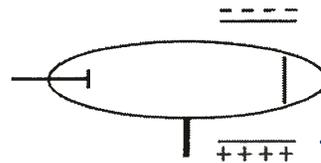
Use the following information to answer Q378:



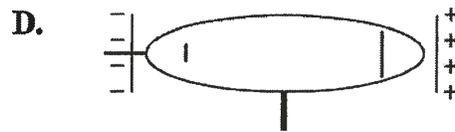
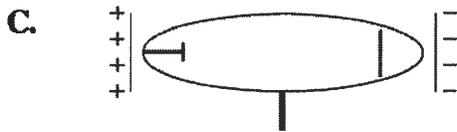
Q378: A magnetic field directed out of the page caused the cathode rays to move up the screen. What arrangement of electric plates would cause them to return to the center?



B.



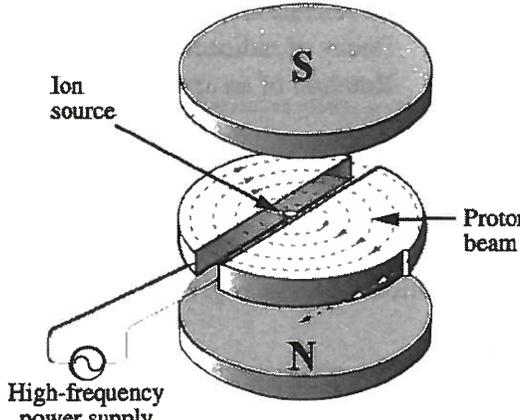
← Attract them towards positive plate to straighten them out.



Diploma Worksheet Questions – Combination Questions (Cyclotron)

Use the following information to answer Q380 – Q381:

A cyclotron uses a magnetic field to move charged particles in a circular path. It also uses a high frequency power supply to repeatedly accelerate the particles.



Ernest Lawrence was the first person to use a cyclotron. His cyclotron accelerated protons to a maximum energy of 8.0×10^4 eV. With this energy, the protons moved in a circular path with a radius of 6.5×10^{-2} m.

Q380: The maximum speed of the protons in Lawrence's cyclotron was

- a. 1.5×10^{13} m/s
- b. 1.7×10^8 m/s
- c. 3.9×10^6 m/s
- d. 9.8×10^{15} m/s

$$E_k = \frac{8.0 \times 10^4 \text{ eV}}{1} \times \frac{1.60 \times 10^{-19} \text{ J}}{1 \text{ eV}} = 1.28 \times 10^{-14} \text{ J}$$

$$E_k = \frac{1}{2} m v^2$$

$$(1.28 \times 10^{-14}) = \frac{1}{2} (1.67 \times 10^{-27}) v^2$$

$$v^2 = 1.5329 \times 10^{13}$$

$$v = 3.92 \times 10^6 \text{ m/s}$$

Q381: The magnitude of the magnetic field used by Lawrence was

- a. 6.3×10^{-1} T
- b. 2.7×10^1 T
- c. 2.4×10^6 T
- d. 1.6×10^9 T

$$F_c = F_m$$

$$\frac{m v^2}{r} = q v B$$

$$\frac{m v}{r} = q B$$

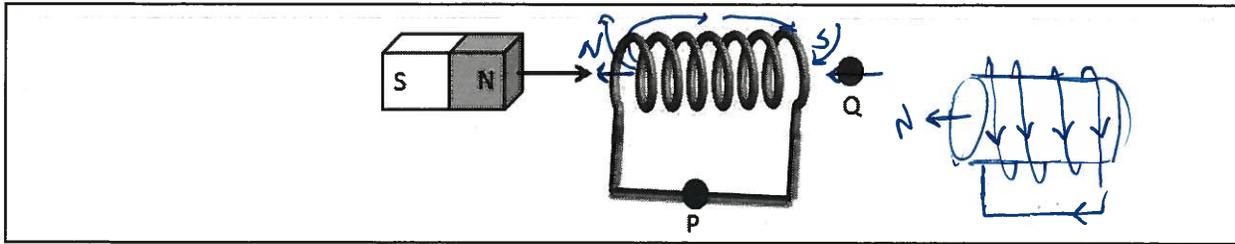
$$B = \frac{m v}{q r} = \frac{(1.67 \times 10^{-27})(3.92 \times 10^6)}{(1.60 \times 10^{-19})(6.5 \times 10^{-2})}$$

