KEY

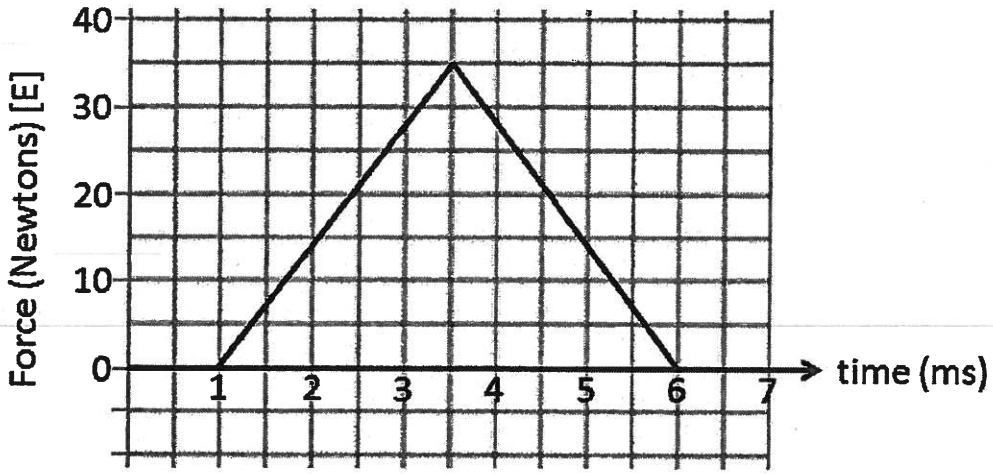
First Name:_____ Last Name:_____

L15.5 – Buffer Day Worksheet – Cumulative Review

Unit 1 – Part 1 – Momentum, Net Force, Impulse and Impulse Graphs

Use the following information to answer Q1:

A 50g rigid sphere, initially travelling at 1.5m/s [W], strikes a wall. The force-time graph is depicted below.



Q1: The ball rebounds with a velocity of _____ m/s [W].

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

0	.	2	5

$F\Delta t$ = Area under graph

$= \frac{1}{2}(5\times10^{-3})(35)$

$= 0.0875$

$F\Delta t = m\Delta v$

$0.0875 = (0.05)\Delta v$

$\Delta v = 1.75$ m/s [E]

$\Delta v = v_f - v_i$

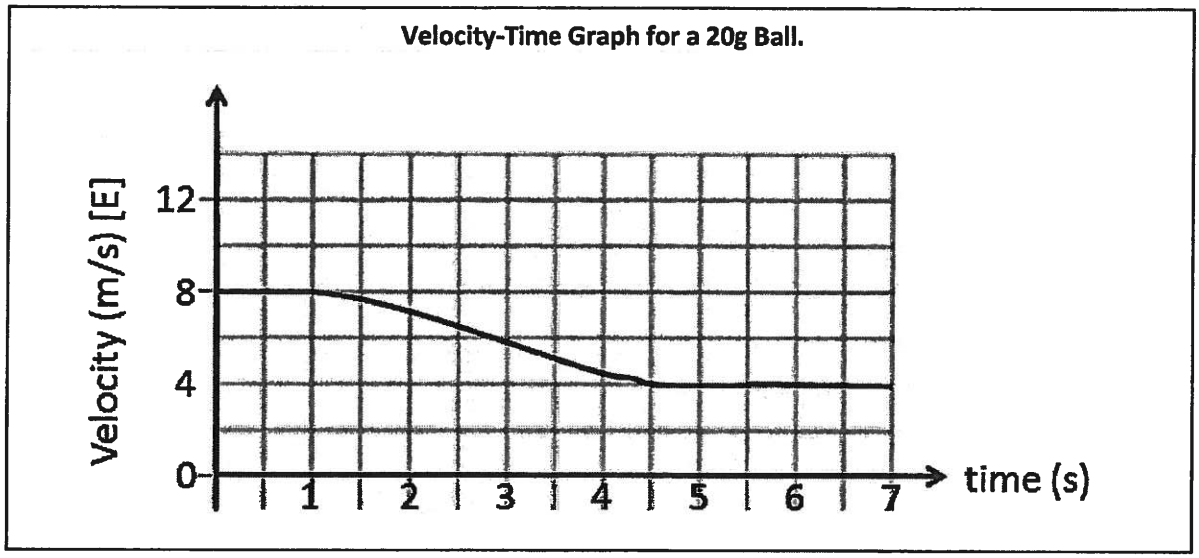
$+1.75 = v_f - (-1.5)$

$1.75 = v_f + 1.5$

$v_f = 0.25$ [E]

