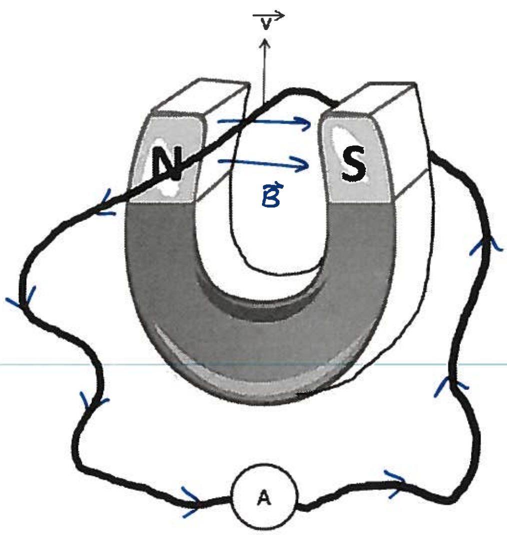
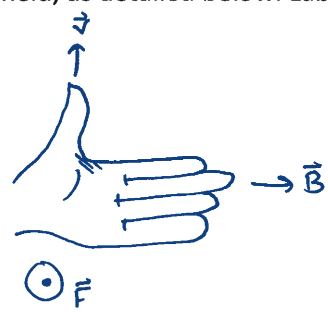
KEY

First Name:________________________ Last Name:________________________

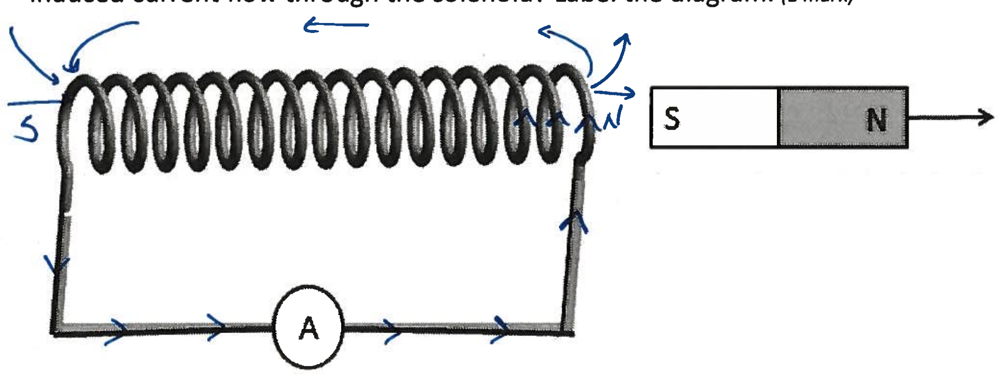
L17 – FQ – Motor Effect, Generator Effect, and Mass Spectrometer

Q1: A wire is raised upward through a magnetic field, as detailed below. Label the direction of current flow in the diagram below. *(1 mark)*





Q2: A magnet is pulled away from a solenoid, as diagrammed below. In what direction would the induced current flow through the solenoid? Label the diagram. *(1 mark)*



KEY

Use the following information to answer Q3-Q5:

A mass spectrometer accelerates electrons at the "*Acceleration Plates*" to a speed of 4.00 x 10^5 m/s. The electrons then go through a "*Velocity Selector*" with an electric field strength of 1.80 kN/C [up]. Finally the electrons enter a "*Detection Chamber*" with a magnetic field of 2.50 mT [into the page].

Acceleration Plates

$q_e = 1.60 \times 10^{-19} C$

$m_e = 9.11 \times 10^{-31}\ kg$

$v = 4.00 \times 10^5\ m/s$

$\Delta V = ?$

Velocity Selector

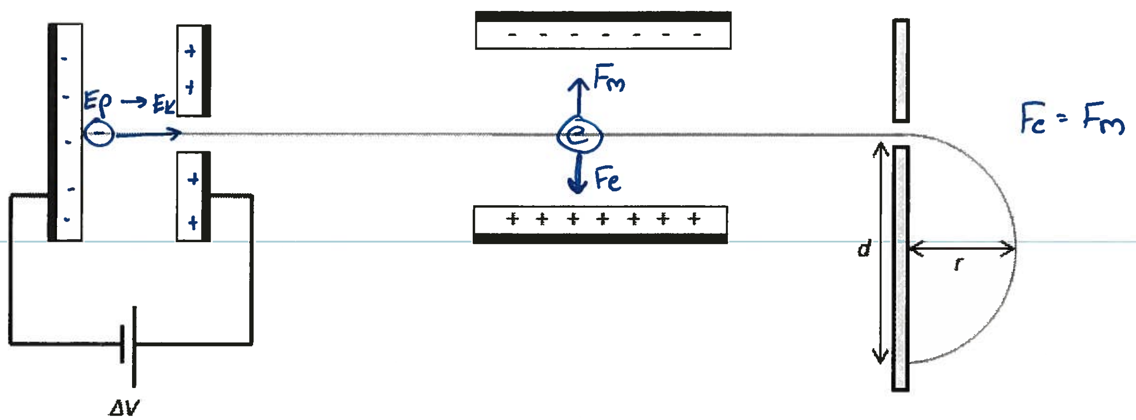
$\vec{E} = 1.80 kN/C\ [up]$

$\vec{B} = ?$

Detection Chamber

$\vec{B} = 2.50 mT\ [into\ page]$

$r = ?$



Q3: The voltage across the *Acceleration Plates* is ***a.bc*** x 10^{-d} V, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

