KEY

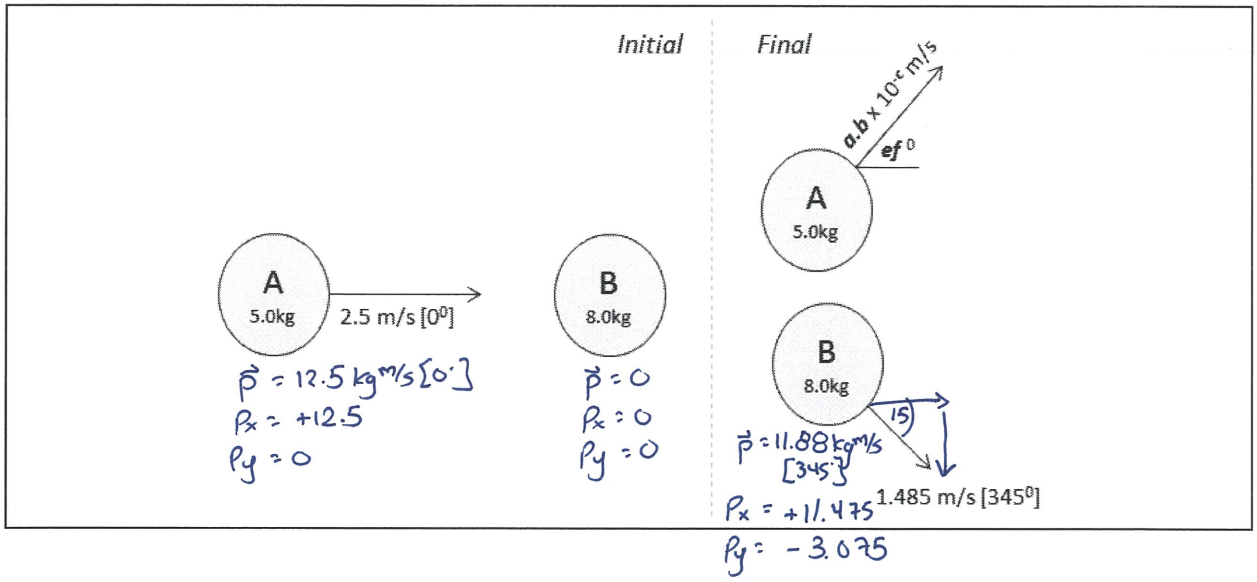
First Name:_____ Last Name:_____

L24 – Worksheet – Buffer Day – Cumulative Review

All questions on this worksheet have been given to the students previously… but it is good to review. Questions have ***intentionally*** not been put in any particular order.

Cumulative Review

Use the following information to answer Q1:



$\vec{p} = 12.5\ kg\,m/s\ [0°]$
$p_x = +12.5$
$p_y = 0$

$\vec{p} = 0$
$p_x = 0$
$p_y = 0$

$\vec{p} = 11.88\ kg\,m/s\ [345°]$
$p_x = +11.475$
$p_y = -3.075$

Q1: In an isolated system, *Object A* hits *Object B* inelastically. *Object A* then rebounds upward with a velocity of ***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)*