KEY

Use the following information to answer Q2:



Q2: The impulse acting on the ball over this time period is ***a.bc*** x 10^{-d} Ns, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

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

8	0	0	2

$p_i = mv_i$
$= (0.020)(8)$
$= 0.16\ kg\,m/s$

$p_f = mv_f$
$= (0.020)(4)$
$= 0.08\ kg\,m/s$

$\Delta p = 0.08\ kg\,m/s$

$F\Delta t = m\Delta v$

$F\Delta t = 0.08\ kg\,m/s$

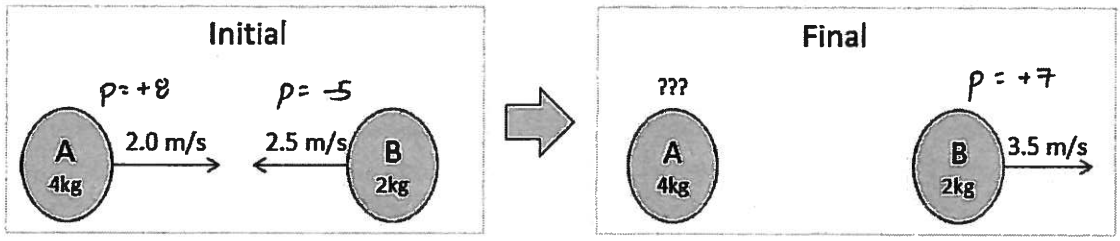
$\approx 8.00 \times 10^{-2}\ kg\,m/s$

KEY

Unit 1 – Part 2 – Momentum Collisions in 1-Dimension and 2-Dimensions

Use the following information to answer Q3:

Two objects strike and rebound as below:



Q3: The final velocity of *Object A* is _____ m/s [Left].

