University Physics A(1) 2014

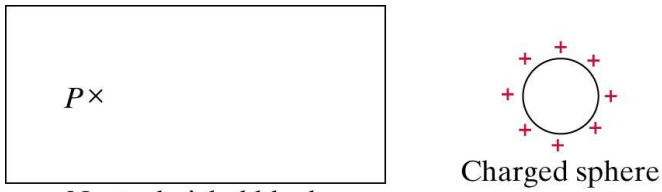
Name (名字): Student number (学号):

New words: Write the Chinese next to these words as you learn them.

insulator	integral
conductor	rod
polarization	ring
equilibrium	disk
mobility	capacitor
uniform charge distribution	spherical shell
symmetry	solid sphere

Problems Show all working.

(1) (a) [15.X.61-62] You place a neutral block of nickel (镍) near a small glass sphere that has a charge of 2×10^{-8} coulombs uniformly distributed over its surface, as shown in the figure below:



(i) About how long do you have to wait to make sure that the mobile electron sea inside the nickel block has reached equilibrium?

A. Less than 1 ns
B. Several hours
C. About 1 second
D. About 10 minutes

(ii) In equilibrium, what is the average drift speed of the mobile electrons inside the nickel block?

A. About 1×10^{5} m/s
B. About 1×10^{-5} m/s
C. 0 m/s

(iii) In the equation $\bar{v} = uE$, what is the meaning of the symbol u?

A. The density of the mobile electrons in the metal, in electrons/m^3.
B. The mobility of an electron inside the metal, in (m/s)/(N/C).
C. The time it takes a block of metal to reach equilibrium, in seconds.

(b) Now, remind yourself about these two concepts:

- The definition of equilibrium inside a conductor; and,
- The relationship between average drift speed and electric field in a conductor.

Use these two concepts to think about which of the following situations are possible inside the nickel block at equilibrium. For each case, there might be more than one reason why it is not possible. Circle the letter for each reason that applies.

Case 1: $\bar{v} = 0$ and $E_{net} = 0$

A. Possible.
B. Not possible by definition of equilibrium
C. Not possible because $\bar{v} = uE_{net}$

Case 2: $\bar{v} = 0$ and $E_{net} > 0$

A. Possible.
B. Not possible by definition of equilibrium
C. Not possible because $\bar{v} = uE_{net}$

Case 3: $\bar{v} > 0$ and $E_{net} = 0$

A. Possible.
B. Not possible by definition of equilibrium
C. Not possible because $\bar{v} = uE_{net}$

Case 4: $\bar{v} > 0$ and $E_{net} > 0$

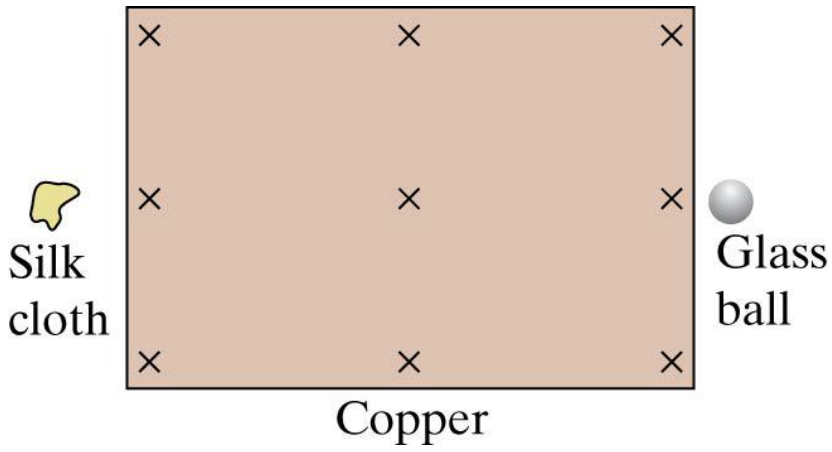
A. Possible.
B. Not possible by definition of equilibrium
C. Not possible because $\bar{v} = uE_{net}$

Now that you have considered each case, which is the only situation that is physically possible?

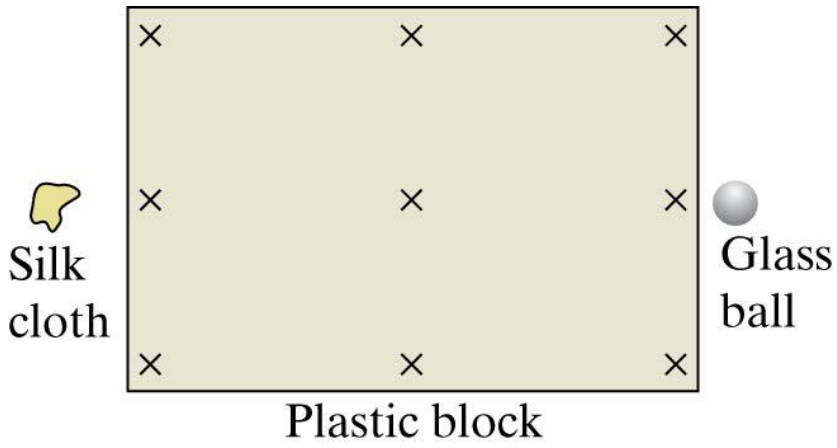
(c) [5.P.66] A small glass ball is rubbed all over with a small silk cloth and acquires a charge of +5 nC. The silk cloth and the glass ball are placed 30 cm apart.