6	5	7	2

x-comp

$p_i = p_f$

$+12.5 + 0 = +11.475 + p_{f_x}$

$p_{f_x} = +1.0248$

y-comp

$p_i = p_f$

$0 + 0 = -3.075 + p_{f_y}$

$p_{f_y} = +3.075$

$p_f = 3.24105\ kg\,m/s$

$v_f = 0.64821\ m/s$

3.075

71.57°

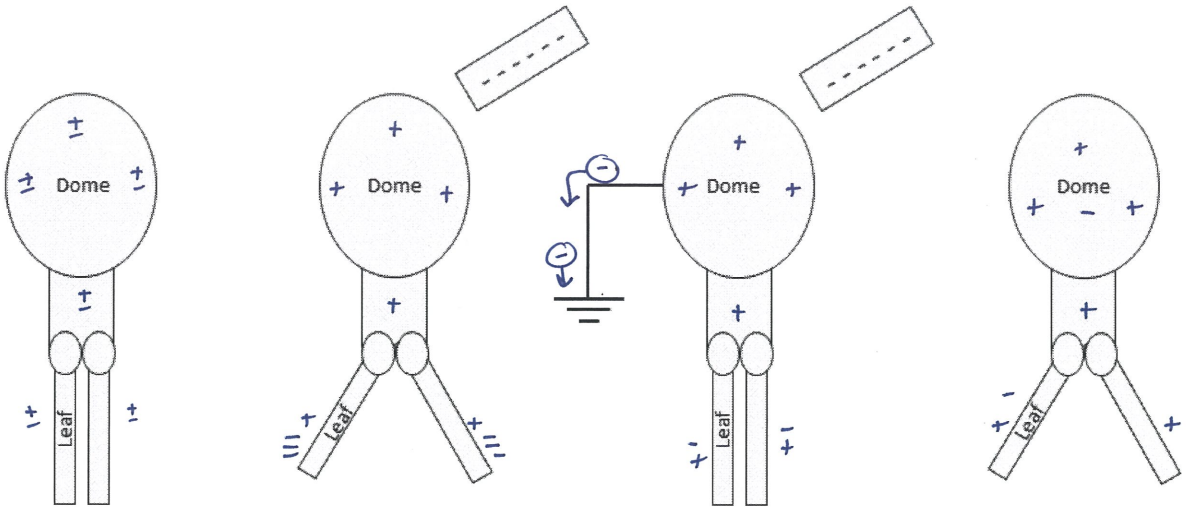
1.0248

$\vec{v}_f \approx 6.5 \times 10^{-1}\ m/s\ [72°]$

KEY

Use the following information to answer Q2:

Charge by Induction



Nature of Charge

1 – Positive

2 – Negative

3 – Neutral

Q2: Match the numbers representing *Nature of Charge* with the regions given below.

Nature of Charge:	1	2	1	1
Region:	Dome in Diagram #2	Leaves in Diagram #2	Dome in Diagram #4	Leaves in Diagram #4

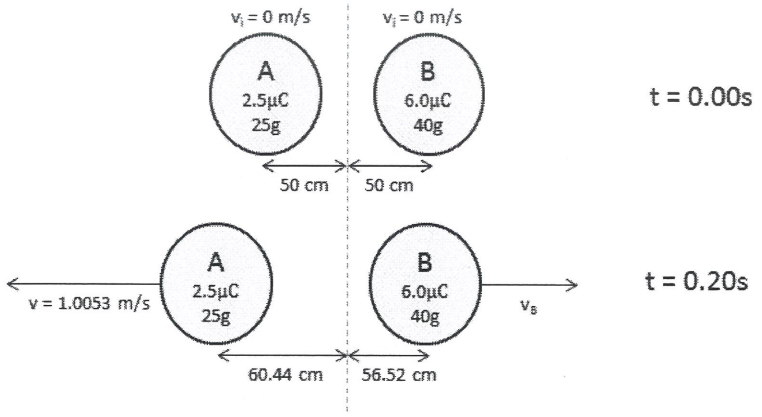
*(Record your **four digit** answer in the Numerical Response boxes below)*

1	2	1	1

KEY

Use the following information to answer Q3-Q4:

Two positively charged spheres are held 1.00m apart. Once released, both charges electrostatically repel from each other, per the diagram below.