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

1	.	0	0

$\vec{p}_i = \vec{p}_f$

$(+8) + (-5) = (\vec{p}_A) + (+7)$

$3 = \vec{p}_A + 7$

$-4\ kg\,m/s = \vec{p}_A$

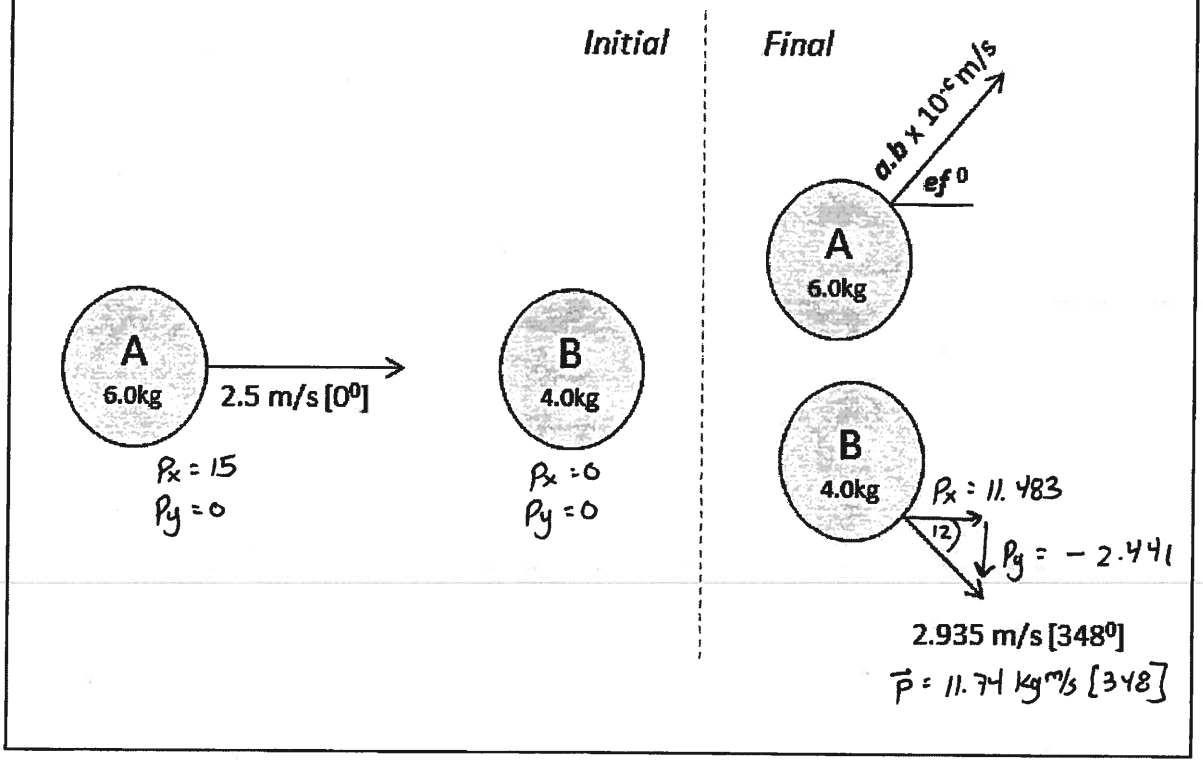
$\vec{p}_A = 4\ kg\,m/s\ [Left]$

$v_A = 1.00\ m/s\ [Left]$

Key

Use the following information to answer Q4:

A 6.0kg object moving at 2.5 m/s [0^0] strikes a stationary 4.0 kg object, as depicted below.



Q4: The final velocity of *Object B* is ***a.b*** x 10^{-c} m/s [ef^0], where ***a, b, e,*** and ***f*** are ___, ___, ___, and ___.

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

7	1	3	5

x-comp

$P_i = P_f$

$15 + 0 = 11.483 + P_A$

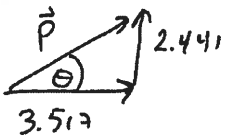
$P_A = 3.517$ kg m/s

y-comp

$P_i = P_f$

$0 + 0 = P_A + (-2.441)$

$P_A = +2.441$



$\theta = \tan^{-1}\left(\frac{2.441}{3.517}\right) = 35°$

$\vec{P}_{A_f} = 4.281$ kg m/s

$\vec{V}_{A_f} = 0.7135$ m/s [35°]

$\approx 7.1 \times 10^{-1}$ m/s [35°]

KEY

Unit 2 – Part 1 – Coulomb's Law, Electric Fields, and Parallel Plates

Use the following information to answer Q5:

An initially neutral electroscope has a positive rod placed near the electroscope without making contact (Diagram #2). The positive charge is then removed (Diagram #3.