$$B = 0.6287 \text{ T}$$

$$B \approx 6.3 \times 10^{-1} \text{ T}$$

Challenge Questions

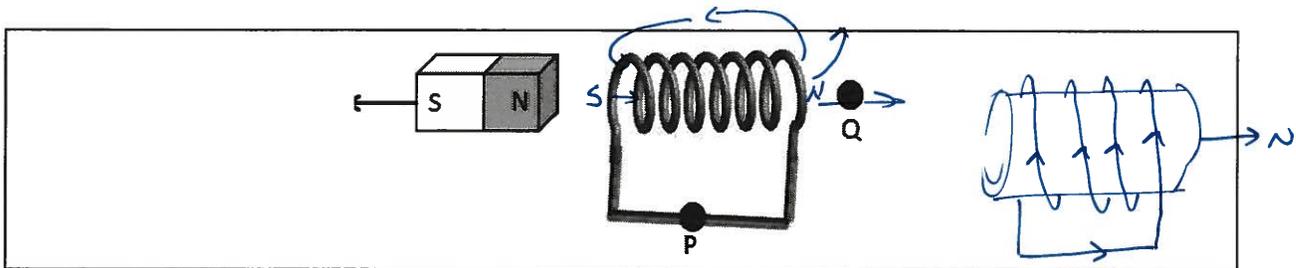
Use the following information to answer Q1:



Q1: The induced current at Point P is directed to the i. The induced magnetic field at Point Q is directed to the ii.

	i.	ii.
<input checked="" type="radio"/> A.	left	left
<input type="radio"/> B.	left	right
<input checked="" type="radio"/> C.	right	left
<input type="radio"/> D.	right	right

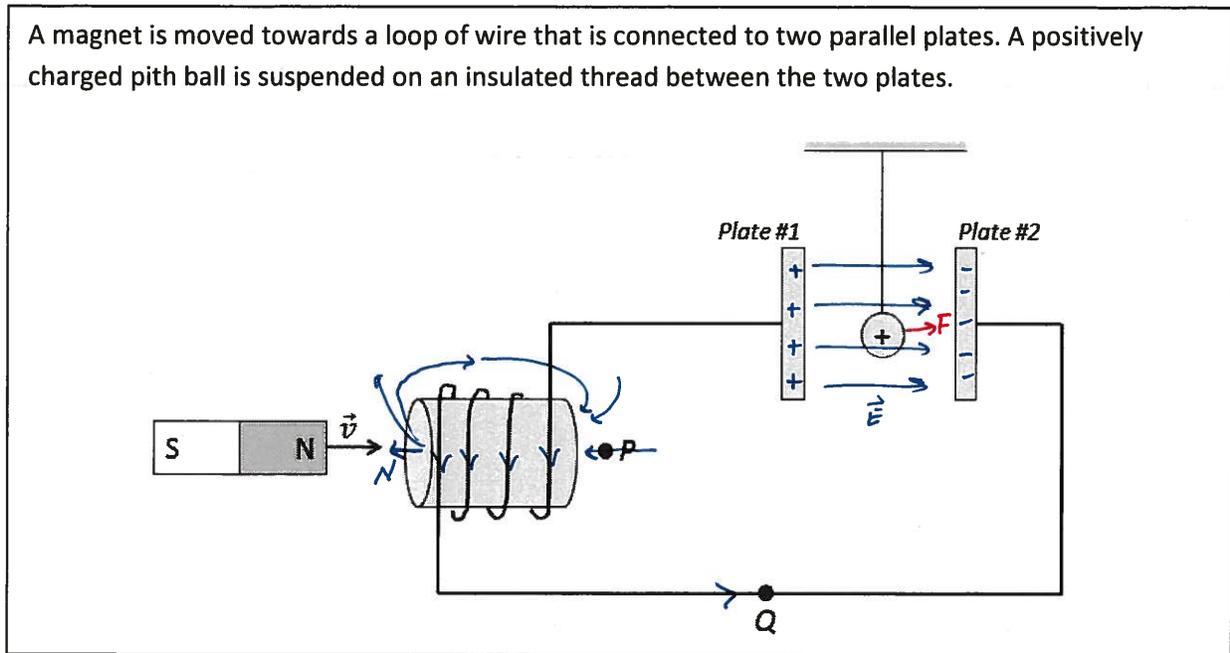
Use the following information to answer Q2:



