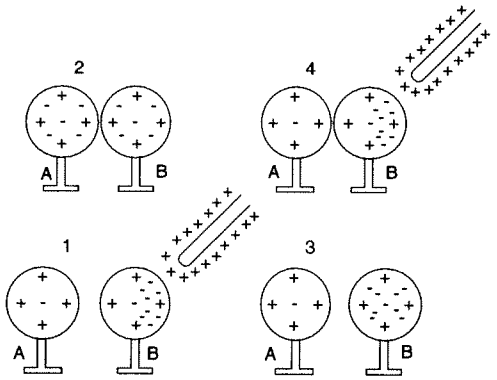
P30 Unit B Review Ver:9 **Name** _____

(___ 15 mc + ___ 3 NR) __ x 2 = __/36 + ____ / 14LA = ___ /50 Total

1. **Numerical Response**

Charge Redistribution

The overall process indicated by steps 1 to 4 is induction. Indicate the order of operation needed to place a net positive charge on shere A and leave shere B with a net negative charge *(note: in diagrams 2 and 4 the objects are touching)*
Answer ~~1234~~ 2 4 1 3



2. An electrically charged comb attracts small pieces of torn paper lying on a wooden desk because
   A. the polar molecules of the paper cause a redistribution of the charge on the comb
   B. the pieces of paper become charged
   C. tearing the paper results in charge separation
   ✓D. the comb induces a charge separation in the paper

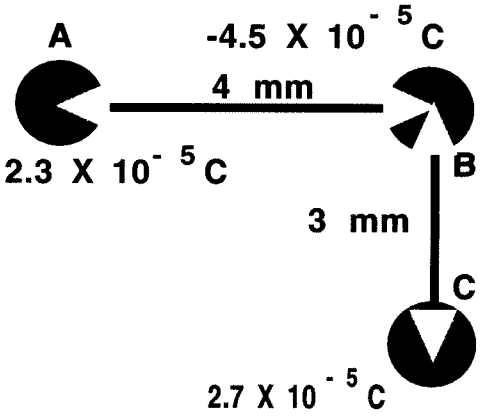
3. A positively charged rod is brought close to but does not touch an uncharged electroscope. The charges on the electroscope knob and leaves respectively are
   A. positive and positive
   B. positive and negative
   ✓C. negative and positive
   D. negative and negative

4. A negatively charged ebonite rod was inserted into a beaker containing a number of neutral carbon-coated pith balls. The following observations were made:
   1. First, when the ebonite rod was placed close to the pith balls, the pith balls were attracted to the rod.
   2. Next, the pith balls remained in contact with the rod for a fraction of a second.
   3. Finally, the pith balls jumped away from the rod.

   Explain these observations in terms of charge distributions and electrostatic forces. You may use diagrams as part of your explanation.
   6 marks

5. How many electrons are transferred in a 30 C bolt of lightning?
   2 marks
   Answers 1.875×10^{20} electrons

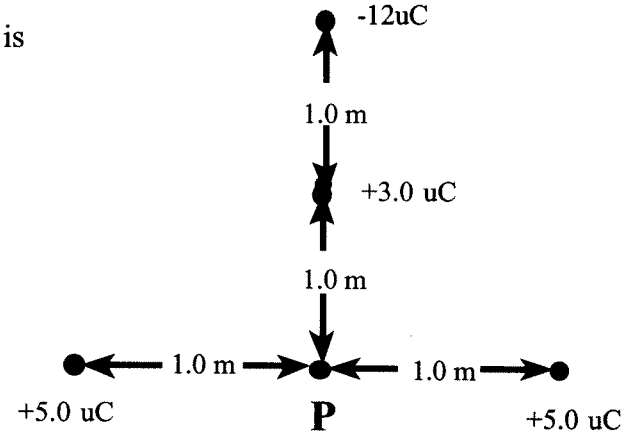
6.



What is the net force on charge B?

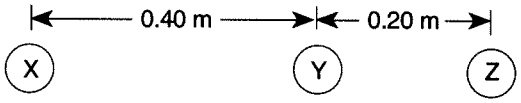
Answer a.bc x 10^d
into numeric response abcd
F = 1.35 x 10^6 Ñ
@ 64° S of West

7. The magnitude of the net electric field at point P due to these four point charges is



✓A. 0.0 N/C
B. 5.4 x 10^4 N/C
C. 4.5 x 10^4 N/C
D. 2.7 x 10^4 N/C

8. Charges X, Y and Z have values of +10 uC, +1.0 u C, and +10.0 u C respectively.



The net electrostatic force acting on Y because of X and Z is

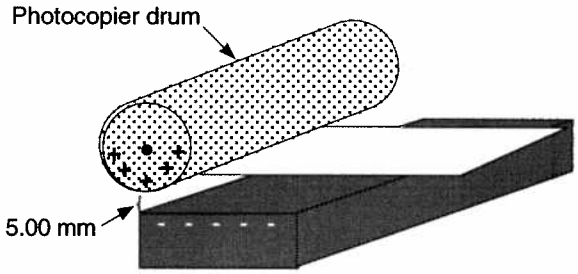
A. 2.2 N to the right
B. 0.56 N to the left
C. 2.8 N to the right
✓D. 1.7 N to the left

Use this information to answer the next 3 questions.

The Photocopier

A typical copier has an aluminum drum that is coated with a thin layer of the semiconductor selenium. The drum is rotated through a container of toner. The toner consists of tiny charged plastic beads coated with carbon grains. The coated beads are attracted to the charged areas of the selenium layer on the drum but not to the areas where the charge has dispersed. A sheet of paper is then pressed against the drum and the coated beads are transferred to the paper. The paper is heated and the beads melt, attaching the carbon to the paper to form the image.

Assume that the beads of toner (dry ink) and letters on the drum act as point charges. The charge on each bead of toner is -6.40×10^{-16} C and the average charge on the part of the drum with the image of the letter copied is $+7.10 \times 10^{-13}$ C.



9. When the toner and the drum are separated by 5.00 mm, the force of attraction between the letter and the toner bead, expressed in scientific notation is, b $\times 10^{-13}$ N. The value of b is _____. (Round and record your answer to three digits.)

Answer F = 1.63×10^{-13} N

10. Suppose the charge on each bead of toner is reduced to -1.60×10^{-16} C. To have the same force of attraction between a letter and a toner bead as before, the distance separating the drum and the toner must be changed to

A. 1.30 mm
B. 2.00 mm
✓C. 2.50 mm
D. 1.00 mm

Answer 2.50 mm

11. If the drum is positive and the toner is negative, the direction of the electric field at a point halfway between the drum and toner is

A. from the toner to the drum
B. in the same direction of the drum rotation
C. in the opposite direction of the drum rotation
✓D. from the drum to the toner

12. Two positive charges, q1 of 2.0×10^{-6} C and q2 of 3.0×10^{-6} C, are separated by 3.0 m. The electric force between them is

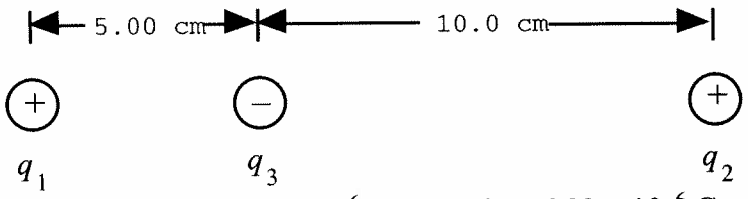
A. 6.0×10^{-3} N (attraction)
B. 2.0×10^{-3} N (repulsion)
C. 2.0×10^{-3} N (attraction)
✓D. 6.0×10^{-3} N (repulsion)

Answer 6.0×10^{-3} N (repulsion)

13. At a distance 5.06 m from a point charge of magnitude 6.02×10^{-6} C, the magnitude of the electric field strength is b $\times 10^{3}$ N/C. The value of b is _____. (Round and record your answer to three digits.)