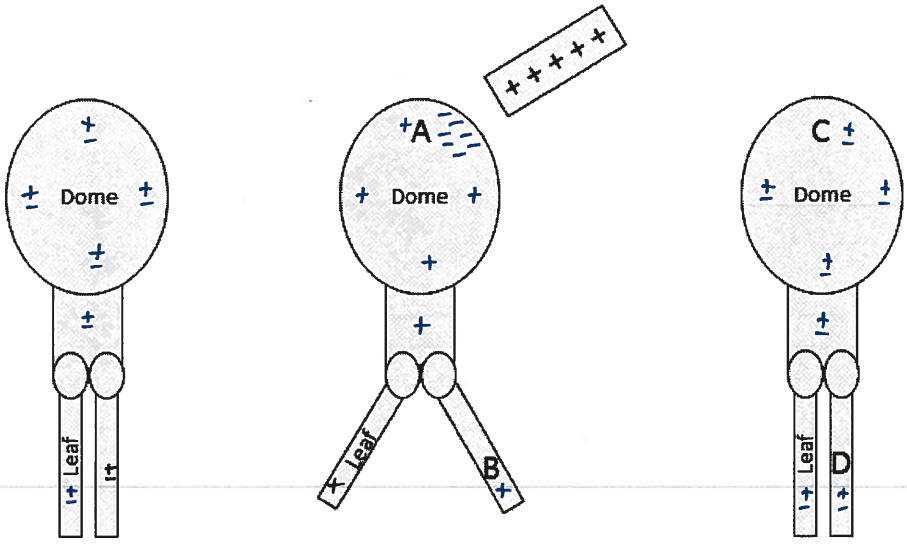


Diagram #1 Diagram #2 Diagram #3

Nature of Charge

1 – Positive
2 – Negative
3 – Neutral

Q5: The nature of the charge at various locations on an electroscope can be described using the numbers given above.

Charge:	2	1	3	3
Location:	**Nature of charge at location A in Diagram #2**	**Nature of charge at location B in Diagram #2**	**Nature of charge at location C in Diagram #3**	**Nature of charge at location D in Diagram #3**

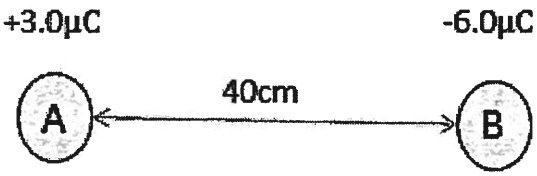
*(Record your **four digit** answer in the Numerical Response boxes below)*

2	1	3	3

KEY

Use the following information to answer Q6:

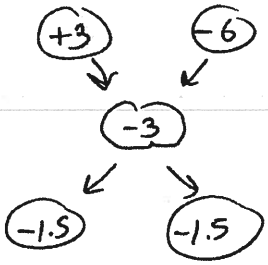
Two charges are initially placed 40cm apart, per the diagram below.



The charges are momentarily brought into contact before returning them to their original positions.

Q6: The electrostatic force between the two charged spheres is

a. 0.13 N [attractive]
b. 0.13 N [repulsive]
c. 1.01 N [attractive]
d. 1.01 N [repulsive]



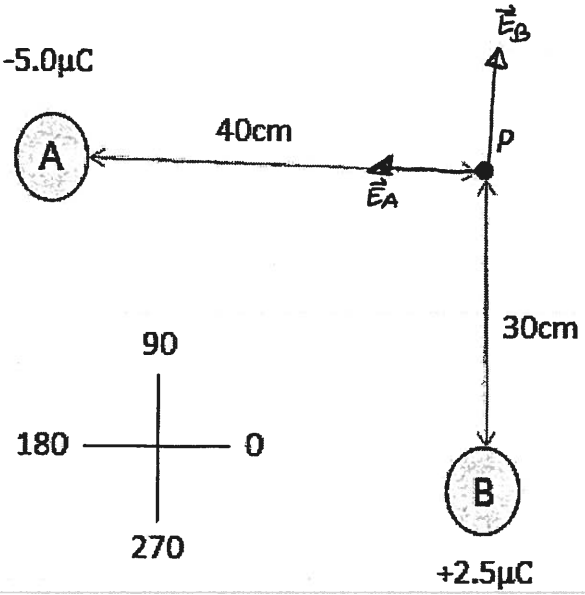
$$F_e = \frac{(8.99\times10^{9})(1.5\times10^{-6})(1.5\times10^{-6})}{(0.4)^2}$$

$F_e = 0.1264\ N$ [repulsive]

KEY

Use the following information to answer Q7:

Two charges are placed at right angles to each other, per the diagram below.



Q7: The net electric field at *Point P* is at _____ degrees, in polar coordinates.

