Key

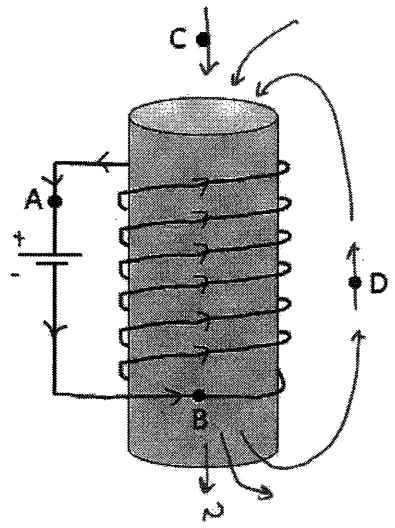
First Name:_____ Last Name:_____

L17 – Worksheet – Electromagnetism Review

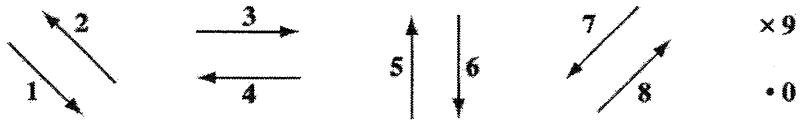
First and Second Hand Rules

Use the following information to answer Q1:

A solenoid is given a current per the diagram below:



Directions



Q1: The directions of the current and the magnetic field can be described using the numbers given above.

Direction:	↓ 6	→ 3	↓ 6	↑ 5
Field:	**Direction of current at *Position A***	**Direction of current at *Position B***	**Direction of magnetic field at *Position C***	**Direction of magnetic field at *Position D***

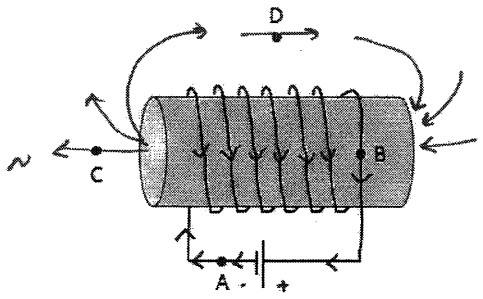
*(Record your **four digit** answer in the Numerical Response boxes below)*

6	3	6	5

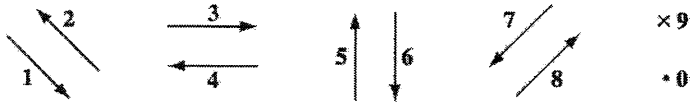
Key

Use the following information to answer Q2:

A solenoid is given a current per the diagram below:



Directions



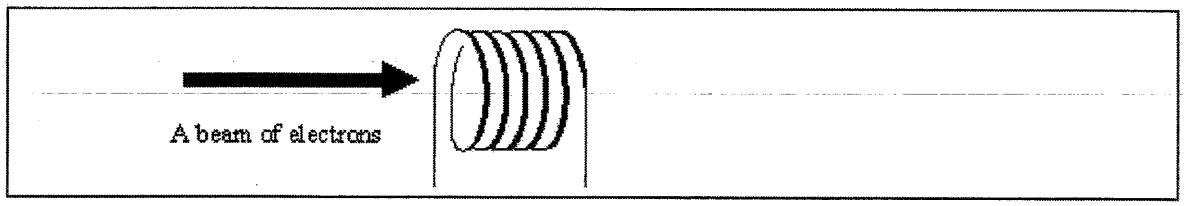
Q2: The directions of the current and the magnetic field can be described using the numbers given above.