Answer 2.11

14. The diagram shows three charges (q_1, q_2, and q_3).

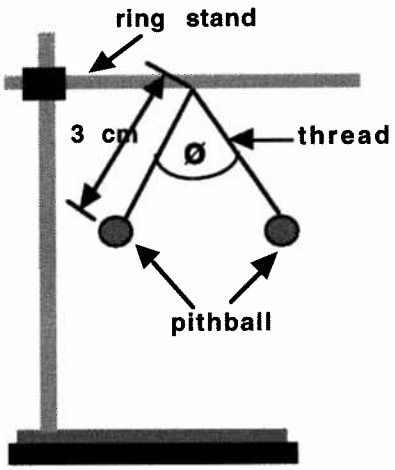


The charge on q_1 is $+ 8.00 \times 10^{-6}$ C, on q_2 is $+ 6.00 \times 10^{-6}$ C, and on q_3 is $- 5.00 \times 10^{-6}$ C.

What is the resultant force on q_3?

A. 171 N, directed right
✓B. 117 N, directed left
C. 117 N, directed right
D. 171 N, directed left

15. If the two equally charged pithballs of mass 2.0 mg each are hung by two pieces of thread from a single point by a 3 cm thread, If the angle between the the two pieces of thread is 15°, What is charge on the pithballs



8 marks for answer
3 marks communication

Answer q=1.33 x 10^{-10} C per pithball

16. What is the the force of attraction between an electron and proton if they are seperated by 1.4×10^{-10} m.

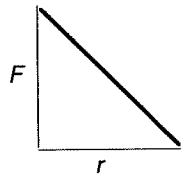
4 marks
F = 1.2 x 10^{-8} N

17. The force of repulsion between two unequal like charges is

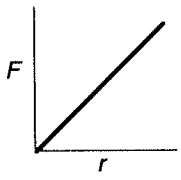
✓A. inversely proportional to the square of the distance separating the charges
B. directly proportional to the sum of the charges
C. directly proportional to the square of each charge
D. inversely proportional to the distance separating the charges

18. Two point charges are separated by a distance r. The graph that best shows the relationship between the magnitude of the electric force F and the separation r is

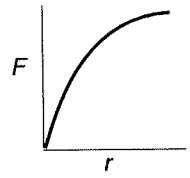
A.



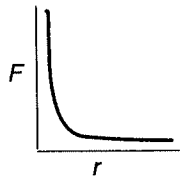
B.



C.

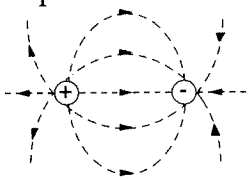


✓D.

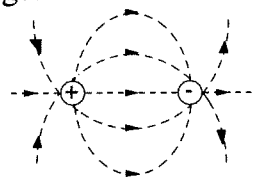


19. One object has a positive charge, while a second object has a negative charge. The diagram that best represents the electric field surrounding the charges is

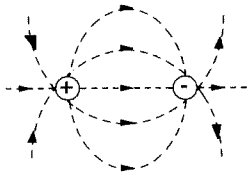
✓A.



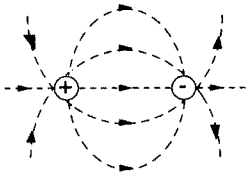
B.



C.



D.



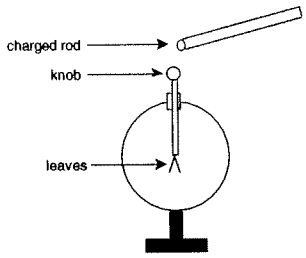
20. When a glass rod is rubbed with silk, the glass rod acquires a positive charge; when a rubber rod is rubbed with fur, the rubber rod acquires a negative charge.

Glass and rubber rods, silk and fur, and a metal-leaf electroscope are on hand. All of then are initially uncharged.
A) Explain how you would place a net positive charge on an uncharged electroscope by conduction, and describe the movement of charges that would occur at each stage. You may wish to include appropriately labelled diagrams as part of your explanation.

B) Explain how you would place a net positive charge on an uncharged electroscope by induction, and describe the movement of charges that would occur at each stage. You may wish to include appropriately labelled diagrams as part of your explanation.
6 marks

21. When a charged rod is close to a neutral electroscope, the leaves the electroscope are observed to spread apart.

While the charged rod is held close to the knob of the electroscope, one can infer that

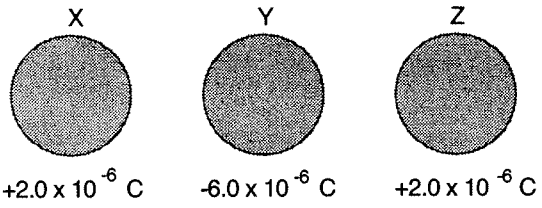


A. both the leaves and the knob have a charge opposite to that of the rod
✓B. only the leaves have a charge similar to that of the rod
C. only the leaves have a charge opposite to that of the rod
D. both the leaves and the knob have a charge similar to that of the rod

22. How many extra electrons does an object have if it has a negative charge of 1.58×10^{-17}C ?

A. 44
✓C. 99
B. 33
D. 123

23. Charge Redistribution



Three identical insulated metal spheres, Z, Y, and X, have their initial charges as indicated.

If Z is touched to Y and then Z is touched to X, the charge remaining on X will be
✓A. zero
B. -6.7×10^{-7} C
C. $+6.7 \times 10^{-7}$ C
D. -3.3×10^{-6} C

24. Many asthma cases are due in part to airborne dung pellets from dust mites. A scientist in Britain invented a fabric for use in air filters and carpets that removes the airborne pellets by electrostatic attraction. If the dung pellets are neutral or have a positive or negative charge, the fabric in the air filter would have to contain some fibres that are

✓A. positively charged and some fibres that are negatively charged.
B. neutral
C. positively charged and some fibres that are neutral
D. negatively charged and some fibres that are neutral