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

1	3	8	

$\vec{E}_A = \frac{kq_A}{r^2}$

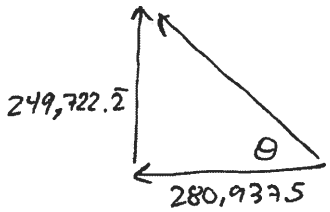
$= \frac{(8.99\times10^9)(5\times10^{-6})}{(0.4)^2}$

$= 280,937.5$ N/C

$\vec{E}_B = \frac{kq_B}{r^2}$

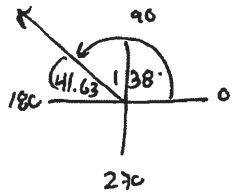
$= \frac{(8.99\times10^9)(2.5\times10^{-6})}{(0.3)^2}$

$= 249,722.\overline{2}$ N/C



$\theta = \tan^{-1}\left(\frac{o}{a}\right)$

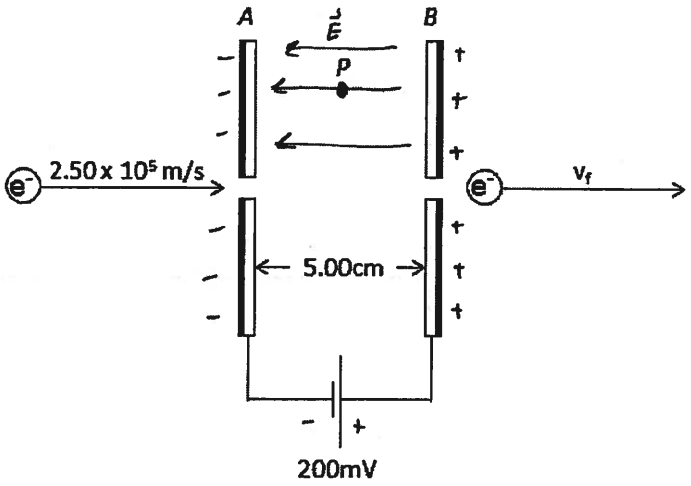
$\theta = 41.63° \Rightarrow \theta = 138°$



KEY

Use the following information to answer Q8-Q10:

An electron is injected into a parallel plate apparatus per the diagram below:



Q8: In the diagram above, *Plate A* is __*i*__ charged and the electric field at *Point P* is to the __*ii*__.

	i.	*ii.*
A.	positively	right
B.	positively	left
C.	negatively	right
(D.)	negatively	left

Q9: Upon exiting the plates, the final velocity of the electron is ***a.bc*** x 10^{d} m/s, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

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

3	6	4	5

$E_{K_i} + E_{P_i} \rightarrow E_{K_f}$

$\frac{1}{2}mv_i^2 + q\Delta V = \frac{1}{2}mv_f^2$

$\frac{1}{2}(9.11\times10^{-31})(2.5\times10^{5})^2 + (1.60\times10^{-19})(200\times10^{-3}) = \frac{1}{2}mv_f^2$

$2.846875\times10^{-20} + 3.2\times10^{-20} = \frac{1}{2}(9.11\times10^{-31})v_f^2$

$v_f = 364,352.123382$

$v_f \approx 3.64\times10^{5}$ m/s

KEY

Q10: The impulse experienced by the electron while in this region is ***a.b*** x 10^{-cd} Ns, where ***a***, ***b***, ***c***, and ***d*** are ___, ___, ___, and ___.

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

1	0	2	5

$F\Delta t = m\Delta v$

Impulse = Change in Momentum

$p_i = mv_i$
$= (9.11\times10^{-31})(2.50\times10^{5})$
$= 2.2775\times10^{-25}$ kg m/s

$p_f = mv_f$
$= (9.11\times10^{-31})(364{,}352)$
$= 3.319247\ldots\times10^{-25}$ kg m/s