Direction:	← 4	↓ 6	← 4	→ 3
Field:	**Direction of current at *Position A***	**Direction of current at *Position B***	**Direction of magnetic field at *Position C***	**Direction of magnetic field at *Position D***

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

4	6	4	3

Use the following diagram to answer Q3:



Q3: A beam of electrons pass through a solenoid connected to a power supply. The effect on the beam passing through a current-carrying solenoid is:

a) a deflection of the beam path
b) an increase in speed
c) a decrease in speed
(d) no effect at all

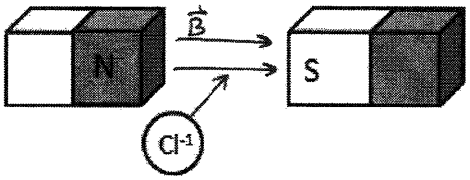
Doesn't cross field lines.
$F_m = qv_\perp |B|$ where $v_\perp = 0$ m/s.

KEY

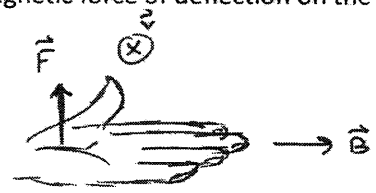
Motor Effect (Third Hand Rule) on a Point Charge

Use the following diagram to answer Q4-Q5:

A chlorine ion (Cl^{-1}) *with a mass of* 5.85×10^{-26} *kg is projected with an energy of 8.50 keV perpendicularly into a magnetic field with a strength of 0.650 T.*



Q4: Based on the information above, the magnetic force of deflection on the chlorine ion will be towards:



a) the left
b) the right
c) the top of the page
d) the bottom of the page

Q5: The magnitude of the magnetic force experienced by the Chlorine ion (Cl^{-1}) is $a.b \times 10^{-cd}$ N, where ***a,b,c*** and ***d*** are ___, ___, ___, and ___.

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

2	2	1	4

$E_K = \frac{8.50\ keV}{1} \times \frac{1000\ eV}{1\ keV} \times \frac{1.60 \times 10^{-19}\ J}{1\ eV}$

$E_K = 1.36 \times 10^{-15}\ J$

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

$(1.36 \times 10^{-15}) = \frac{1}{2}(5.85 \times 10^{-26}) v^2$

$v^2 = 4.649... \times 10^{10}$

$v = 2.15628 \times 10^5\ m/s$

$F_m = qvB$

$= (1.60 \times 10^{-19})(2.15628 \times 10^5)(0.650)$

$= 2.24 \times 10^{-14}\ N$

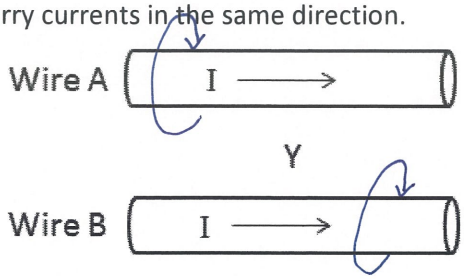
$\approx 2.2 \times 10^{-14}\ N$

KEY

Motor Effect (Third Hand Rule) on a Current Carrying Wire

Use the following diagram to answer Q6-Q7:

Two parallel wires, A and B, carry currents in the same direction.



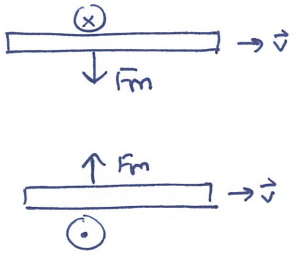
Q6: Refer to the diagram above. At position Y, between the two current carrying wires, the direction of the magnetic field of wire A is ___i___ and the magnetic field of wire B is ___ii___.

	i	*ii*
A	out of the page	out of the page
B	into the page	out of the page
C	out of the page	into the page
D	into the page	into the page

a) A b) B c) C d) D

Q7: The force on Wire A will be ___i___, and the force on Wire B will be ___ii___.