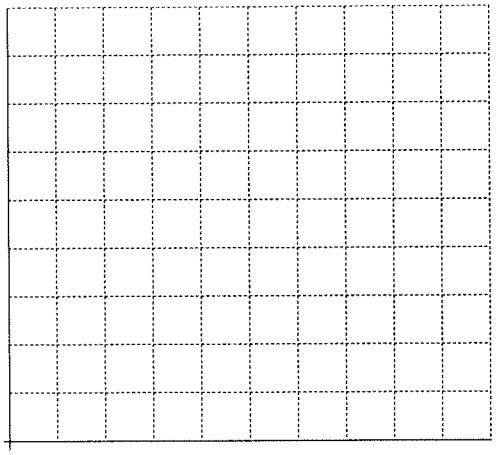
25. In a Millikan oil drop experiment, the plates are 3.0 cm apart and an oil drop of mass 2.6×10^{-9} g is suspended between the plates. The potential difference between the plates is 300 V. The charge on the oil drop is

A. 2.55×10^{-10} C
✓C. 2.55×10^{-15} C
B. 2.9×10^{-12} C
D. 2.9×10^{-15} C

26. In a modified Millikan apparatus, a small charged object that has a mass of 2.5×10^{-6} kg is suspended by the electric field between charged parallel plates. The table shows how the balancing voltage depends on the distance between the plates:

Plate separation (mm)	Balancing voltage (V)
1.1	10
2.0	17
2.4	21
3.1	27
3.5	30
5.0	42

a. On a grid, plot a graph of balancing voltage and plate separation, with the manipulated variable on the horizontal axis. [1 marks]



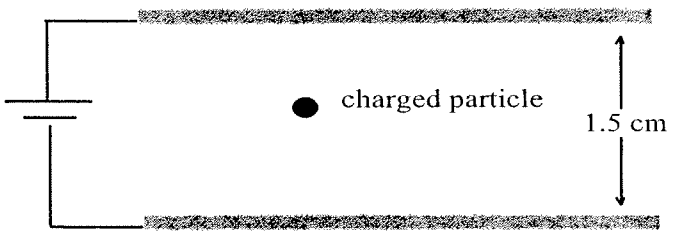
b. Calculate the slope of the graph. What physical quantity or quantities does this slope represent?
[2 marks]

c. Use a suitable averaging technique to determine the magnitude of the charge on the suspended object. [2 marks]

qave = 2.8×10^{-9} C

27. **WRITTEN RESPONSE**

A student injected a small electrically charged particle with a mass of 2.2×10^{-15} kg into a Millikan-like apparatus as shown below.



The student determined the particle's upward acceleration for various potential differences and recorded the data in the table below.

Potential Difference (V)	Upward Acceleration (m/s^2)
340	1.7
380	2.6
400	3.5
420	4.3
460	5.4

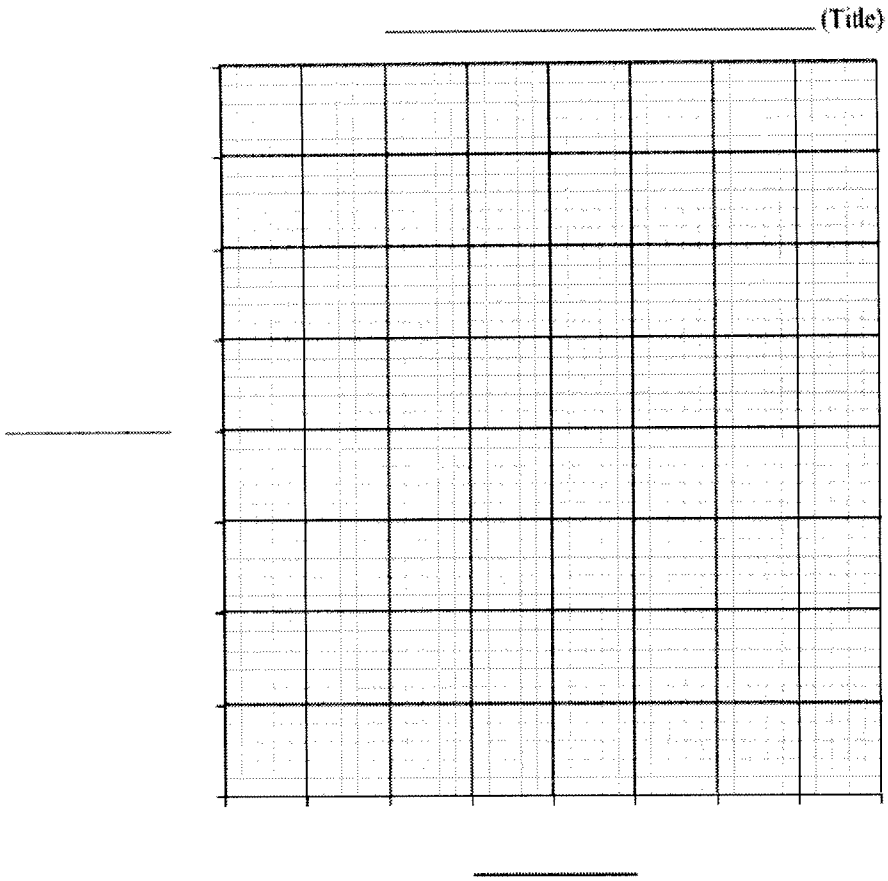
Analyze the results above. In your analysis.

- **Indicate** the polarity of the plates and draw electric field lines showing the electric field direction and shape between the parallel plates.
- **Provide** a graph of the data *(plot the responding variable on the vertical axis)*
- **Determine** the value, units, and significance of the x-intercept.
- Using a proper averaging technique, **determine** the magnitude and sign of the charge present on the small particle.

ANSWER THIS QUESTION ON THE NEXT PAGE

(6 MARKS)

27. **WRITTEN RESPONSE ANSWER PAGE**



q = 1.1 x 10^{-18} C

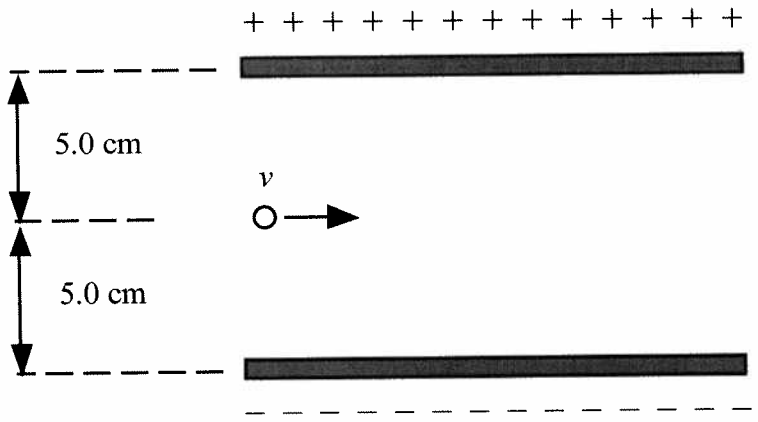
28. The acceleration of an electron in a uniform electric field of magnitude 5.0 x 10^{-4} N/C is

A. 8.0 x 10^{-23} m/s^2
B. 5.5 x 10^{26} m/s^2
C. 9.0 x 10^{6} m/s^2
✓D. 8.8 x 10^{7} m/s^2

29. An alpha particle with an initial velocity of 7.15 x10^{4} m/s enters through a hole in the positive plate between two parallel plates that are 9.00 x 10^{-2} m apart. If the electric field between the plates is 1.7 x 10^{2} V/m, what is the speed of the alpha particle when it reaches the negative plate?