Q3: The instantaneous acceleration of *Object A*, the moment it is released, is

a. 5.39×10^{-3} m/s^2
b. 2.16×10^{-2} m/s^2
(c.) 5.39 m/s^2
d. 2.16×10^{1} m/s^2

$F_e = \frac{kq_1q_2}{r^2} = \frac{(8.99\times10^9)(2.5\times10^{-6})(6.0\times10^{-6})}{(1.0)^2}$

$= 0.13485N$

$a = \frac{F_{net}}{m} = \frac{0.13485}{25\times10^{-3}} = 5.394\ m/s^2$

Q4: What is the impulse experienced by *Object A* within the first 0.20 seconds?

a. 2.35×10^{-2} Ns
(b.) 2.51×10^{-2} Ns
c. 2.70×10^{-2} Ns
d. 2.87×10^{-2} Ns

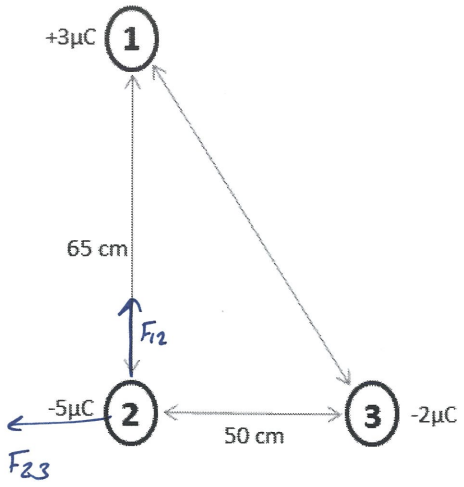
Impulse = Change in Momentum
$= m\Delta v$
$= m(v_f - v_i)$
$= (25\times10^{-3})(1.0053 - 0)$
$= 0.0251325$ Ns
$= 2.51\times10^{-2}$ Ns

KEY

Use the following information to answer Q5 and Q6:

Three Point Charges

Three point charges are arranged according to the diagram below. Charge **2** experiences a force due to the presence of Charge **1** and Charge **2**.



Directions

Q5: Use the vector directions above to fill in the blanks below.

Direction:	↑ 5	← 4	2
Description:	**Direction of Force acting on Charge 2 due to Charge 1**	**Direction of Force acting on Charge 2 due to Charge 3**	**Direction of Net Force acting on Charge 2**

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

5	4	2	

Q6: The magnitude of the net electrostatic force acting on Charge 2 is ***a.bc*** x 10^{-d} N, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

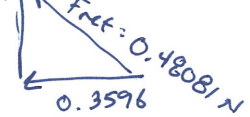
*(Record your **four-digit** answer in the Numerical Response boxes below)*

4	8	1	1

$F_{12} = \frac{kq_1q_2}{(0.65)^2} = 0.3191715976\overline{33}$

$F_{23} = \frac{kq_2q_3}{(0.50)^2} = 0.3596$

0.319171...

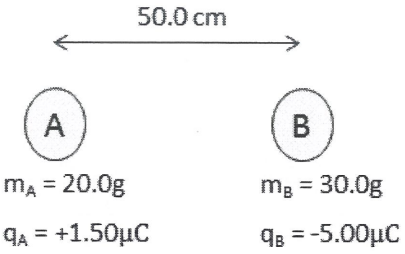


$F_{net} \approx 4.81 \times 10^{-1}\,N$

KEY

Use the following information to answer Q7-Q9:

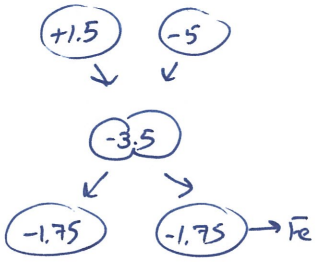
Two conductive spheres are arranged per the diagram below.



The conductive spheres are momentarily brought into contact, and then returned to their original position. Both items are then released simultaneously.