	i	*ii*
A	upward	upward
B	downward	upward
C	upward	downward
D	downward	downward



a) A b) B c) C d) D

Q8: A copper wire is connected to a battery so that is has a current in it. A segment of the wire is perpendicular to a horizontal 1.5 T magnetic field. The length of the wire in the magnetic field is 3.0 cm, and the mass of the wire affected by the magnetic field is 20g. In order to suspend the segment of wire, the minimum current in the wire must be

a) 0.044 A
b) 0.23 A
c) 4.4 A
d) 44 A

$F_m = F_g$

$I l |\vec{B}| = mg$

$I(3.0\times10^{-2})(1.5) = (20\times10^{-3})(9.81)$

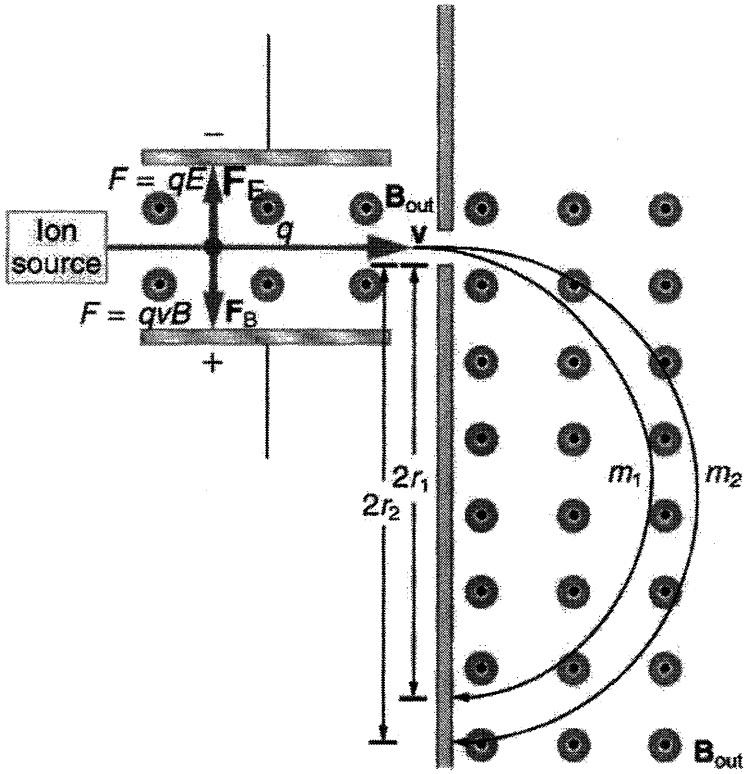
$I = 4.36\,A$

KEY

Motor Effect and Circular Motion

Use the following diagram to answer Q9:

Below is an image of a Mass Spectrometer. A charged ion can be accelerated, then enter a uniform magnetic field. By measuring the radius of curvature, the mass of the ion can be determined.



A sodium ion (Na^{+1}) *with a mass of* 2.32×10^{-26} *kg and a charge of* $+1.60 \times 10^{-19}$ *C is projected with a speed of* 3.00×10^{5} *m/s into the uniform magnetic field of 1.250 T.*

Q9: What is the radius of curvature, ***r***, of the sodium ion in the magnetic field, ***measured in centimeters***?