(6 marks)
8.11 x 10^{4} m/s

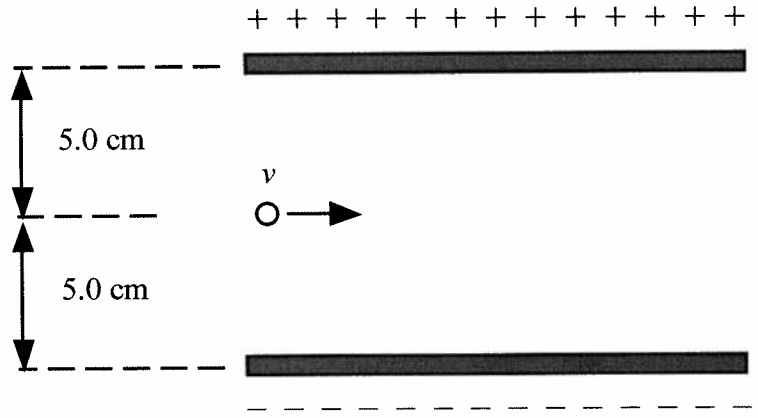
30. The diagram shows an electron traveling at 2.00 x10^6 m/s in an electric field that is 10 cm long.



A) If the electric field is 20.0 N/C how much far will the electron travel verticaly as it passes between the plates.

d = 4.39 mm

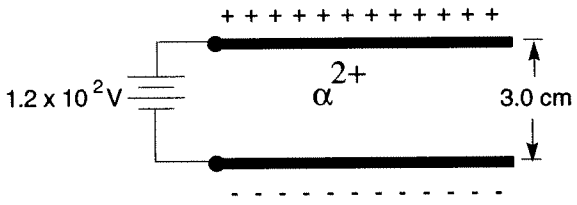
31. The diagram shows a particle with a charge of -3.00×10^{-6} C moving through a region of uniform electric field. The positively changed plate is directly above the negatively charged plate.



The particle has a mass of 3.50×10^{-5} kg and it moves horizontally to the right through the electric field of 75.0 N/C and under the influence of gravity. Using appropriate formulas and a logical method, find the net vertical force on the particle while it is travelling through the electric field.

1.1 x 10^{-4} N Down

32. A) Draw the electric field between the two plates.



B) Determine the electric field at 1.0 cm from the positive plate.

C) How much work is done to move the alpha particle 1.0 cm toward the positive plate?

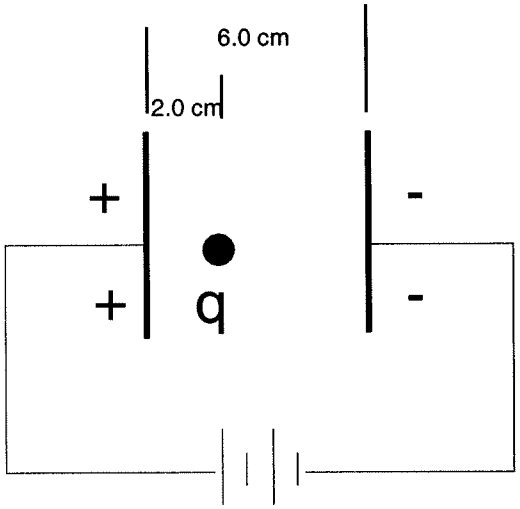
D) If the alpha particle is released at the positive plate, with what speed will it reach the negative plate?

B) E = 4.0 x 10^3 N/C

C) W = 1.28x 10^{-18}J

D) v = 1.07 x 10^5 m/s

33. **A Point Charge between Parallel Plates**



Two vertical plates 6.0 cm apart have an unknown voltage across them.

A point charge of q = $^+3.00 \times 10^{-6}$ C and 3.5×10^{-10} kg is placed 2.0 cm from the positive plate and experiences an electrostatic force of 4.00×10^{-4} N.

a. The Voltage across the two plates is _____V

b. The electric field strength at the point charge is _____N/C

c. If the charge starts at rest 2.0 cm from the positive plate and is let go. What is its speed at the negative plate?

d. Draw the electric fields between the plates.

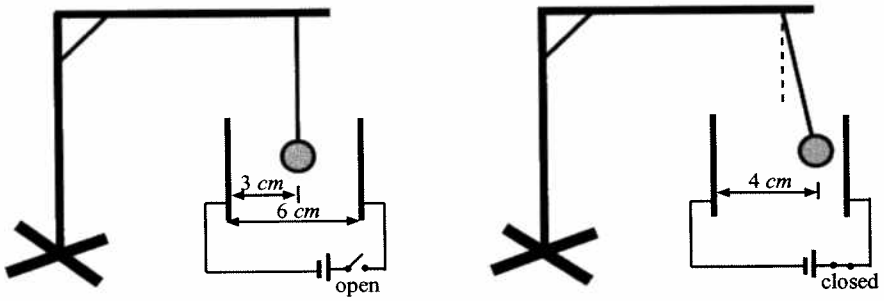
A) V = 8.0 V

B) F = 133 C

C) Vf = 370 m/s

34. *Use this information to answer the next 2 questions*

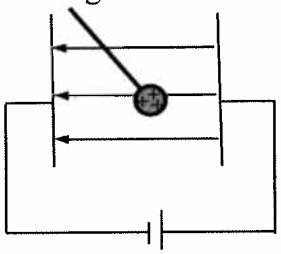
Two parallel plates separated by 6.0 cm have 10,000 V potential difference between them.



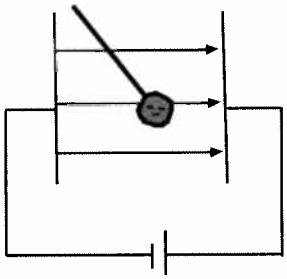
A 10 gram charged pithball is hung between the plates. When the switch is closed it moves 1.0 cm closer to one of the plates.

Which diagram shows the correct electric field and charge on the pithball?

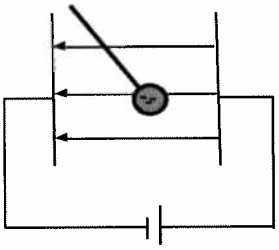
A.



B.



✓C.



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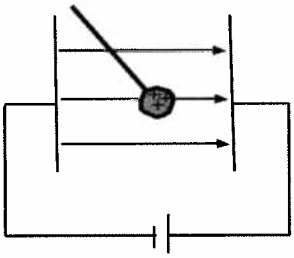


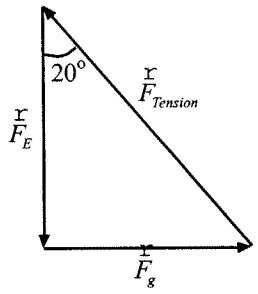
#1 NUMERIC RESPONSE

In the previous experiment, the force on the pithball was determined to be 3.57×10^{-3} N. Therefore the charge on the pithball must be **a.bc x 10^{-d} C**

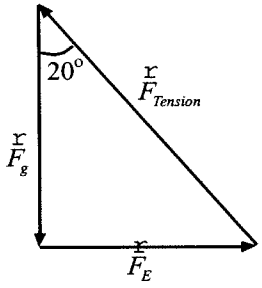
2148 answer

35. To determine the force on the pithball the experimentor used the relationship between the angle the rope makes with vertical. Which diagram will allow the student to correctly determine the electrical force?

