

# Midterm Exam No. 01 (2014 Summer)

## PHYS 203B: College Physics

Date: 2014 Jun 23

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1. **(10 points.)** Four identical metal spheres have charges of  $q_A = +Q$ ,  $q_B = +\frac{1}{4}Q$ ,  $q_C = -\frac{3}{4}Q$ , and  $q_D = -\frac{3}{2}Q$ . Spheres  $A$ ,  $B$ , and  $C$ , are brought together so they touch, and then they are separated. Then sphere  $C$  is touched to sphere  $D$  and separated. What is the resultant charge on sphere  $C$ ?
2. **(10 points.)** What is the electric force between a glass ball with  $3.0\ \mu\text{C}$  of charge and a rubber ball with  $-4.0\ \mu\text{C}$  of charge when their centers are separated by 5 cm?
3. **(20 points.)** Four point charges have equal magnitudes, all four being positive. These charges are fixed to the corners of a square. The magnitude of each of the charges is  $4.0\ \mu\text{C}$ , and the lengths of the sides of the square are 2.0 cm. Calculate the magnitude of the net force that each charge experiences.
4. **(10 points.)** An electric field of  $246,500\ \text{N/C}$  points due west at a certain spot. What are the magnitude and direction of the force that acts on a charge of  $-6.8\ \mu\text{C}$  at this spot?
5. **(20 points.)** Charges of  $-q$  and  $+2q$  are fixed in place, with a distance of  $a = 2.0\ \text{m}$  between them. See Fig. 1. A dashed line is drawn through the negative charge, perpendicular to the line between the charges. On the dashed line, at a distance  $y$  from the negative charge, there is at least one spot where the total potential is zero. Find  $y$ .

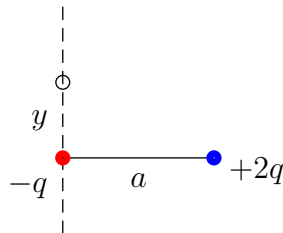


Figure 1: Problem 5

6. **(10 points.)** A proton and an electron are moving due east in a constant electric field that also points due east. The electric field has a magnitude of  $4.3 \times 10^5\ \text{N/C}$ . Determine the ratio of the magnitude of the acceleration of the proton to that of the electron.

7. **(10 points.)** A spherical surface completely surrounds a collection of charges. Find the electric flux through the surface if the collection consists of five protons and five electrons.
8. **(10 points.)** Draw some of the electric field lines between two unlike charges of equal magnitude. Draw equipotential surfaces for this configuration.
9. **(20 points.)** A proton accelerates from rest in a uniform electric field of  $620 \text{ N/C}$ . At some time later, its speed is  $1.40 \times 10^6 \text{ m/s}$ .
- (a) What is the magnitude of the acceleration of the proton?
  - (b) How long does it take the proton to reach this speed?
  - (c) How far has it moved in this time interval?
  - (d) What is its kinetic energy at the later time?
10. **(20 points.)** Figure 2 shows three resistors connected in parallel to a battery. The battery has a voltage of  $V = 10.0 \text{ V}$ , and the resistors have equal resistances of  $R = 300.0 \Omega$ .
- (a) Determine the equivalent resistance across the battery.
  - (b) Determine the voltage across each of the resistor.
  - (c) Determine the current passing through each resistor.
  - (d) Determine the power consumed by each resistor.

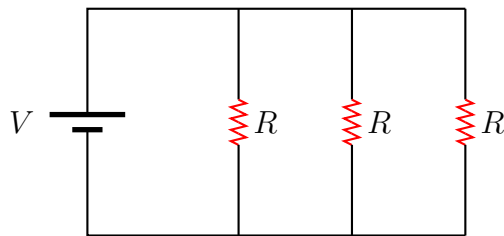


Figure 2: Problem 10