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

4	5	6	1

Physics Principle #5 - Conservation of Energy

$E_p \rightarrow E_k$

$q\Delta V \rightarrow \frac{1}{2}mv^2$

$(1.60\times10^{-19})\Delta V = \frac{1}{2}(9.11\times10^{-31})(4.00\times10^{5})^2$

$\Delta V = 0.4555 V$

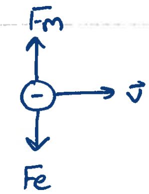
$\Delta V \approx 4.56\times10^{-1}\ V$

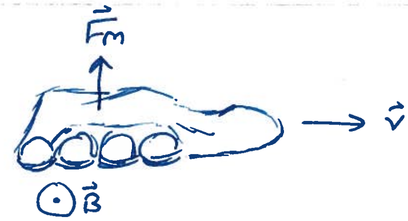
KEY

Q4: The magnetic field across the *Velocity Selector* is

a. 4.50×10^{-3} T [into page]
(b.) 4.50×10^{-3} T [out of page]
c. 7.20×10^{8} T [into page]
d. 7.20×10^{8} T [out of page]

Physics Principle # Ø - Uniform Motion ($\vec{F}_{net} = 0$)





$$F_e = F_m$$
$$q|\vec{E}| = qv|\vec{B}|$$
$$|\vec{E}| = v|\vec{B}|$$
$$|\vec{B}| = \frac{|\vec{E}|}{v} = \frac{1.80 \times 10^{3}}{4.00 \times 10^{5}} = 0.0045\,T$$
$$\approx 4.50 \times 10^{-3}\,T$$

Q5: The radius of curvature in the detection chamber is

a. 9.11×10^{-7} m
(b.) 9.11×10^{-4} m
c. 1.10×10^{3} m
d. 1.10×10^{6} m

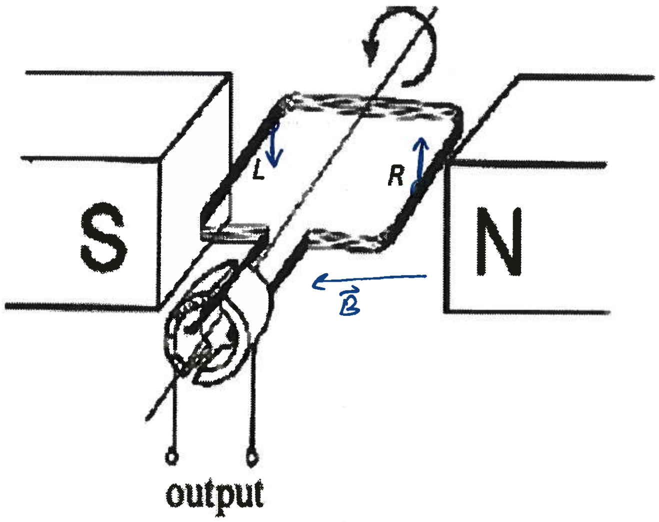
Physics Principle # 2 - Uniform Circular Motion ($\vec{F}_{net}$ is radially inward)

$$F_c = F_m$$
$$\frac{mv^{2}}{r} = qvB$$
$$\frac{mv}{r} = qB$$
$$mv = qBr$$
$$\frac{mv}{qB} = r$$
$$r = \frac{(9.11 \times 10^{-31})(4.00 \times 10^{5})}{(1.60 \times 10^{-19})(2.50 \times 10^{-3})}$$
$$r = 0.000911$$
$$r \approx 9.11 \times 10^{-4}\,m$$

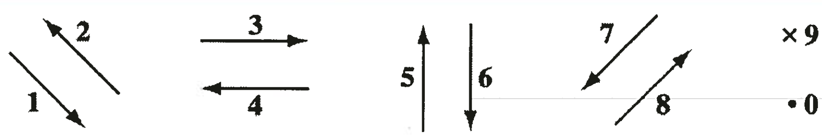
■ KEY ■

Use the following diagram to answer Q6:

An electric generator is depicted below:



Directions



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

Direction:	↓ 6	7 ↙ or ⊙ Ø	↑ 5	8 ↗ or ⊗ 9
Field:	Direction of motion of wire at *Position L*	Direction of the induced current at *Position L*	Direction of the motion of wire at *Position R*	Direction of the induced current at *Position R*

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

6	7	5	8

or

6	0	5	9

(It's a matter of perspective)

MARKING:

Beginning	0.0 – 2.5
Progressing	3.0 – 4.0
Competent	4.5 – 5.5
Exemplary	6.0