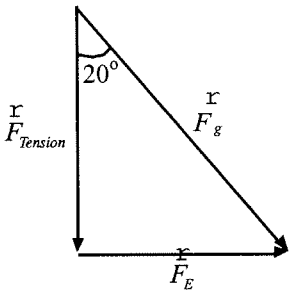
A.



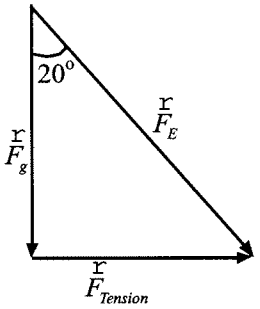
✓B.



C.



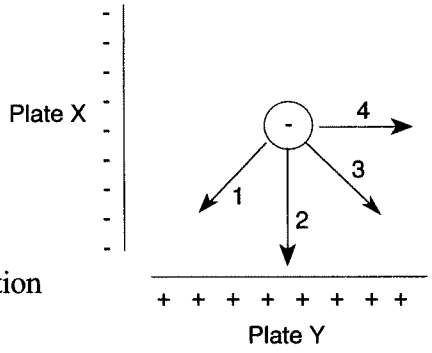
D.



36. Charged Sphere in an Electric Field

A negatively charged sphere experiences a force because of the equal and opposite charges on plates X and Y.

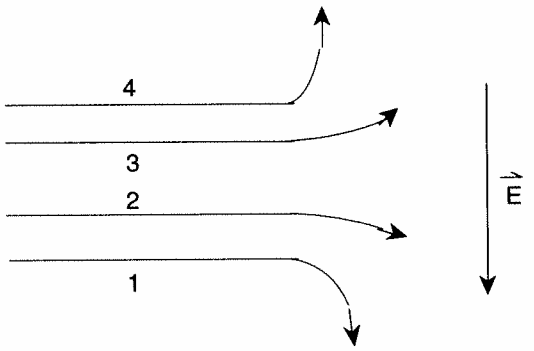
The negatively charged sphere will likely move in direction



A. 4
B. 1
C. 2
✓D. 3

37. **Numerical Response**

Paths of Charged Particles in an Electric Field

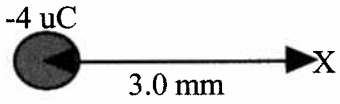


The masses and speeds of the particles are equal.

Which statement is true?

A. The charges on particles 3 and 4 are equal in magnitude and in sign.
B. The charges on particles 2 and 3 are equal in magnitude and in sign.
C. The charges on particles 3 and 4 are equal in magnitude but not in sign.
✓D. The charges on particles 2 and 3 are equal in magnitude but not in sign.

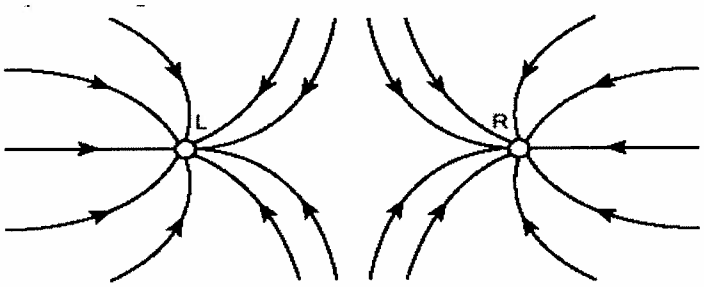
38. A)
Determine the strength of an electric field at point X 3.0 mm from a -4.0 uC charge.
3 marks



B)
Determine the strength and direction of the force on an electron placed at point X.
3 marks

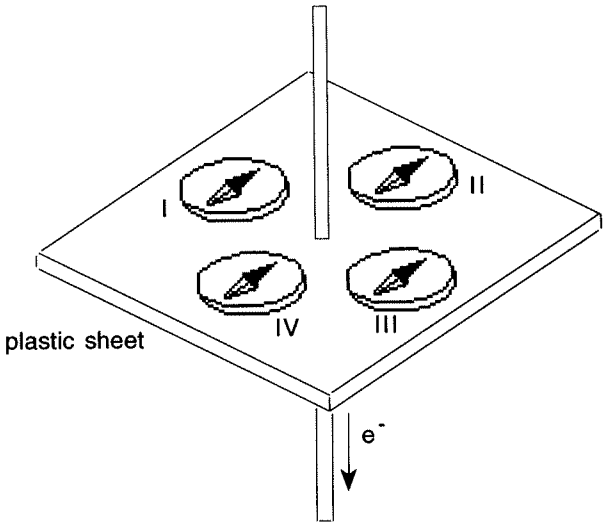
A) E = 4.0 x 10^{9} N/C
B) F = 6.4 x 10^{-10} N away

39. **Indicate the polarity of L and R**



✓A. **L** Negative **R** Negative
B. **L** Negative **R** Positive
C. **L** Positive **R** Negative
D. **L** Positive **R** Positive

40. Current and Its Magnetic Field



If the effects of the Earth's magnetic field are ignored, which compass needle is oriented correctly? *(note: the black end is a northpole of a magnet)*

A. IV
B. I
C. II
✓D. III

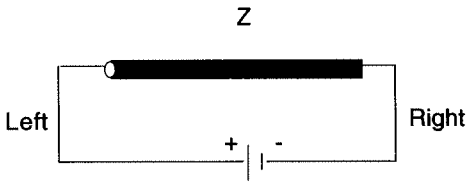
41. The diagram shows two long straight and parallel conductors with currents as shown. The electrons are flowing out of the page for Conductor W [shown with a (•)] and flowing into the page for Conductor Y [shown with a (×)]

The force that Conductor W experiences because of the presence of Conductor Y is

✓A. repulsion due to the interaction of their magnetic fields
B. attraction due to the interaction of their magnetic fields
C. repulsion due to the interaction of their electric fields
D. attraction due to the interaction of their electric fields

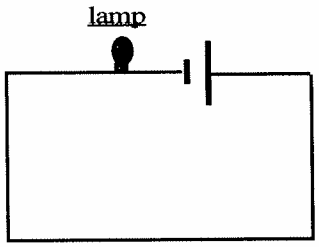
42. Magnetic Field of an Electric Current

A current is present in a piece of copper rod. The direction of the magnetic field at point Z is

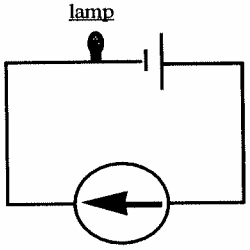


A. into the page
✓B. out of the page
C. to the left
D. to the right

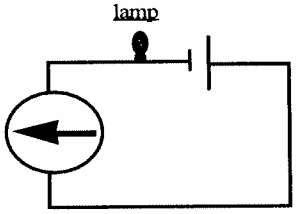
43. In an experiment similar to Oerstead's a student connects a lamp to a battery. Which diagram below shows the correct deflection of the compass needle when the electricity is flowing?