Q7: The acceleration of *Object B* is

a. 3.67 m/s^2 [Right]
b. 3.67 m/s^2 [Left]
c. 8.99 m/s^2 [Right]
d. 8.99 m/s^2 [Left]



$F_e = \frac{(8.99\times10^9)(1.75\times10^{-6})(1.75\times10^{-6})}{(0.50)^2}$

$F_e = 0.1101275\,N$

$a = \frac{F_{net}}{m} = \frac{0.1101275}{30\times10^{-3}}$

$a = 3.67\ m/s^2\ [right]$

Q8: When predicting the acceleration of *Object B*, state the two physics principles you used, in the order you used them.

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

7	1		

7 - Conservation of Charge
1 - Accelerated Motion ($\vec{F}_{net} \neq 0$)

Q9: Which situation best describes the relative impulses experienced by each object at the moment of release?

Impulse is F_{at} Same force for same time

a. 

b. 

c. 

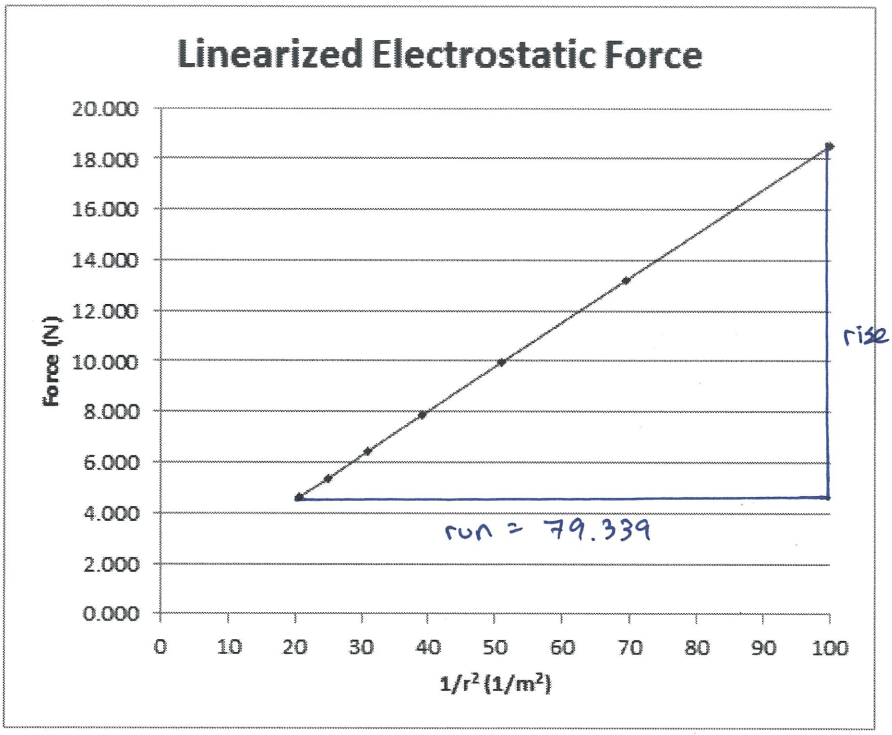
d. 

KEY

Use the following information to answer Q10:

The electrostatic attraction between a +3.00μC charge and an unknown charge is graphed below.

r	1/r^2	F
0.100	100.000	18.531
0.120	69.444	13.174
0.140	51.020	9.944
0.160	39.063	7.848
0.180	30.864	6.411
0.200	25.000	5.383
0.220	20.661	4.622