$\Delta p = 1.0\times10^{-25}$ kg m/s

$F\Delta t = 1.0\times10^{-25}$ Ns

Alternate Method

$\vec{E} = \frac{\Delta V}{\Delta d} = 4$ N/C

$\vec{F} = q\vec{E} = 6.40\times10^{-19}$ N

$a = \frac{F_{net}}{m} = 7.025246981341\times10^{11}$ m/s^2

$a = \frac{v_f - v_i}{t}$ or $t = \frac{v_f - v_i}{a}$

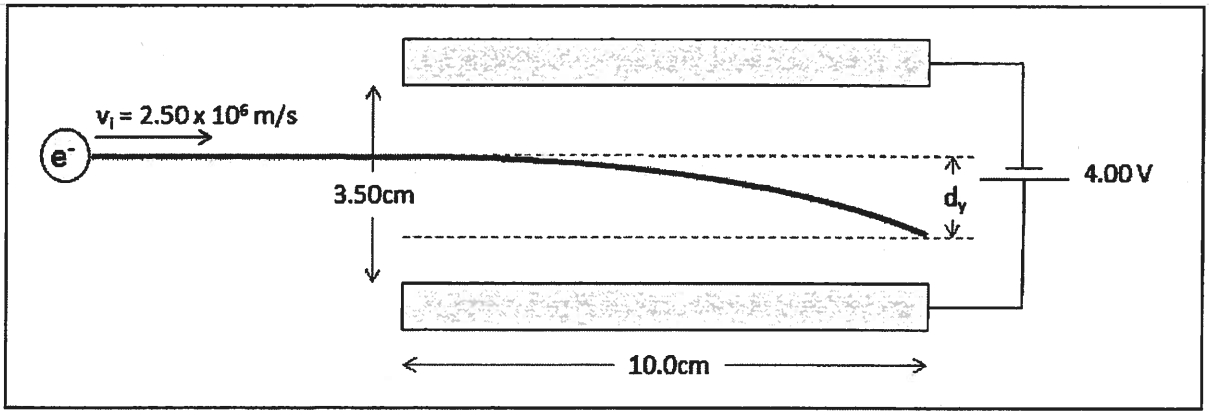
$t = \frac{364{,}352.123382 - 2.5\times10^{5}}{7.025246981341\times10^{11}}$

$t = 1.627731006271\times10^{-7}$

$F\Delta t = (6.40\times10^{-19})(1.6277\ldots\times10^{-7})$

$F\Delta t = 1.0\times10^{-25}$ Ns

Use the following information to answer Q11:



Q11: The vertical displacement of the electron, while between the parallel plates, is _____ cm.

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

1	.	6	1

(A) $|\vec{E}| = \frac{\Delta V}{\Delta d} = \frac{4}{0.035} = 114.285714286$ N/C

(B) $\vec{F} = q\vec{E} = (1.60\times10^{-19})(114.2857\ldots) = 1.828571428571\times10^{-17}$ N

(C) $a = \frac{F_{net}}{m} = \frac{1.8285\ldots\times10^{-17}}{9.11\times10^{-31}} = 2.007213423\,25\times10^{13}$ m/s^2

(D) x-comp

$v_x = 2.5\times10^{6}$ m/s
$d_x = 0.10$ m
$t = ?$

$v = \frac{d}{t}$ or $t = \frac{d}{v}$

$t = 4.00\times10^{-8}$ s

y-comp

$v_i = 0$
$a = 2.007\ldots\times10^{13}$
$d_y = ?$
$t = ?$

$d = v_i t + \frac{1}{2}at^2$

$d = \frac{1}{2}(2.007\ldots\times10^{13})(4.00\times10^{-8})^2$

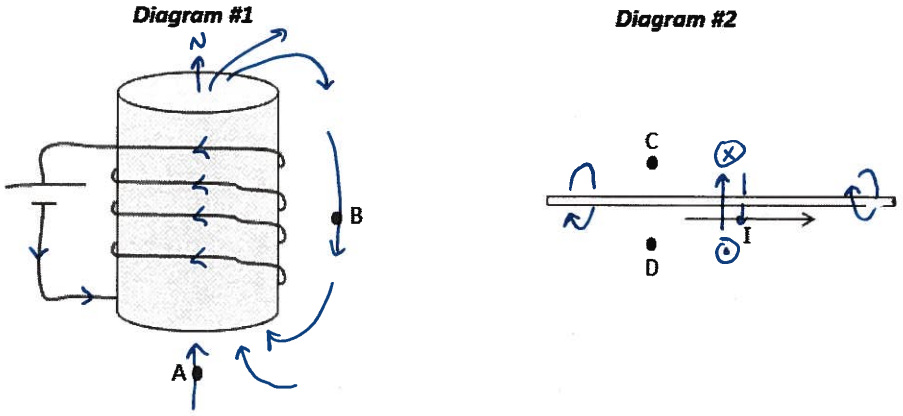
$d = 0.0160577\ldots$ m $\simeq 1.61$ cm