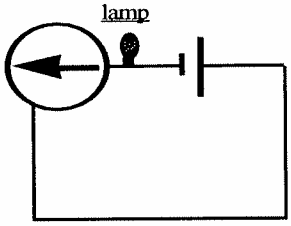
A.



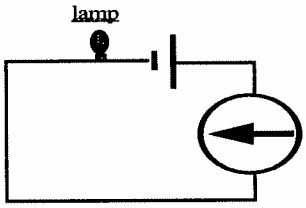
B.



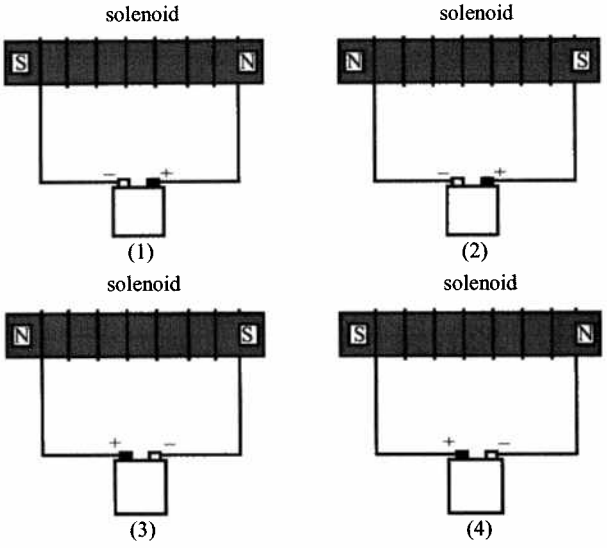
C.



✓D.



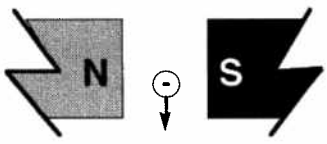
44. Each diagram shows the connection of a solenoid to a battery.



Which diagrams show the relationship between the north pole of the solenoid and the given polarity of the battery?

A. 3 and 4 only
B. 2 and 3 only
✓C. 1 and 3 only
D. 1 and 2 only

45. Charge in a Magnetic Field

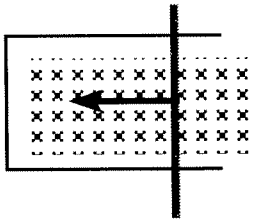


A negative charge moves through a magnetic field.

The charge will be deflected
✓A. into the page
B. toward the left side of the page
C. toward the right side of the page
D. out of the page

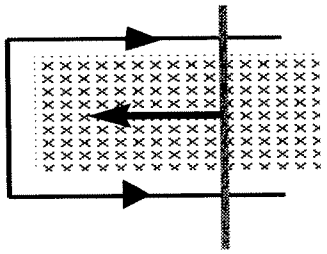
46.

The black arrow shows the direction of the velocity of the wire.

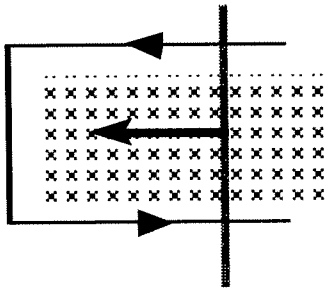


The correct direction of induced electron flow is

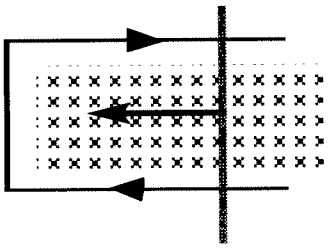
A.



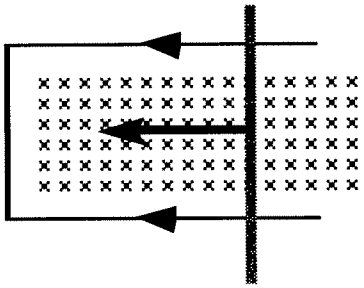
✓B.



C.

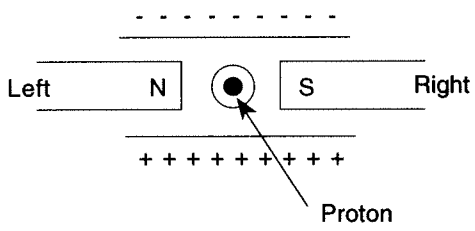


D.



47. Proton in Perpendicular Electric and Magnetic Fields

A proton emerging in a direction out of the page encounters a magnetic field and an electric field at right angles to each other, as indicated in the diagram. The proton will deflect toward the

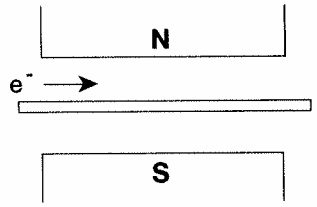


A. right side of the page
✓B. top of the page
C. bottom of the page
D. left side of the page

48. A proton and an electron travelling at the same velocity enter a magnetic field at right angles to the field. Compared to the electron's deflection, the proton's deflection will be in the
A. opposite direction, with a smaller radius of curvature
B. same direction, with a smaller radius of curvature
C. same direction, with a larger radius of curvature
✓D. opposite direction, with a larger radius of curvature

49. A 2.3 g wire is suspended in a magnetic field of 0.12 T. What must the current be if the wire exposed to the magnetic field is 3.6 cm long?
4 marks
I=5.2 A

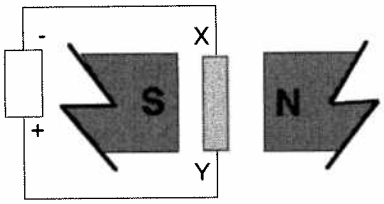
50. A Current-Carrying Wire in an External Magnetic Field



The part of the wire in the magnetic field is 10.0 cm long and carries a current of 10.0 A. If the strength of the magnetic field is 0.050 T, then the resulting force on the wire is

A. 5.0 N out of the page
✓B. 0.050 N out of the page
C. 5.0 N into the page
D. 0.050 N into the page

51. Wire in a Magnetic Field

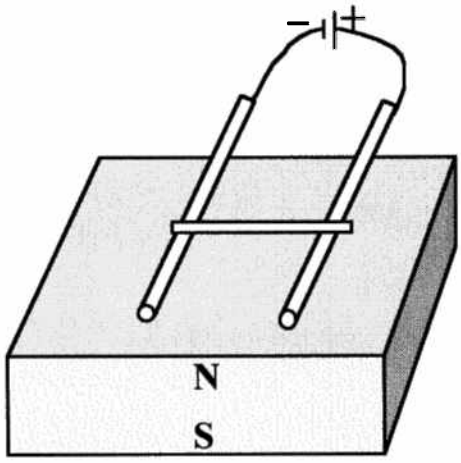


Wire XY is 4.0 cm long. It carries a 0.50 A current perpendicular to a magnetic field of magnitude 6.0×10^{-4} T.