Q10: The unknown charge is

a. +6.50μC
b. -6.50μC
c. +6.87μC
d. -6.87μC

$m = \frac{rise}{run} = \frac{13.909}{79.339} = 0.175311007197$

$|\vec{F}| = \frac{kq_1q_2}{r^2}$

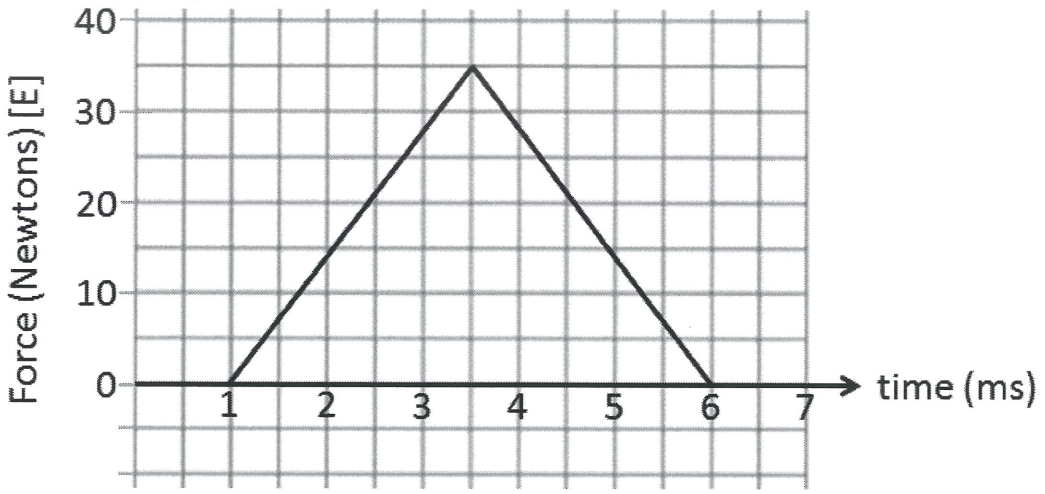
$|\vec{F}| = (kq_1q_2)\frac{1}{r^2} + 0$

$y = (m)x + b$

KEY

Use the following information to answer Q11:

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



Q11: The ball rebounds with a velocity of _____ m/s [E].

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

0	.	2	5

Impulse = Area under graph $= \frac{1}{2}(5\times10^{-3})(35)$
$= 0.0875\,Ns$

$F_{net} = m\Delta v$
$(0.0875) = (50\times10^{-3})\Delta v$
$\Delta v = 1.75\ m/s\ [E]$

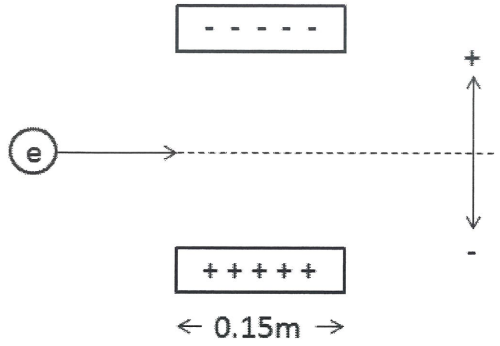
$\Delta\vec{v} = 1.75\ m/s\ [E]$
$\vec{v}_i = -1.5\ m/s\ [E]$
$\vec{v}_f = ?$

$\Delta\vec{v} = \vec{v}_f - \vec{v}_i$
$+1.75 = v_f - (-1.5)$
$1.75 = v_f + 1.5$
$0.25 = v_f$
$\vec{v}_f = 0.25\ m/s\ [E]$

KEY

Use the following information to answer Q12:

Two parallel plates are 1.35m apart, with a Potential Difference of 40.5V, as shown below.



An electron is fired horizontally at 2.40×10^5 m/s through the plates.

Q12: Upon exiting the plates, the electron will have experienced a vertical deflection of ____ m. *(5 marks)*

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

1	.	0	3

① $|\vec{E}| = \frac{\Delta V}{\Delta d} = \frac{40.5\,V}{1.35\,m} = 30\,N/C$

② $|\vec{F}| = q|\vec{E}| = (1.60\times10^{-19})(30) = 4.80\times10^{-18}\,N$

③ $a = \frac{F_{net}}{m} = \frac{4.80\times10^{-18}\,N}{9.11\times10^{-31}\,kg} = 5.268935236\times10^{12}\,m/s^2$