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

3	.	4	8

$F_c = F_m$

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

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

$mv = qBr$

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

$r = \frac{(2.32\times10^{-26})(3.00\times10^{5})}{(1.60\times10^{-19})(1.250)}$

$r = 0.0348\,m$

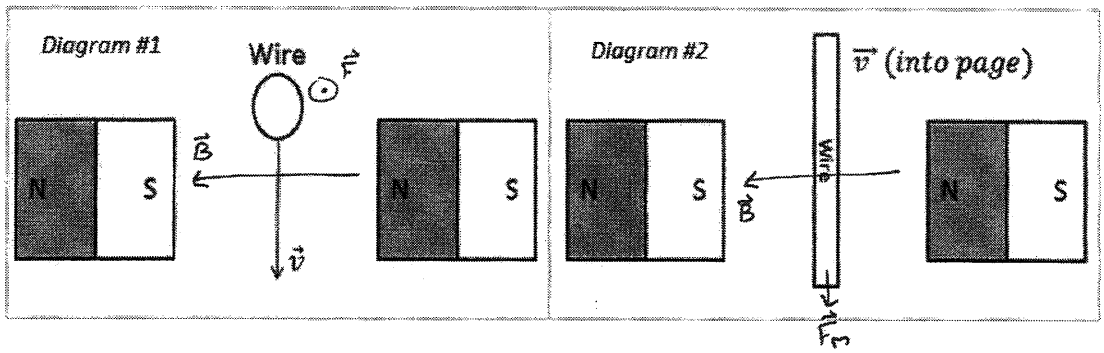
$r \approx 3.48\,cm$

KEY

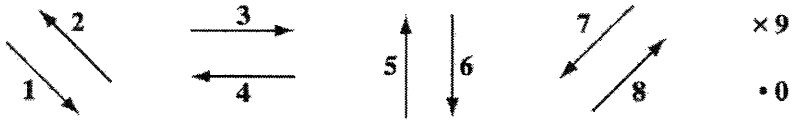
Generator Effect

Use the following information to answer Q10:

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



Directions



Q10: The directions of the motion of the electrons in the wire can be described using the numbers given above.

towards us

Direction:	⊙ Ø	↓ 6
Field:	**Direction of motion of the electrons in the wire in *Diagram #1***	**Direction of motion of the electrons in the wire in *Diagram #2***

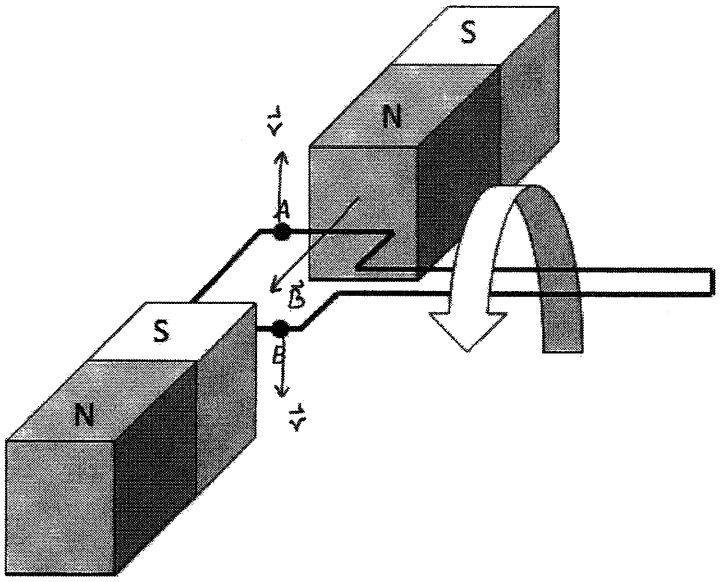
*(Record your **two digit** answer in the Numerical Response boxes below)*

Ø	6		

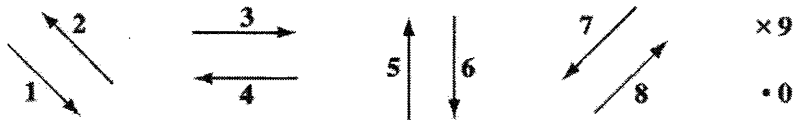
KEY

Use the following information to answer Q11:

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



Directions



Q11: The directions of the motion of the wire, the magnetic field, and the induced current can be described using the numbers given above.

Direction:	↙ 7	↑ 5	← 4
Field:	**Direction of magnetic field at *Position A***	**Direction of the motion of the wire at *Position A***	**Direction of the induced current at *Position A***