The force on wire XY is

A. 3.0×10^{-4} N out of the plane of the page
✓C. 1.2×10^{-5} N out of the plane of the page
B. 1.2×10^{-5} N into the plane of the page
D. 3.0×10^{-4} N into the plane of the page

52. A 12 volt car battery is connected across the apparatus shown. The magnetic has a field of 0.975 T.



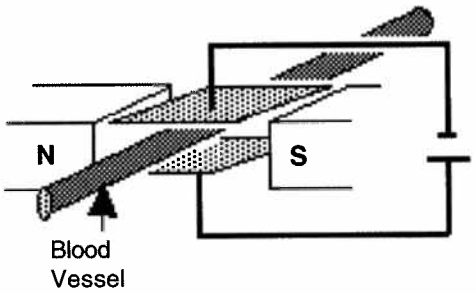
Two of wires shown are glued to the magnet and the third is 6cm long and is free to roll as shown in the diagram. If the wires are connected to a 12V battery and the circuit has a resistance of 0.5 Ω.

- Determine the current in the curcuit
- Determine the force and direction on the free wire.
- What is the direction of force on the two wires glued to the magnet.

8 marks

I = 24 A

The diagram below represents an artificial heart. It works by pulsing the electric field causing the positive and negative ions in the blood to move toward the electric plates. This creates a motion of the ions perpendicular to the magnetic which creates motion along the vessel.



Use this question to answer the next 2 questions.

53. What is the direction of the positive and negative ions in the blood
A. positive out the page and negative out of the page
B. positive into the page and negative out of the page
✓C. positive into the page and negative into the page
D. positive out of the page and negative into the page

54. A sodium ion (Na^+) can reach a velocity of 10 m/s as it approaches the top of the blood vessel From this determine the sideways force on the ion if the magnetic field is 0.10T.
A. 1.6×10^{-17} N
✓B. 1.6×10^{-19} N
C. $1.76\ 10^{-18}$ N
D. 1.45×10^{-20} N
F=1.6 x 10^{-19} N

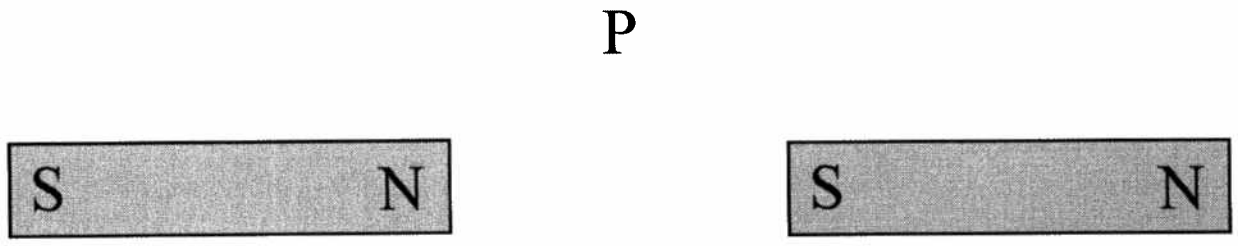
55. An electron travels due west at 2.5×10^7 m/s through a magnetic field that has an intensity of 2.0×10^{-2} T. The direction of the field is due north. The resulting magnitude and direction of the force on the electron will be

A. 5.0×10^5 N downward
✓B. 8.0×10^{-14} N vertically
C. 8.0×10^{-14} N downward
D. 5.0×10^5 N vertically

56. In an experiment, students project a proton with a speed of 3.0×10^4 m/s perpendicularly into a magnetic field. Then, into the same field, they project an electron with a speed of 1.5×10^4 m/s in the same direction. The students should observe that the force exerted by the field on the electron compared to the proton will be

✓A. half the size but in the opposite direction
B. double the size but in the same direction
C. half the size but in the same direction
D. equal the size and direction

57. Two identical magnets are placed as shown. At point P which is equidistant between the two magnets



What is the direction of the field at point P

A. ←

✓B. →

C. ↙

D. ↗

58. A unit combination equivalent to the tesla is

A. (N•A,m)

✓B. ($kg / A•s^2$)

C. A / kg

D. ($kg•m / A•s^2$)

59. A magnetic field exerts no force on

✓A. a stationary electric charge

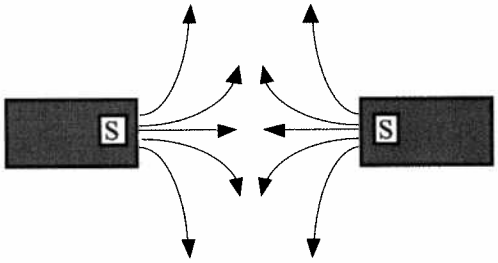
B. a magnet

C. an iron bar

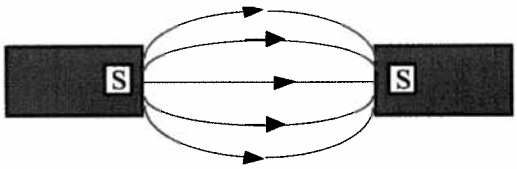
D. an electric current

60. Which diagram best represents the lines of force between two south poles of a permanent bar magnet?

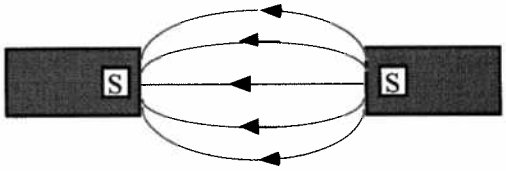
A.



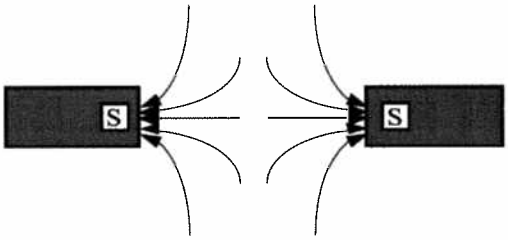
B.



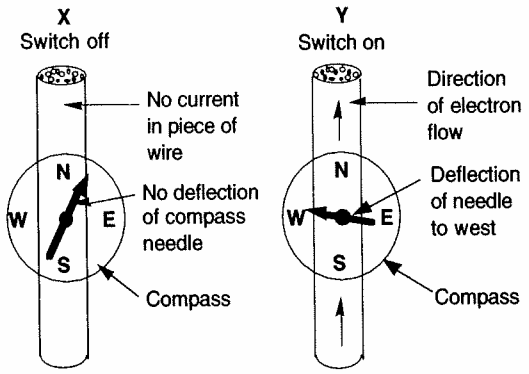
C.



✓D.



61. Current Flow in a Wire

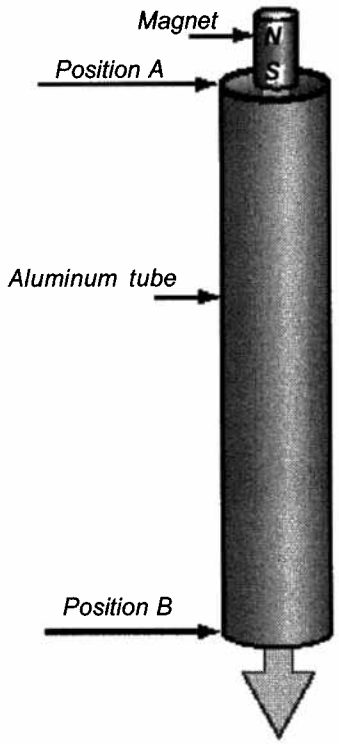


If the direction of the electron flow in diagram Y is reversed, the compass needle will point

A. south
✓C. east
B. north
D. west

62. The unit tesla is equivalent to the unit combination
A. (C•m)/(N•s)
✓B. N/(A•m)
C. (A•m)/N
D. (N•m)/(C•s)

63. A student dropped a 100 g neodynium magnet through an aluminium tube as shown in the diagram. The student observes that the magnet reaches terminal velocity almost instantly. She also notes it takes the magnet 5.5 s to travel the 0.60 m from Position A to Position B.