x-comp

$v_x = \frac{dx}{t}$

$t = \frac{dx}{v_x} = \frac{0.15}{2.40\times10^5}$

$t = 6.25\times10^{-7}\,s$

y-comp

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

$d = \frac{1}{2}at^2$

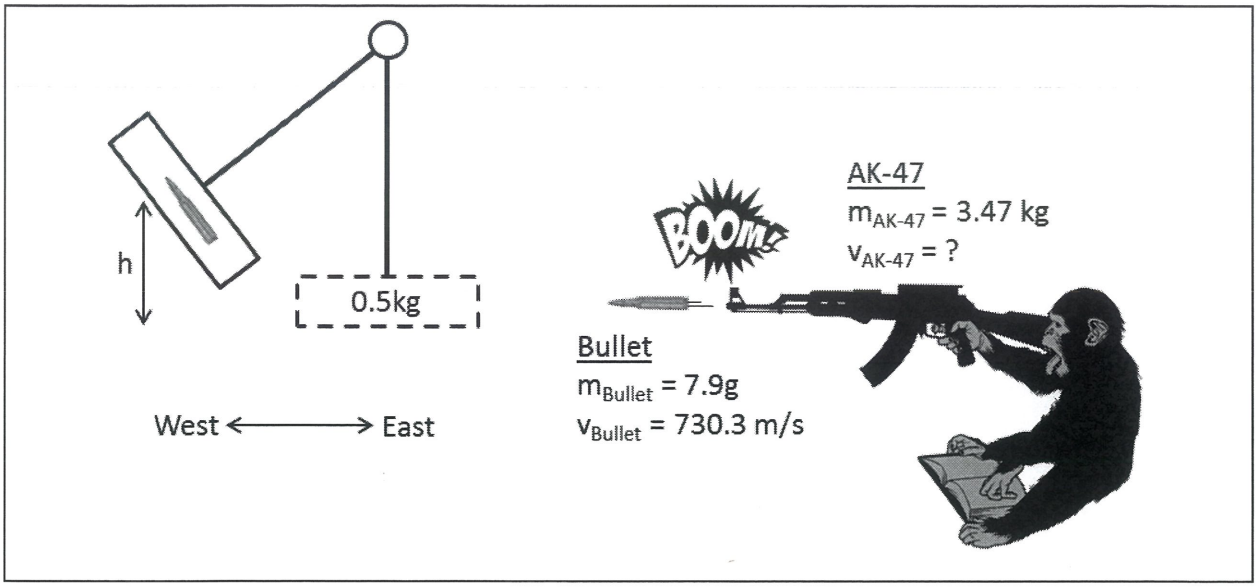
$d = \frac{1}{2}(5.2689...\times10^{12})(6.25\times10^{-7})^2$

$d = 1.029088913\,28\,m$

$d \approx 1.03\,m$

KEY

Use the following information to answer Q13:



Q13: After impact, the pendulum swings forward and rises to what height, in meters?

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

6	.	5	8

Cons. of Momentum

$p_i = p_f$

$(7.9\times10^{-3})(730.3) + (0.5)(0) = (0.5079)v_f$

$5.76937 + 0 = (0.5079)v_f$

$v_f = 11.35926363\,46$ m/s

Cons. of Energy

$E_K \rightarrow E_P$

$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}(11.35926363\,46)^2 = (9.81)h$

