PHY 1120 Name: Alex Yeoh

Quiz - Chapter 18 6/26/20

Clearly check or fill in the box in front of the answer(s) you are selecting. Each question will one BEST, correct answer. (MC: 2 pts each, Short Answer: 5-10 pts each)

1) Two small metal spheres, (A) = +10μC and (B) = -20μC, are connected together with a conducting wire. What will be the effect after the connection?

(A) The charges will switch positions, A) = -20μC and (B) = +10μC
(B) The charges will equalize to +15μC on each sphere
(C) The charges will equalize to +5μC on each sphere
(D) The charges will equalize to -5μC on each sphere
(E) The charges will be zero because of the Conservation of Charge

Explain: The charges want to spread out as evenly as possible, so they equalize

They equalize to -5μC because $+10\mu C + (-20\mu C) = -10\mu C$ but this is over two spheres, so $\frac{-10\mu C}{2} = -5\mu C$

2) When a cloth rag is rubbed on a glass rod, which of the following is true?

(A) The rubbing action creates a positive charge on the glass rod.
(B) The rubbing action transfers positive charge to the glass rod.
(C) The total net charge produced is zero.
(D) The total net charge produced increases the longer the glass rod is rubbed.
(E) The answer depends on the type of cloth.

Explain: The only material above glass on the triboelectric series is dry human hands, so the cloth will likely be a material that would be more likely to gain electrons than cloth.
Electrons are moving, so a positive charge is created rather than transfered.

3) An electric field is pointing from West to East. A proton is placed in that electric field. What will be the effect on the proton?

(A) It will accelerate towards the East
(B) It will move with a constant velocity East
(C) It will remain stationary
(D) It will move with a constant velocity West
(E) It will accelerate towards the West

Explain: E-fields and force are parallel when the test charge is positive.
It accelerates because $F = m\underline{a}$ Therefore, it would not move with a constant velocity or stay stationary.

4) Two identical, electrical charges are separated by a small distance. What changes could I make to this situation to exactly double the force between the two charges?

(A) Double the size of both charges
(B) Double the size of one charge
(C) Double the distance between the charges
(D) Halve the distance between the charges
(E) More than one of the above

Explain: $F = k\frac{aQ}{r^2}$

original: $F = \frac{q \cdot q}{r^2} \cdot k$

doubled: $F = \frac{Q \cdot q}{r^2} k$ where $Q = 2q$, $F = \frac{2q \cdot q}{r^2} k = 2\frac{q \cdot q}{r^2} k$

$2\frac{q \cdot q}{r^2} k$ is double $\frac{q \cdot q}{r^2} k$

5) An empty, hollow, metal shell has a negative charge placed at it's center. Where is the electric field equal to zero?

(I) Outside the shell
(II) In the metal thickness of the shell
(III) Inside the shell

(A) Only (I) (B) Only (II) (C) Only (III) (D) (I) & (II) (E) (I) & (III)

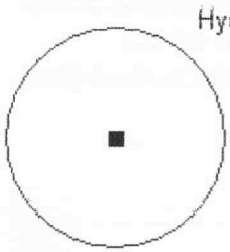
Explain: force inside the thickness of metal, assuming statics, is $= 0$. $F = qE = 0$ therefore $E = 0$
The negative charge pushes the electrons ~~closer~~ that are closer to it further away ~~inducing a~~ causing the inside of the shell to be more positive and the outside more negative, which causes electric fields

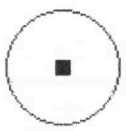
Complete the short-answer question below. Be aware the question may have multiple parts. You must answer all parts to receive full credit. Show all work. Partial credit may be given for partially correct or complete answers. (5-10 pts. each)

6) What is the net charge on a Chlorine Atom. Explain you answer. (5 pts)

The net charge of a Chlorine Atom is 0 because it is an atom, not an ion which implies that it would have an equal number of protons and electrons.

7) Below are scale diagrams of a hydrogen (H) and helium (He) atom. As you can see the He atom is approximately 1/2 the radius of the H atom. The H atom has $1p^+$ and $1e^-$, the helium atom has $2p^+$, $2n^o$, and $2e^-$. Use what you've learned this semester to explain why the He atom should be smaller than the H atom. (10 pts)





1 Å = 0.1 nm —1s

https://www.uwgb.edu/dutchs/Petrology/ScaleAtomsHeKr.HTM

~~assuming the force is 1 and remains~~

assumptions/simplifications

- force is 1 and remains 1
- the charge of a proton is +1
- the charge of a neutron is 0
- the charge of an electron is -0
- $k = 1$
- $F = k\frac{qq}{r^2}$