(i) On the diagram below, draw the electric field vectors qualitatively at the locations marked ×. Pay careful attention to directions and relative magnitudes (i.e. if the field is relatively strong at a location, draw a longer arrow; if it is weak, draw a shorter arrow). [不用算，只用画.]

(ii) Next, a neutral block of copper (铜) is placed between the silk and the glass. On the diagram below, carefully show the approximate charge distribution for the copper block and the electric field vectors inside the copper at the ×.



(iii) The copper block is replaced by a neutral block of plastic. Carefully show the approximate molecular polarization of the plastic block at the locations marked × in the figure below.



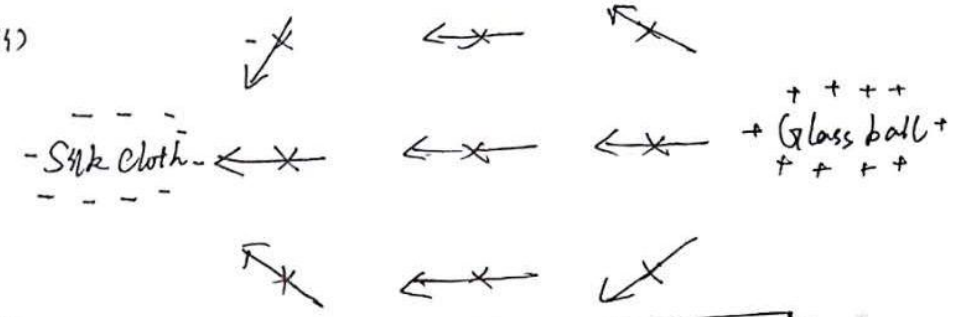
(iv) What happens to the net electric field at the location of the glass ball when the plastic block is in place, compared to when there is no block? Does the net force on the ball get bigger or smaller, or stay the same? Explain briefly.

第九周作业

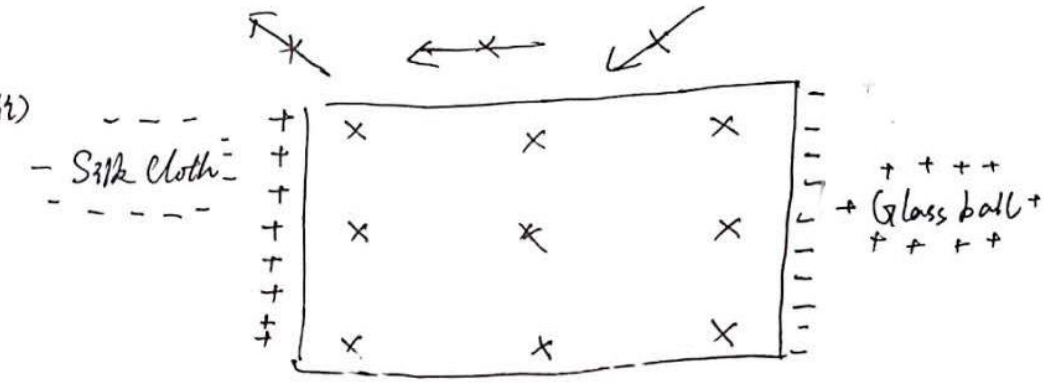
(1) (a) (i) A (ii) C (iii) B

(b) 1. A 2 C 3. BC 4. B. 、 Case 1.

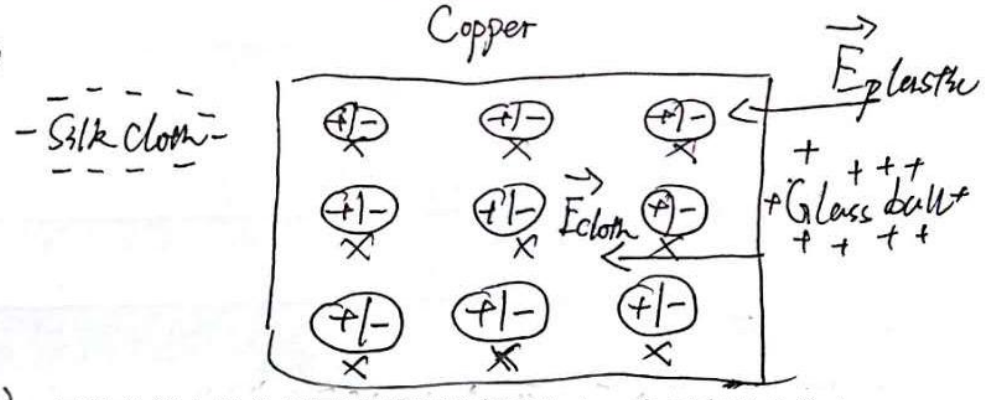
(c) (i)



(ii)



(iii)



(iv) 因为丝绸布的作用导致玻璃球电场向左，电子电场也往左。

所以 $|\vec{E}_{net}| > |\vec{E}_{silk}|$ 、 $|\vec{F}_{net}| = |q\vec{E}_{net}|$ 、则力变大.