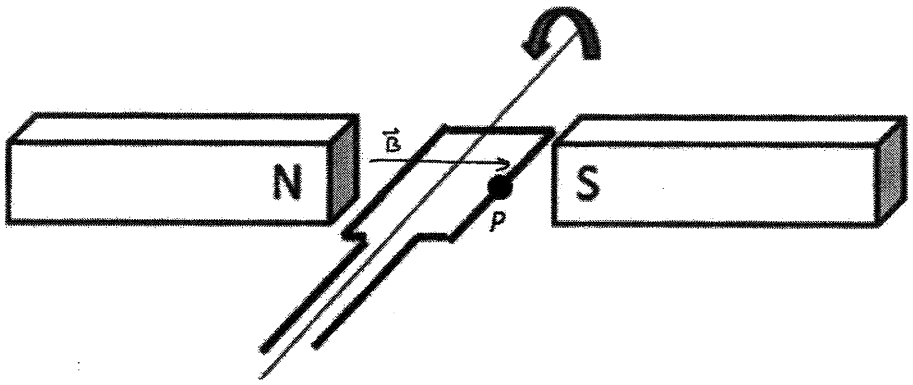
*(Record your **three digit** answer in the Numerical Response boxes below)*

7	5	4	

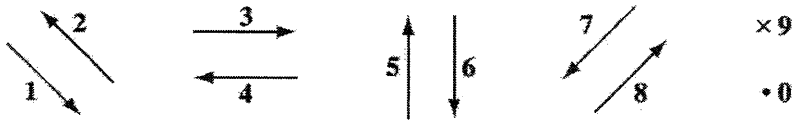
Key

Use the following information to answer Q12:

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



Directions



Q12: The directions of the motion of the wire, the magnetic field, and the induced current can be described using the numbers given above.

Direction:	→ 3	↑ 5	↙ 7 or ⊙ ∅
Field:	**Direction of magnetic field at *Position P***	**Direction of the motion of the wire at *Position P***	**Direction of the induced current at *Position P***

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

3	5	7	

or

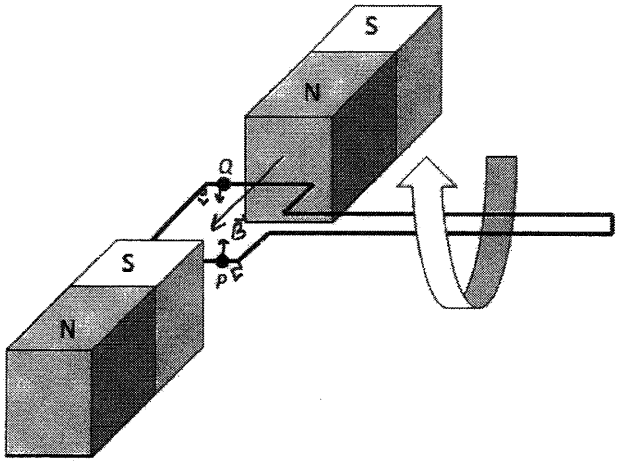
3	5	∅	

depending on perspective

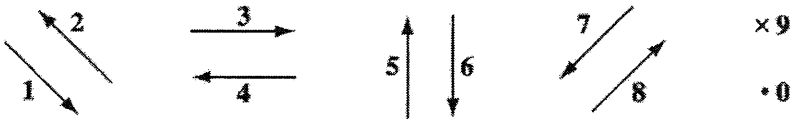
KEY

Use the following information to answer Q13:

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



Directions



Q13: The directions of the motion of the wire, the magnetic field, and the induced current can be described using the numbers given above.

Direction:	↙ 7	↑ 5	← 4	→ 3
Field:	**Direction of magnetic field at *Position P***	**Direction of the motion of the wire at *Position P***	**Direction of the induced current at *Position P***	**Direction of the induced current at *Position Q***

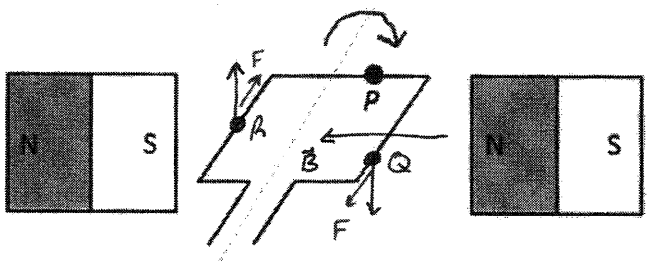
*(Record your **four digit** answer in the Numerical Response boxes below)*