$F = k\frac{Qq}{r^2} = 1 = 1\frac{Qq}{r^2}$, $\frac{1}{Qq} = r^2$, $r = \sqrt{\frac{1}{Qq}}$

Hydrogen

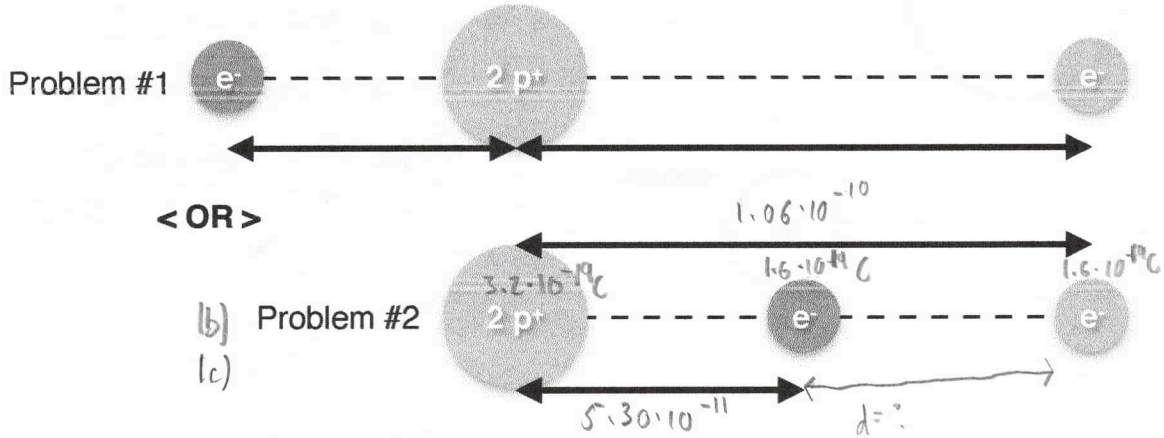
$r = \sqrt{\frac{1}{1 \cdot 1}} = \sqrt{\frac{1}{1}} = 1$

Helium

$r = \sqrt{\frac{1}{2 \cdot 2}} = \sqrt{\frac{1}{4}} = \frac{\sqrt{1}}{\sqrt{4}} = \frac{1}{2}$

PSP Style: Solve the problem. Make sure to show your work in **detail**. (25 pts each)

8) Assume you have a Helium atom (two protons, two electrons, and two neutrons) where one electron is in the 1s shell, and the second electron is in the 2s shell. The two possible positions of the subatomic particles are shown below. The radius of the 1s shell is 5.30×10^{-11} m and the 2s shell is 1.06×10^{-10} m. Pick **ONLY ONE** of the configurations below and determine the net force on the electron in the 1s shell (the darker shaded electron) from the other charged particles. (25 pts)



(b) Problem #2

(c)

Problem #2

1a) what is the net force on the 1s electron?

1d) Net F on 1s $e^- = ?$

2a) Charge of $e^- = 1.6 \cdot 10^{-19}$ C

Charge of $2p^+ = 3.2 \cdot 10^{-19}$ C

r 1s e^- to $2p^+ = 5.30 \cdot 10^{-11}$ m

r 2s e^- to $2p^+ = 1.06 \cdot 10^{-10}$ m

2b) d between $e^- = ?$

F $2p^+ = ?$

F 2s $e^- = ?$

3a) Force calc, $F = k \cdot \frac{Qa}{r^2}$

3b) Force calc, to calculate the individual forces on the 1s e^-

3c)

4a) $d = 1.06 \cdot 10^{-10} - 5.30 \cdot 10^{-11} = 5.30 \cdot 10^{-11}$

$F\,2p^+ = 9 \cdot 10^9 \cdot \frac{3.2 \cdot 10^{-19} \cdot 1.6 \cdot 10^{-19}}{(5.3 \cdot 10^{-11})^2} = 1.64 \cdot 10^{-7}$ N

$Fe^- = 9 \cdot 10^9 \cdot \frac{1.6 \cdot 10^{-19} \cdot 1.6 \cdot 10^{-19}}{(5.3 \cdot 10^{-11})^2} = 8.20 \cdot 10^{-8}$ N

4b) Net $F = 8.20 \cdot 10^{-8} + 1.64 \cdot 10^{-7} = 2.46 \cdot 10^{-7}$ N (towards $2p^+$)

4c) Yes, it makes sense

4d) I don't see why not

4e) The net force on the 1s shell electron from the other charged particles is $2.46 \cdot 10^{-7}$ N