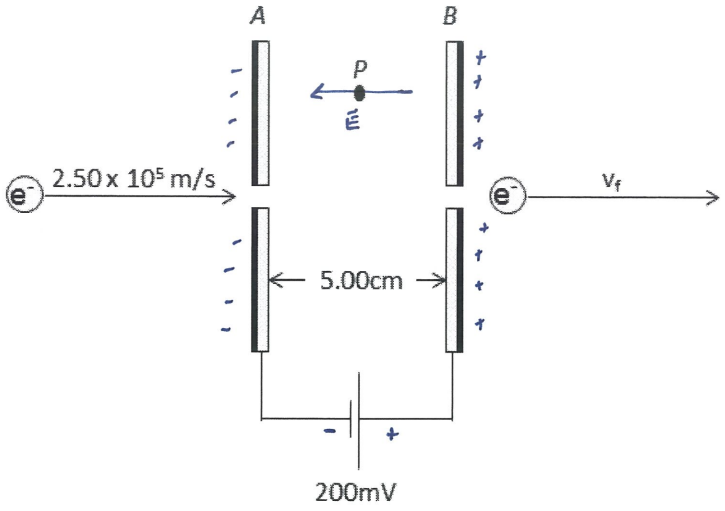
$h = 6.57659889501$

$h \approx 6.58$m

Key

Use the following information to answer Q14-Q15:

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



Q14: In the diagram above, *Plate A* is __neg (i)__ charged and the electric field at *Point P* is to the __left (ii)__.

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

Q15: 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

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

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

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

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

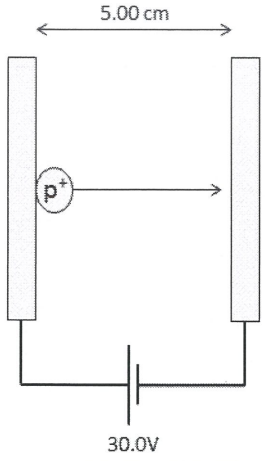
$v_f = 3.64352\times10^{5}\,m/s$

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

KEY

Use the following information to answer Q16:

A proton is placed between two parallel plates.



Q16: The impulse imparted to the proton 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	3	2	2

Option #1

$|\vec{E}| = \frac{\Delta V}{\Delta d} = \frac{30V}{0.05m} = 600\ N/C$

$|\vec{F}| = q|\vec{E}| = (1.60\times10^{-19})(600) = 9.6\times10^{-17}\ N$

$a = \frac{F_{net}}{m} = \frac{9.6\times10^{-17}}{1.67\times10^{-27}} = 5.7485...\times10^{10}\ m/s^2$

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

$0.05 = (0)t + \frac{1}{2}(5.7485...\times10^{10})t^2$

$t = 1.3189\,326\,492\,8\times10^{-6}\ s$

$Ft = (9.6\times10^{-17})(1.3189...\times10^{-6})$

$= 1.266175...\times10^{-22}\ Ns$

$\approx 1.3\times10^{-22}\ Ns$

Option #2

$E_p \rightarrow E_K$

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

$(1.60\times10^{-19})(30) = \frac{1}{2}(1.67\times10^{-27})v_f^2$

$v_f = 7.5819...\times10^{4}\ m/s$

$Ft = m\Delta v$

$= (1.67\times10^{-27})(7.5819...\times10^{4} - 0)$

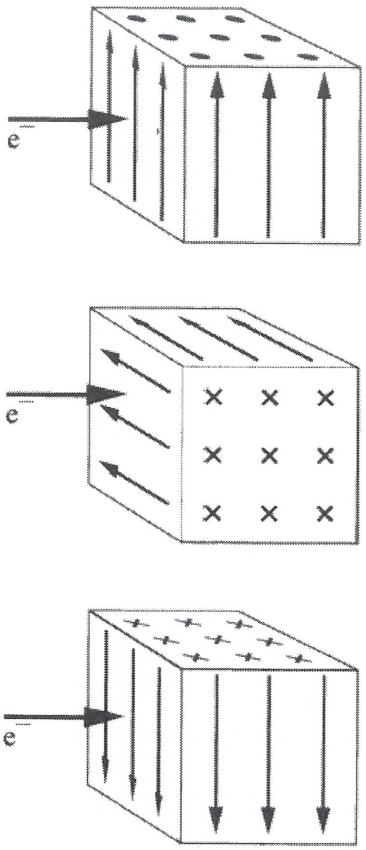
$= 1.266175...\times10^{-22}\ Ns$

$\approx 1.3\times10^{-22}\ Ns$

KEY

Use the following information to answer Q17:

Moving electrons can be deflected by electric fields, gravitational fields, and magnetic fields. One electron is allowed to enter each type of field, as shown below.



