Physics 1520, Spring 2011

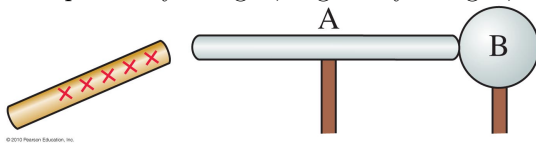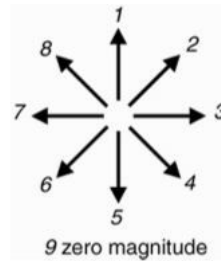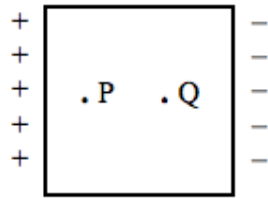Quiz 3, Form: [A]

Name: _____

Date: _____

Numeric answers must include units. Sketches must be labeled. All short-answer questions must include your reasoning, for full credit. A correct answer with no reasoning will only receive partial credit.

Section 1. Exercises

1. A metal rod A and metal sphere B on insulating stands touch each other as shown below. They are originally neutral. A positively charged rod is brought near (but not touching) the far end of A. While the charged rod is still close, A and B are separated. The charged rod is then withdrawn. Is *rod A* then positively charged, negatively charged, or neutral?
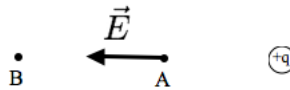

   (a)   positively charged

   (b)   negatively charged

   (c)   neutral

2. A neutral metal block is polarized as shown, due to an applied uniform electric field made by external charges (not shown). What is the direction of the applied electric field (that causes the polarization) at point P?
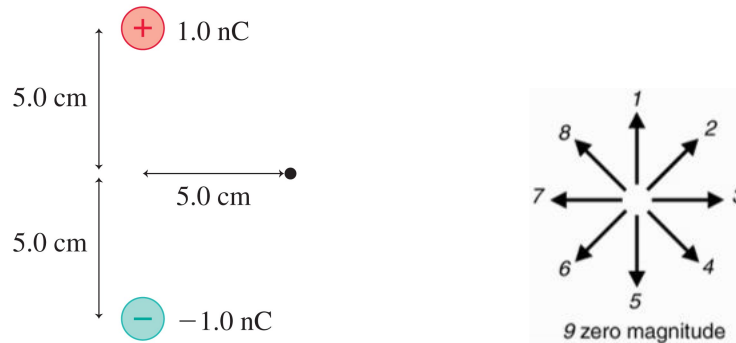

   (a)   1

   (b)   3

   (c)   5

   (d)   7

   (e)   9

3. If the electric potential at point P in the previous question is 3 V, then the electric potential at Q

   (a)   is less than 3 V.

   (b)   is greater than 3 V.

   (c)   is 3 V.

   (d)   cannot be determined from the given information.

4. Two 5.0 cm x 5.0 cm square aluminum electrodes are placed 0.5 mm apart and are connected to a 100 V battery. What is the magnitude of the electric field between the plates?

   (a)   50 V/m
   (b)   5000 V/m
   (c)   50,000 V/m
   (d)   2500 V/m
   (e)   200,000 V/m

5. If you leave the plates in the previous question connected to the battery and if you fill the region between the plates with an insulator of dielectric constant $K = 150$, the capacitance C will be

   (a)   greater than before.
   (b)   less than before.
   (c)   the same as before.

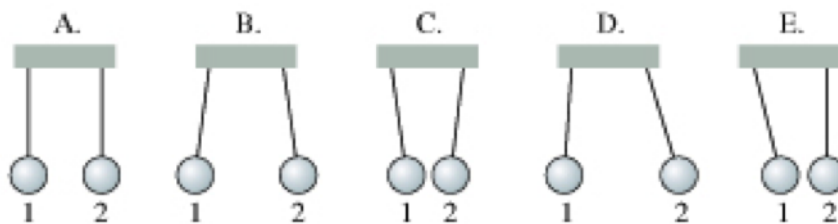6. The electric field at location A due to the positively charged sphere is $\vec{E}$.

   If location B is twice as far from the sphere as location A, then the electric field at location B is

   (a) $4\,\vec{E}$
   (b) $2\,\vec{E}$
   (c) $1/2\,\vec{E}$
   (d) $1/4\,\vec{E}$
   (e)   zero

7. What is the direction of the net electric field at the location of the dot?

   (a)   1
   (b)   3
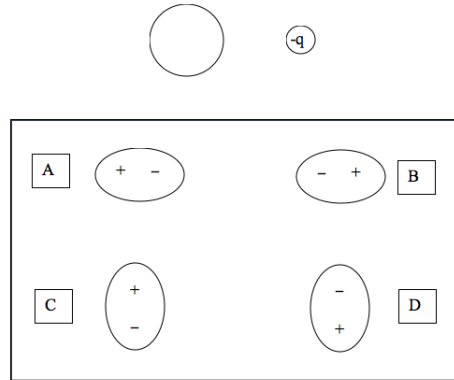   (c)   5
   (d)   7
   (e)   9

8. A small piece of neutral aluminum contains 10^{15} atoms. Aluminum has an atomic number of 13 which means that an Al atom has 13 protons in its nucleus. If the piece of aluminum is then charged and has a net positive charge of 3.2 µC, how many electrons did it lose?

