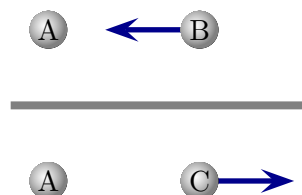


## Concepts of Physics: Homework 7

Due: 20 October 2023

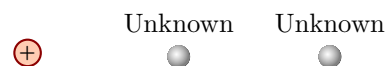
### 1 Pairs of charged balls

Various pairs of balls that may or may not be charged are placed near each other and the observed interactions are as illustrated. What interaction would occur if C were placed near to B? Explain your answer.



### 2 Combined electric forces

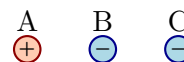
Three charged particles are held at fixed locations. The distances between adjacent charges are the same and the sizes of their charges are the same. The particle on the left is positively charged.



- Suppose there is no net force on the middle charge. What type of charge could the particle on the right have? Explain your answer.
- Suppose the net force on the middle charge points right. What type of charge could the particle on the right have? Explain your answer.

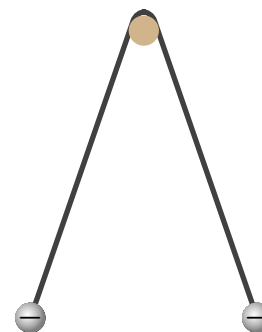
### 3 Electric forces and charge particle motion

Three charged particles are held at fixed locations. The distances between adjacent charges are the same and the sizes of their charges are the same. The charge in the middle (B) is initially held at rest and is then released. After it is released, which way will it begin to move? Explain your answer.



### 4 Electroscope

Two negatively charged metal spheres are connected by a metal wire. This is suspended over an insulating peg as illustrated. The spheres separate. Later, a positively charged rod is held near to the peg and it does not touch the wire. Describe what happens to the spheres as the rod approaches the peg.



5 Hobson, *Physics, Concepts and Connections, 5ed*, Ch. 8 Conceptual Exercise 14, page 184.

## 6 Motion of an ion

An ion is an atom that has lost (or perhaps gained) one or more electrons. Consider:



- A potassium ion: a neutral potassium atom that has lost one electron.
- A calcium ion: a neutral calcium atom that has lost two electrons.



In separate experiments each is held at rest the same distance above a negatively charged sheet of metal and then released.

- Describe the motion of the charges after they have been released.
- At the moment of release, will the force on the calcium ion be the same as, larger than or smaller than the force on the potassium ion? Explain your answer.
- Suppose that each charge is observed when it has moved the same distance from or towards the plate. Will the speed of the calcium ion be the same as, larger than or smaller than the speed of the potassium ion? Explain your answer.
- The motion of calcium ions is not a hypothetical issue. Briefly describe some reasons why it is important for your life. You can look up this information.

## 7 Magnesium ions

Magnesium is a light metal that is very reactive (it burns easily). It is found in magnesium chloride (a salt used to coat roads). There are several types of magnesium atom but each has 12 protons. The most common type (called magnesium-24) also has 12 neutrons. A single magnesium-24 atom has mass  $4.0 \times 10^{-26}$  kg.

- Suppose that you have a chunk of magnesium with mass 0.12 kg (about 4.2 oz). Determine the total number of magnesium atoms in the chunk.
- Determine the total number of protons, neutrons and electrons in the chunk.
- Suppose that each of the magnesium atoms in the chunk is ionized by losing one electron. Determine the total charge of the remaining magnesium ions.

## 8 Reading exercise

Read sections 8.4 to 8.6 (pages 173–183). The following exercises are intended to give you an understanding of the concepts presented in the text.

- a) A particular battery provides 18J of energy to 2C of charge that moves through the battery. Determine the voltage of the battery.
- b) Suppose that the battery is connected to a bulb, and the same 2C of charge eventually flows through the bulb. Does this charge gain or lose energy as it flows through the bulb? Explain your answer.
- c) Do Concept Check 5 without looking at the answer. Did your choice match the correct answer?