Q17: If the electron is deflected downward in each field, then field 1, field 2, and field 3 are, respectively,

a. Electric, magnetic, and gravitational
b. Gravitational, magnetic, and electric
c. Magnetic, gravitational, and electric
d. Magnetic, electric, and gravitational

KEY

Use the following *information to answer Q18:*

Magnetic Fields around Current in a Wire

Diagram #1

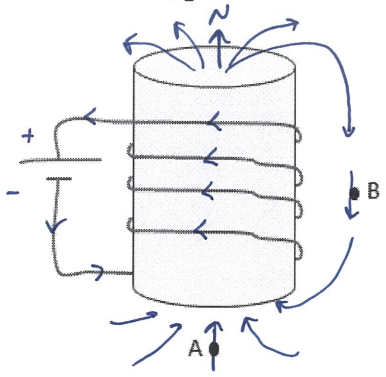
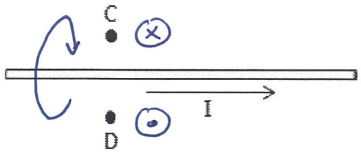
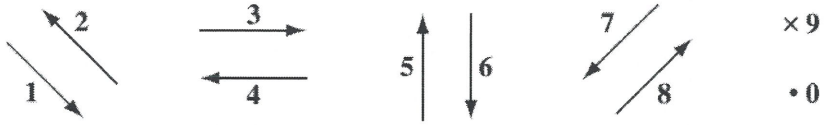


Diagram #2



Directions



Q18: The directions of magnetic fields at various locations can be described using the numbers given above.

Direction:	↑ 5	↓ 6	⊗ 9	⊙ ∅
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***

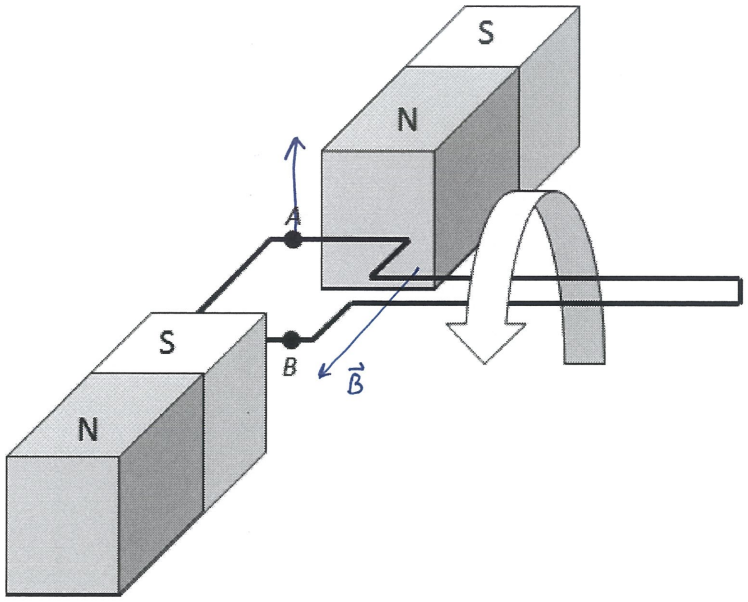
*(Record your **four digit** answer in the Numerical Response boxes below)*

5	6	9	∅

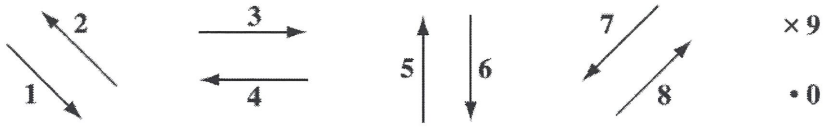
KEY

Use the following information to answer Q19:

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



Directions



Q19: 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	