7	5	4	3

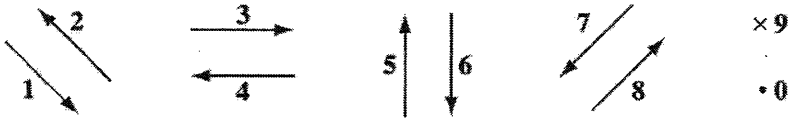
KEY

Use the following information to answer Q14:

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



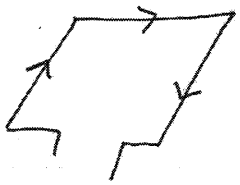
Directions



Q14: The directions of the motion of the wire, the magnetic field, and the induced current can be described using the numbers given above.

Direction:	← 4	→ 3
Field:	**Direction of magnetic field at *Position P***	**Direction of the induced current wire at *Position P***

Current continues in loop.



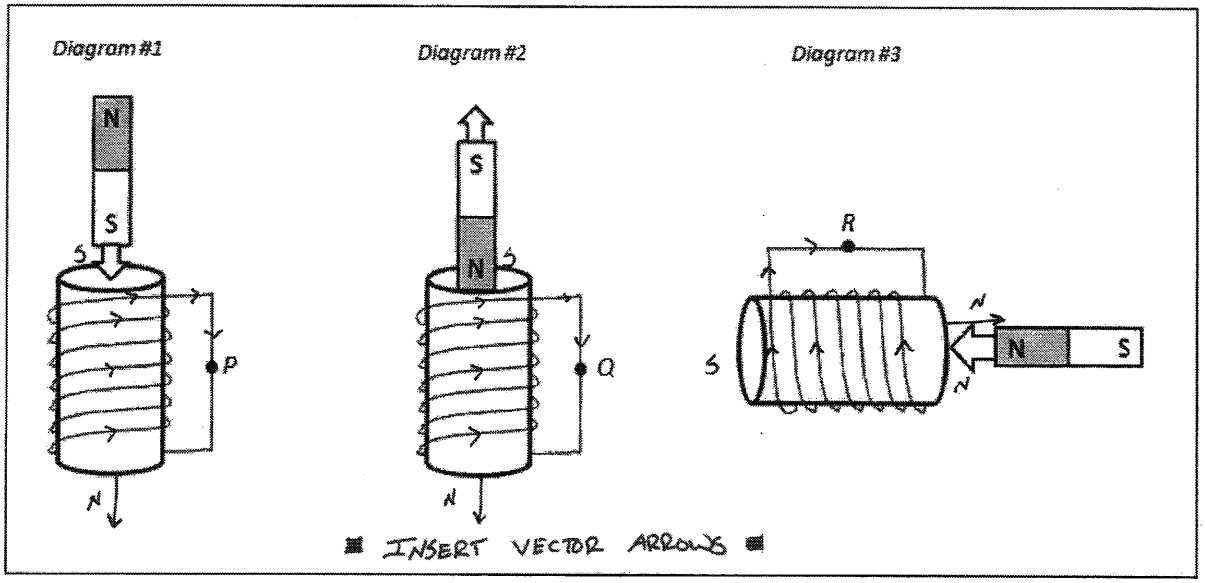
*(Record your **two digit** answer in the Numerical Response boxes below)*

4	3		

KEY

Lenz's Law

Use the following information to answer Q15:



Q15: The direction of current at various points in the wire can be described using the numbers given above.

