Full Solution

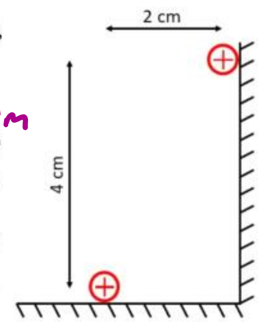
Sunday, April 30, 2023 9:52 AM

Physics 203

Quizbit | Charges and Forces

Part A: Work individually to produce a handwritten solution to **Part A (question 1)** of this Quizbit. Submit an image of your solution to Canvas. The quality of your solution and communication is far more important than the final answer!

1) Two small charged spheres are arranged as shown, placed against frictionless surfaces. Each sphere has a charge of **+2.35 μC** and a mass of **5.62 g**.
q m
   (a) What is the distance between the two charges?
   (b) What is the magnitude of the electric force on the bottom charge?
   (c) The bottom charge is allowed to move. Using a standard coordinate system, find the initial acceleration ***vector*** of the charge. (Hint: draw a FBD!!!)



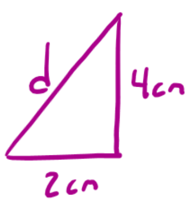
Hints:

$\left|\vec{F}^E\right| = k\,\frac{|q_1||q_2|}{|\Delta\vec{r}|^2}$

$k = 8.99 \times 10^9 N\frac{m^2}{C^2}$

$C^2 = A^2 + B^2$

(a)



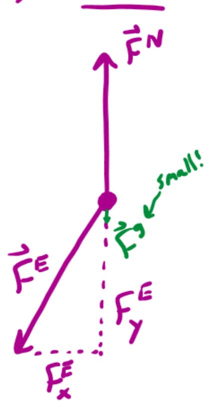
$d^2 = (2\,cm)^2 + (4\,cm)^2$

$d = \sqrt{20\,cm^2}$

$d = 4.47\,cm = 0.0447\,m$

(b) $\left|\vec{F}^E\right| = k\,\frac{q_1 q_2}{d^2} = 24.8\,N$

(c) FBD



y: $\Sigma F_y = m\cancel{a_y}^{0}$

$\Rightarrow F^E_y + F^g_y = F^N$

x: $\Sigma F_x = ma_x$

$F^E_x = ma_x$

$\sin\theta = \frac{F^E_x}{|F^E|}$

$\Rightarrow F^E_x = -|F^E|\sin\theta$

$F^E_x = -(24.8\,N)\sin(26.6)$

$F^E_x = -10.7\,N$

$\Rightarrow a_x = \frac{-10.7\,N}{5.62\times10^{-3}\,kg}$

$a_x = -1{,}910\,m/s^2$

$\boxed{\vec{a} = -1910\,m/s^2 \text{ in x-direction} \quad \text{or} \quad \vec{a} = \langle -1910, 0\rangle\,m/s^2}$

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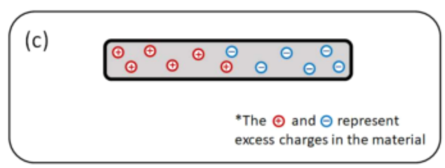
Part B: As a group, assign roles to each member. One person should be the writer, one should be the recorder in charge of submitting the group solution to Gradescope (or Canvas), and if you have a third member, they should be the advice giver. Write each group member's name on the solution! Make sure to rotate roles so that each person has a chance to be the writer. **Work together to produce a written solution to Part A, then additionally answer Part B (questions 2, 3, and 4)**. Submit an image of your work to Gradescope or Canvas. **Questions 2, 3, and 4 have a total of 4 correct answers.** Discuss with your group, then clearly indicate which answers you think are correct. **Only the first 4 selected answers will be counted** (to prevent selecting every answer!).

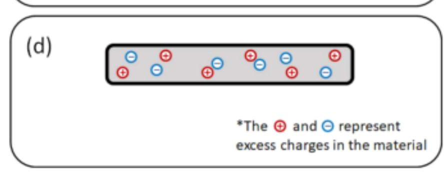
2) You start with two identical neutral, conducting, spheres labeled A and B. Sphere A always stays to the left of sphere B. Which of the following procedures results in a negatively charged sphere B?

☐ (a) Touch both spheres together. Bring a positive rod close (no touching!) to the left side of sphere A. Pull the two spheres apart.
☑ (b) Touch both spheres together. Bring a negative rod close (no touching!) to the left side of sphere A. Pull the two spheres apart.
☐ (c) Touch both spheres together. Touch a positively charged conducting rod to sphere A. Pull the two spheres apart.
☐ (d) Touch both spheres together. Touch a positively charged insulating rod to sphere A. Pull the two spheres apart.
☐ (e) It is not possible to get a negatively charged sphere B unless both spheres are insulating spheres.

3) Which of the following written descriptions and/or pictures represent a polarized system?

☐ (a) A PVC (polyvinyl chloride) pipe has excess electrons uniformly distributed on it after being rubbed against fur. The PVC pipe is far from other objects.
☑ (b) A net neutral wooden board when a charged PVC (polyvinyl chloride) pipe is placed near, but does not touch, the wooden board.
☑ (c) Image (c).
☐ (d) Image (d).





4) Which of the following statements are true about a scenario where you get an electrostatic shock from a metal object?

☐ (a) Protons transfer between you and the metal, resulting in the shock.
☐ (b) Neutrons transfer between you and the metal, resulting in the shock.
☑ (c) Electrons transfer between you and the metal, resulting in the shock.
☐ (d) Speed force particles transfer between you and the metal, resulting in the shock and probably superpowers too.