   (a) 3.1×10^5 electrons
   (b) 5×10^{12} electrons
   (c) 1×10^{15} electrons
   (d) 1.3×10^{16} electrons
   (e) 2×10^{13} electrons

9. Two electrically neutral conducting balls hang from threads. Choose the diagram (A – E) in the figure below that shows how the balls hang if Ball 1 has a positive charge, $+Q$, and Ball 2 has twice the charge of Ball 1, $+2Q$.
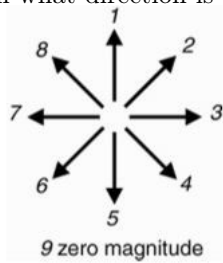

   (a)   A
   (b)   B
   (c)   C
   (d)   D
   (e)   E

10. For the previous question, *on* which ball is the electric (i.e. Coulomb) force the greatest in magnitude?

   (a)   Ball 1
   (b)   Ball 2
   (c)   Neither, because the electric (i.e. Coulomb) force on each sphere is the same.

11. The force on a positively charged particle due to an electric field is

   (a)   in the same direction as the electric field.
   (b)   opposite the electric field.
   (c)   neither, because it depends on the strength of the electric field.
   (d)   none of the above because electric fields don't exert forces on charged particles.

Questions: 12–14:

12. A negatively charged ion is near a neutral atom. Which diagram shows the polarization of the neutral atom?
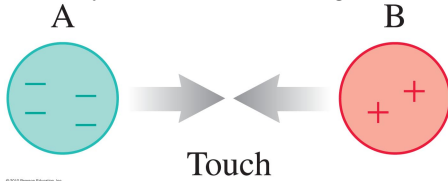

(a)   A.
(b)   B.
(c)   C.
(d)   D.
(e)   None of the above because the neutral atom will not polarize.

13. In what direction is the force *on the neutral atom?*

(a)   1
(b)   3
(c)   5
(d)   7
(e)   9

14. In what direction is the force *on the negatively charged ion?*
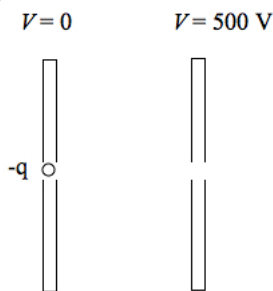
(a)   1
(b)   3
(c)   5
(d)   7
(e)   9

4

15. In what type of material can mobile electrons move freely throughout the material?

    (a)   conductor

    (b)   insulator

    (c)   both a conductor and an insulator

    (d)   neither a conductor nor an insulator

16. Sphere A with initial charge -50 nC touches Sphere B with initial charge $+25$ nC. Which statement correctly describes how charge is transferred?

Touch

    (a)   Sphere A gains protons and loses electrons. Sphere B gains electrons and loses protons.

    (b)   Sphere A gains electrons and loses protons. Sphere B gains protons and losed electrons.

    (c)   Sphere A loses electrons and Sphere B gains electrons.

    (d)   Sphere B loses protons and Sphere A gains protons.

Section 2. Critical Thinking

17. A proton is located at x $= 1.0$ nm, y $= 0.0$ nm and an electron is located at x $= 0.0$ nm, y $= 4.0$ nm. What is the magnitude of the force by the proton on the electron?

    (a) 5.3×10^{-18} N

    (b) 5.3×10^{8} N

    (c) 5.9×10^{-15} N

    (d) 1.4×10^{-11} N

18. An electron $(q = -1.6 \times 10^{-19}$ C) that is initially at rest is accelerated across plates that have a potential difference of 500 V.
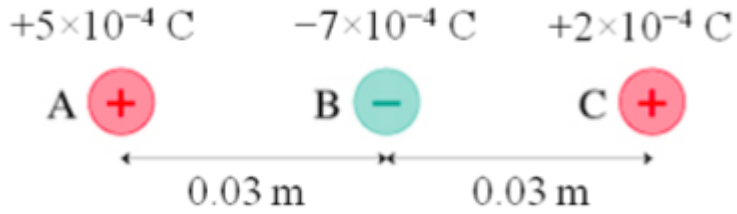

What is the speed of the electron when it reaches the 500 V plate?

    (a) 1.5×10^{8} m/s

    (b) 2.2×10^{5} m/s

    (c) 9.4×10^{6} m/s

    (d) 3.1×10^{5} m/s

    (e) 1.3×10^{7} m/s

19. What is the direction of the electric field between the plates in the previous question?

    (a) $\vec{E}$ points to the left

    (b) $\vec{E}$ points to the right

    (c)   neither, because the electric field between the plates is zero

20. What is the net force on charge B in the figure?

$+5\times10^{-4}$ C -7×10^{-4} C $+2\times10^{-4}$ C

A (+)   B (−)   C (+)

0.03 m   0.03 m

    (a)   zero

    (b) 4.90×10^{6} N to the left

    (c) 4.90×10^{6} N to the right

    (d) 2.10×10^{6} N to the left

    (e) 2.10×10^{6} N to the right

Answer Key for Exam $\boxed{\text{A}}$

Section 1. Exercises

1. (b)
2. (e)
3. (c)
4. (e)
5. (a)
6. (d)
7. (c)
8. (e)

9. (b)
10. (c)
11. (a)
12. (b)
13. (b)
14. (d)
15. (a)
16. (c)

Section 2. Critical Thinking

17. (d)
18. (e)

19. (a)
20. (d)