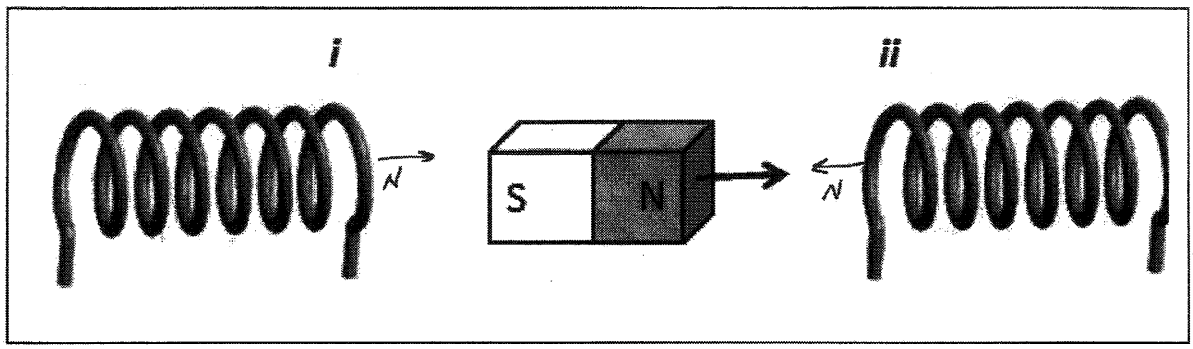
Direction:	↓ 6	↓ 6	→ 3
Field:	**Direction of current in wire at *Position P***	**Direction of current in wire at *Position Q***	**Direction of current in wire at *Position R***

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

6	6	3	

KEY

Use the following diagram to answer Q16:



Q16: Refer to the diagram above. A magnet is moved at uniform speed between two solenoids. The magnetic polarities at positions ***i*** and ***ii***, respectively, are:

	i	*ii*
(A)	north	north
B	north	south
C	south	north
D	south	south

Millikan Experiment

Q17: In Millikan's oil drop experiment, what magnitude of electric field would be required to suspend a 1.5g oil drop of -3e charge in the air?

a) 3.1×10^{16} N/C
b) 9.2×10^{16} N/C
c) 3.1×10^{19} N/C
d) 9.2×10^{19} N/C

$F_e = F_g$

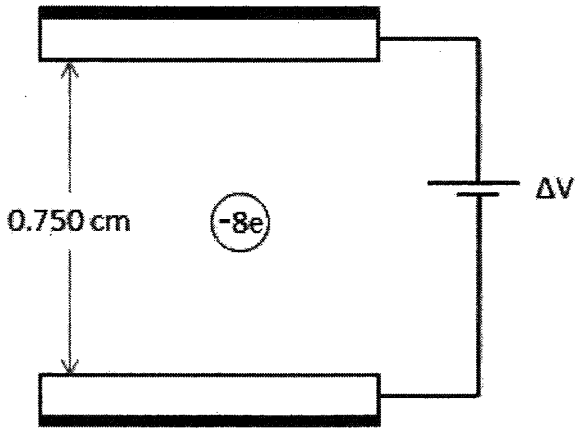
$q|\vec{E}| = mg$

$(3 \times 1.60 \times 10^{-19})|\vec{E}| = (1.5 \times 10^{-3})(9.81)$

$|\vec{E}| = 3.065 \times 10^{16}$ N/C

Use the following information to answer Q18:

A 2.60×10^{-4} kg oil drop is suspended in between parallel plates, as depicted below.



Q18: The voltage applied between the plates is ***a.b*** $\times 10^{cd}$ V, where ***a*** , ***b***, ***c***, and ***d*** are ___, ___, ___, and ___.

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

1	5	1	3

$F_e = F_g$

$q|\vec{E}| = mg$ where $|\vec{E}| = \frac{\Delta V}{\Delta d}$

$q\frac{\Delta V}{\Delta d} = mg$

$\frac{(8 \times 1.60 \times 10^{-19})\Delta V}{0.750 \times 10^{-2}} = (2.60 \times 10^{-4})(9.81)$

$\Delta V = 1.49449 \times 10^{13}$

$\Delta V \approx 1.5 \times 10^{13}$ V