Q2: The induced current at Point P is directed to the i. The induced magnetic field at Point Q is directed to the ii.

	i.	ii.
<input type="radio"/> A.	left	left
<input type="radio"/> B.	left	right
<input type="radio"/> C.	right	left
<input checked="" type="radio"/> D.	right	right

Use the following information to answer Q3-Q4:



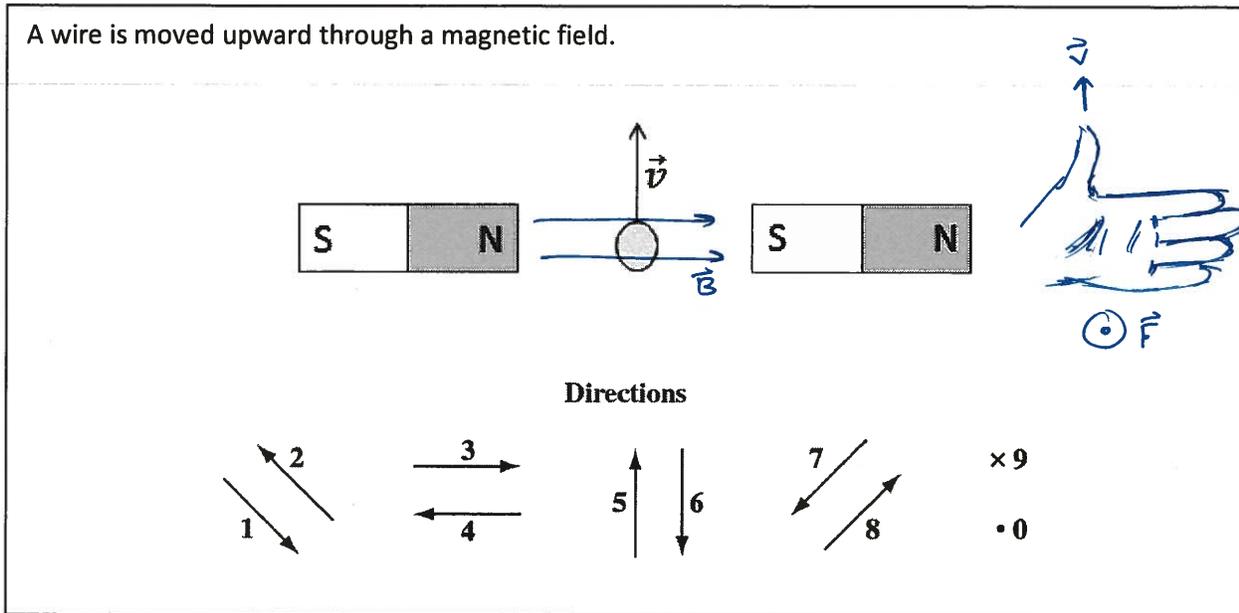
Q3: The direction of the magnetic field at Point P is to the right and the direction of current flow at Point Q is to the left.

	<i>i.</i>	<i>ii.</i>
A.	to the left	to the left
B.	to the left	to the right
C.	to the right	to the left
D.	to the right	to the right

Q4: The direction of the electric field between the plates is to the right, and the pith ball is electrostatically attracted to Plate #2.

	<i>i.</i>	<i>ii.</i>
A.	to the left	Plate #1
B.	to the left	Plate #2
C.	to the right	Plate #1
D.	to the right	Plate #2

Use the following information to answer Q5:



Q5: The directions of the current in the wire can be described using the numbers given above.