- Determine the average magnetic force on the magnet.
- Determine the direction of the induced eddy currents (electron flow) in the aluminum tube as the magnet enters and explain the force slowing the magnet in terms of Lenz's law.
- Why is a plastic or iron tube not used in this experiment?
- What could you change in this experiment to further slow the progress of the magnet?
- Is it possible to stop the motion of the magnet completely?

4 marks
F_B = 0.98 N

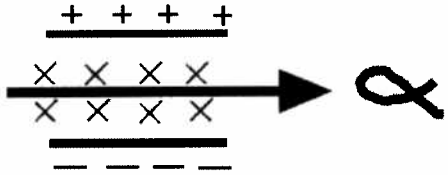
64. An observation supporting the hypothesis that cathode rays are charged particles is that
A. no matter what the cathode is made of, the cathode rays produced have the same characteristics
✓B. cathode rays can be bent by magnetic fields
C. cathode rays are observed only in tubes that contain low-pressure gases
D. when silver (Ag) salts are bombarded with cathode rays, the colors of the salts change

#65 is missing

66. Students use a Thomson's apparatus to send a beam of particles through a region of perpendicular electric and magnetic fields. They set the magnetic field strength at 1.80×10^{-3} T. Then, keeping the same magnetic field, the students place a voltage of 2.80×10^{2} V across a plate separation of 2.50×10^{-2} m. Under these conditions, they observe there is no deflection of the beam. What is the speed of these particles?

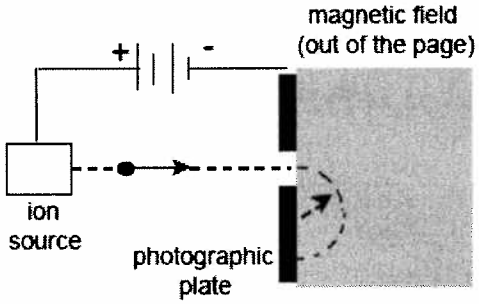
✓A. 6.22×10^{6} m/s
B. 6.12×10^{6} m/s
C. 6.42×10^{6} m/s
D. 6.32×10^{6} m/s

67. What velocity must be present if an alpha particle is not deflected when it passes through a 1.2 T magnetic and a perpendicular 2.4×10^{5} N/C electric field?



B) What would the raduis of curvature be if the electric field was turned off? (If you are unable to find the velocity for part A use the value of 2.0×10^{5} m/s)
8 marks
V = 2.08 x10^{5} m/s
r = 3.6 x 10^{-3} m

68. Path of an Ion in a Mass Spectrograph



$^{12}C^{2+}$ ions are deflected in an arc of radius 0.165 m. What type of ion travelling at the same speed could be detected at a radius of 0.550 m?

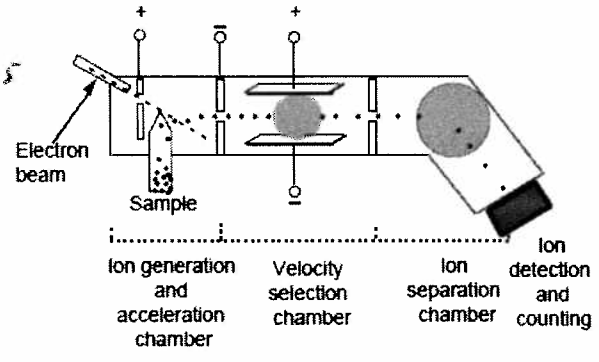
A. $^{113}Cd^{2+}$
B. $^{40}Ca^{+}$
C. $^{113}Cd^{+}$
✓D. $^{40}Ca^{2+}$

A indicates mass of isotope

$^{40}Ca^{2+}$

69. You are an atomic scientist and you want to isolate uranium 235 from uranium 238. Explain how you would do this using the mass spectrometer below.
If the collection point for the U-235 is at a radius of 50.000 cm, what would you set the strength of the magnetic field to in the ion seperation chamber, if you had set magnetic field to 1.34 T , and the electric field to 6.7×10^{5} N/C in the velocity selection chamber and the electron beam to singely ionize the uranium.
8 marks

mass of uranium-235 is 3.92×10^{-25} kg

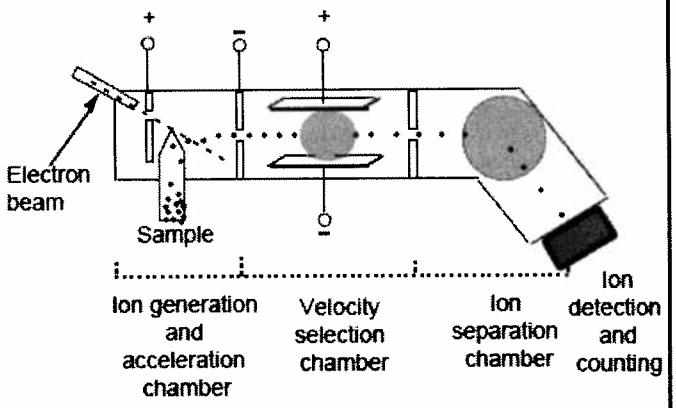


B = 2.45 T

70. You are an atomic scientist and you have been given a pure sample of protactinium. Your task is to determine the ratio amounts of the isotopes using a mass spectrometer.

During your first test you find that you detect only isotopes 229 and 231.

Isotope	Decay mode	1/2 life
$^{228}_{91}Pa$	α	22 h
$^{229}_{91}Pa$	α	1.5 d
$^{230}_{91}Pa$	β	17.4 d
$^{231}_{91}Pa$	α	32500 y



89	90	91	92	93	94	95
Ac	Th	Pa	U	Np	Pu	Am

• You set magnetic field and electric fields in the velocity selection chamber of your mass spectrometer to 1.34 T , and 6.7×10^4 N/C, and the electron beam to singularly ionize the protactinium. Determine the velocity of your ions as they enter the selection chamber.

• If the Pa-229 was found at a radius of 50.000 cm, what was the strength and direction of the magnetic field in the ion separation chamber. (if you were unable to determine the velocity above use 1.0×10^4 m/s) mass of Pa-229 is 3.82×10^{-25} kg

• To confirm that you have found Pa-229 you decided to test the half-life of the element. When you conduct the experiment 6 days later, how much Pa-229 would you expect to find (as a fraction)

• Write the decay reaction for Pa-229

• Do you expect the daughter product to be bent more or less than Pa-229 and why?

7 marks

v= 5.0 x 10^4 m/s

B= 0.24 T

~~**Pa-229 should have only 1/16 of the original**~~