KEY

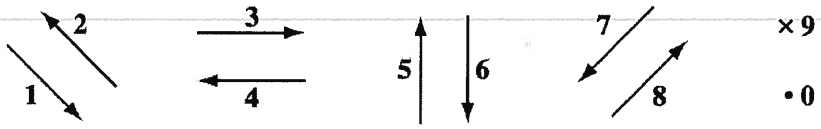
Unit 2 – Part 2 – Magnetic Forces and Fields, Motor and Generator Effect, Millikan Experiment

Use the following information to answer Q12:

Magnetic Fields around Current in a Wire



Directions



Q12: The directions of magnetic fields at various locations can be described using the numbers given above.

Direction:	5	6	9	0
Field:	**Direction of magnetic field at *Position A***	**Direction of magnetic field at *Position B***	**Direction of magnetic field at *Position C***	**Direction of magnetic field at *Position D***

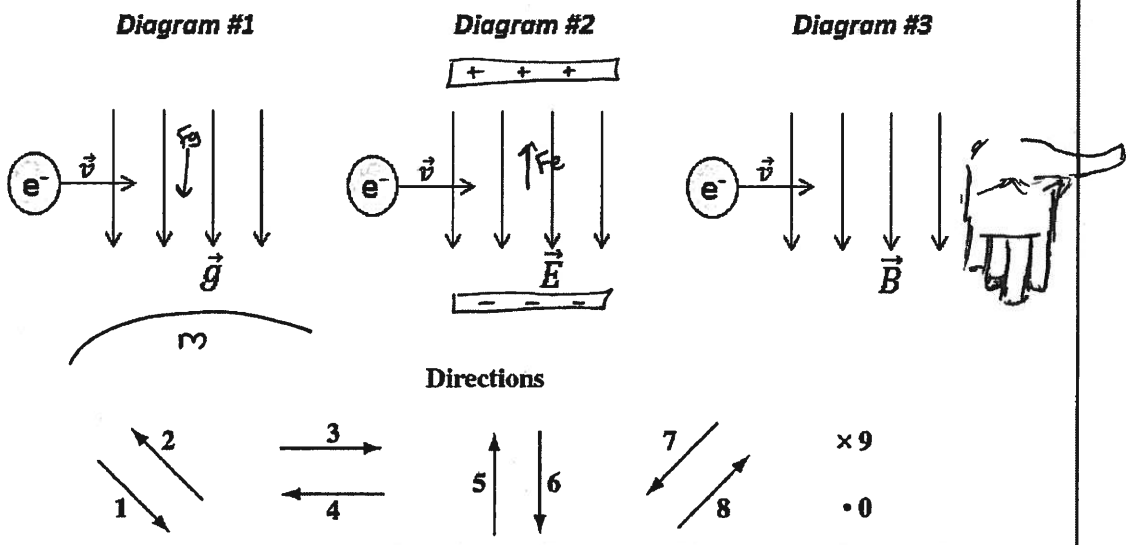
*(Record your **four digit** answer in the Numerical Response boxes below)*

5	6	9	0

KEY

Use the following information to answer Q13:

A moving electron is subject to three different types of fields, per the diagram below.



Q13: The directions of forces can be described using the numbers given above.