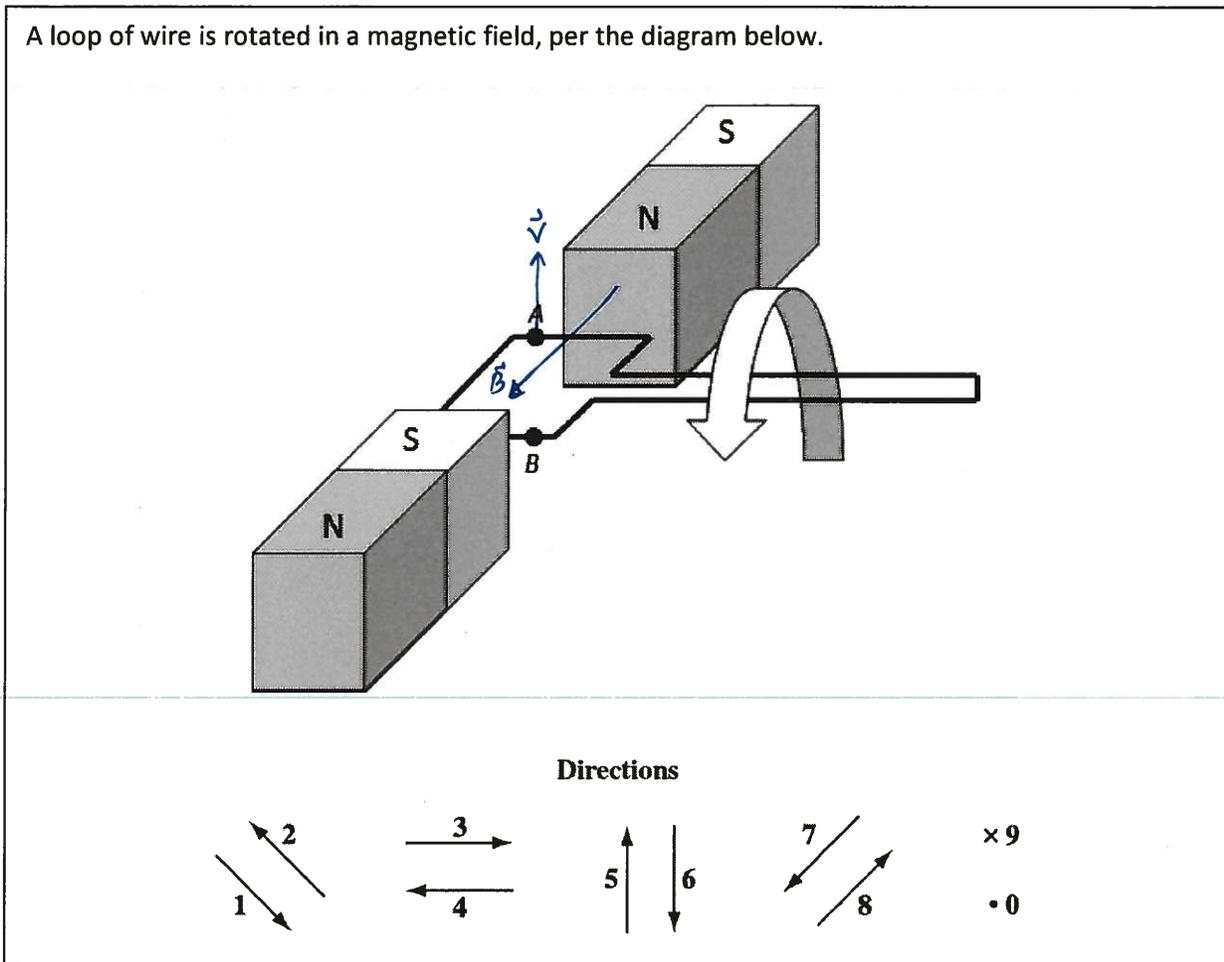
Direction: 0

Field: Direction of induced current in the wire

(Record your **one digit** answer in the Numerical Response boxes below)

0			
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Use the following information to answer Q6-Q7:



Q6: The directions of the motion of the wire, the magnetic field, and the induced current can be described using the numbers given above.

<p>Direction: <u> 7 </u></p>	<p><u> 5 </u></p>	<p><u> 4 </u></p>
<p>Field: Direction of magnetic field at <i>Position A</i></p>	<p>Direction of the motion of the wire at <i>Position A</i></p>	<p>Direction of the induced current at <i>Position A</i></p>

(Record your **three digit** answer in the Numerical Response boxes below)

7	5	4	
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Use the following information to answer Q6-Q7:

A loop of wire is rotated in a magnetic field, per the diagram below.

Directions

								$\times 9$
								$\cdot 0$

Q7: The directions of the motion of the wire, the magnetic field, and the induced current can be described using the numbers given above.

<p>Direction: <u>↙ 7</u></p> <p>Field: <u>↓ 6</u></p> <p>Direction of magnetic field at Position B</p>	<p><u>↓ 6</u></p> <p>Direction of the motion of the wire at Position B</p>	<p><u>→ 3</u></p> <p>Direction of the induced current at Position B</p>
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(Record your **three digit** answer in the Numerical Response boxes below)

7	6	3	
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Cumulative Review from Previous Units

None