Direction:	6	5	∅
Force:	**Gravitational force acting on the electron in Diagram #1**	**Electrostatic force acting on the electron in Diagram #2**	**Magnetic force acting on the electron in Diagram #3**

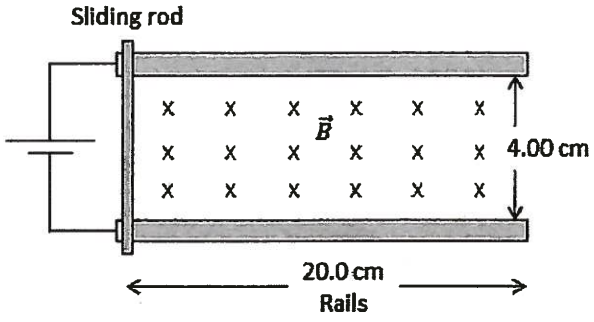
*(Record your **three digit** answer in the Numerical Response boxes below)*

6	5	0	

KEY

Use the following information to answer Q14:

A student designs a simple "rail gun", where a sliding rod completes a circuit loop. Because the sliding rod is subject to an external magnetic field, it experiences a magnetic force which accelerates it to the right. When at the end of the rails, it launches from the rail gun as a projectile.



In the diagram above, the sliding rod has a mass of 10.0g and the magnetic field strength is 5.00T. The battery supplies a current of 4.00A.

Q14: The sliding rod leaves the rails travelling at a speed of ____ m/s.

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

5	.	6	6

$F_m = ILB$

$= (4.00)(0.04)(5.00)$

$= 0.8\ N$

$a = \frac{F_{net}}{m} = \frac{0.8}{0.01} = 80\ m/s^2$

$v_f^2 = v_i^2 + 2ad$

$v_f^2 = 0^2 + 2(80)(0.20)$

$v_f^2 = 32$

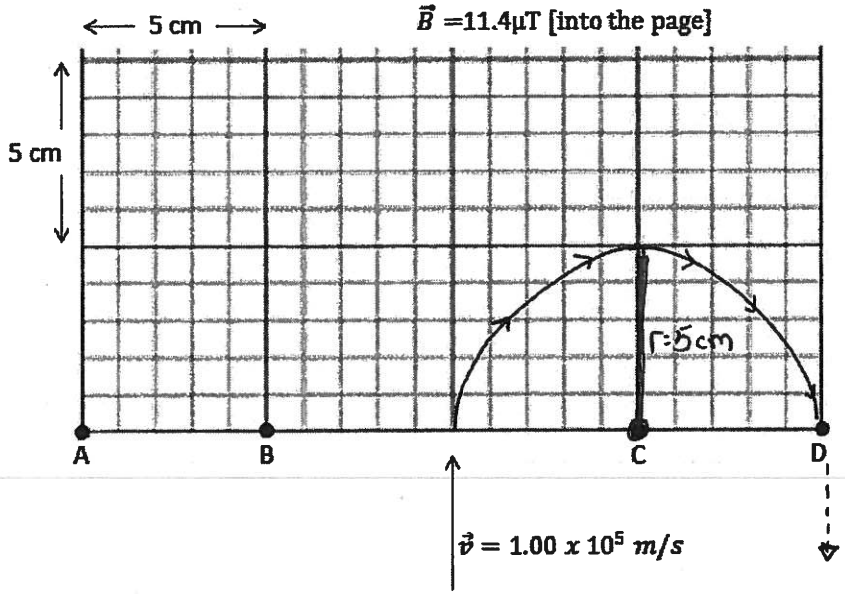
$v_f = 5.656854249\ 49\ m/s$

$v_f \approx 5.66\ m/s$

KEY

Use the following information to answer Q15:

An electron is travelling at 1.00×10^5 m/s through the air when it enters a region of space, depicted with a grid, which has a uniform magnetic field of 11.4μT [into the page]. The moving electron experiences a magnetic force that bends its path.



Q15: The electron leaves this region of space at

a. Position *A*
b. Position *B*
c. Position *C*
d. Position *D*

$F_m = F_c$

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

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

$r = \frac{mv}{qB} = \frac{(9.11\times10^{-31})(1.00\times10^5)}{(1.60\times10^{-19})(11.4\times10^{-6})}$

$r = 4.9945\times10^{-2}$ m

$r \approx 5.0$ cm ← Radius of the circle, not diameter.

Also, negative charge bends to the left (Hand rule).