

General Physics: Class Exam I

15 February 2013

Name: _____

Total: /70

Instructions

- There are 7 questions on 5 pages.
- Show your reasoning and calculations and always justify your answers.

Physical constants and useful formulae

Coulomb's constant: $k = 9.0 \times 10^9 \text{ Nm}^2/\text{C}^2$

Electron charge: $q_{\text{electron}} = -1.60 \times 10^{-19} \text{ C}$

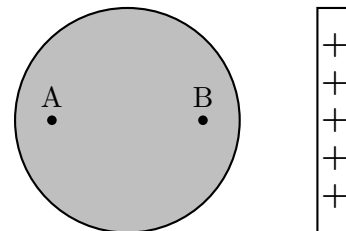
Proton charge: $q_{\text{proton}} = +1.60 \times 10^{-19} \text{ C}$

Electron mass: $m_e = 9.11 \times 10^{-31} \text{ kg}$

Proton mass: $m_p = 1.67 \times 10^{-27} \text{ kg}$

Question 1

A positively charged rod is held next to a solid sphere made of a perfect conducting material. The sphere and rod are held fixed.



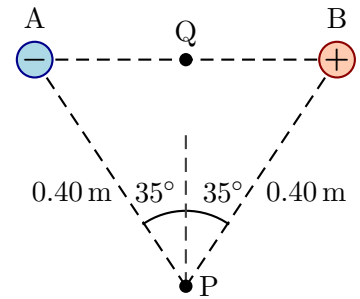
- a) Is the negative charge in the sphere evenly distributed throughout the sphere? Explain your answer.
- b) Is the electric potential at point A the same, larger, or smaller than that at point B? Explain your answer.

Question 2

Two fixed charged particles are situated as illustrated. The charges of these particles are

$$q_A = -16.0 \times 10^{-9} \text{ C} \quad \text{and}$$

$$q_B = +16.0 \times 10^{-9} \text{ C}.$$



- a) Determine the electric field produced by the entire charge distribution at the location labeled P. Describe the direction of the electric field.

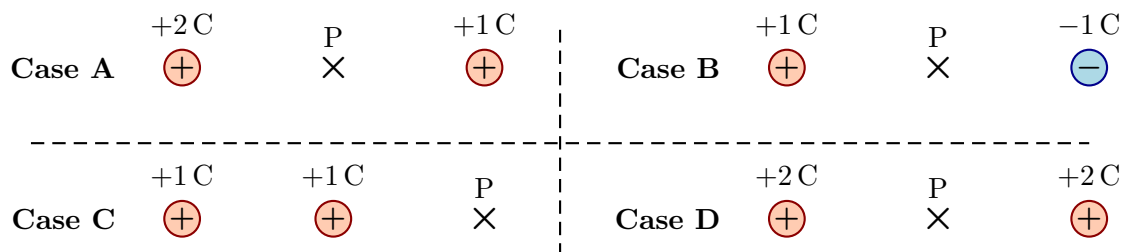
Question 2 continued ...

- b) A student considers the point Q midway between the charges and states that, “The potential at point Q is zero and this means that the electric field at point Q is zero.” Is this claim true or false? Explain your answer.

/18

Question 3

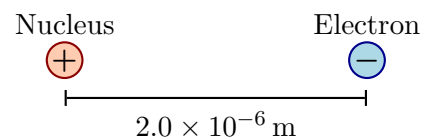
Various arrangements of fixed charges are arranged as illustrated. In which case (choose one) is the magnitude of the electric field produced by the charges at point P largest? Note that the charge magnitudes vary.



/5

Question 4

An electron and a nucleus, consisting of *two protons*, are separated by a distance of 2.0×10^{-10} m. Determine the electric potential produced by the nucleus at the location of the electron **and** the electric potential energy of the electron in this configuration.



/10

Question 5

A positively charged particle, Zog, is held fixed. Another charged particle, X, is given a brief kick and moves toward Zog. Consider the motion of X after the kick.

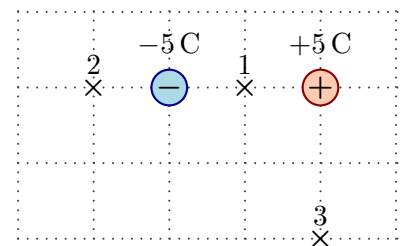


- a) Which of the following (choose one) is true regarding the change in electric potential seen by X?
- i) $\Delta V > 0$ is X is positive, $\Delta V < 0$ is X is negative,
 - ii) $\Delta V < 0$ is X is positive, $\Delta V > 0$ is X is negative,
 - iii) $\Delta V > 0$ regardless of X's charge.
 - iv) $\Delta V < 0$ regardless of X's charge.
- b) Which of the following (choose one) is true regarding the change in electric potential energy seen by X?
- i) $\Delta U_{\text{elec}} > 0$ is X is positive, $\Delta U_{\text{elec}} < 0$ is X is negative,
 - ii) $\Delta U_{\text{elec}} < 0$ is X is positive, $\Delta U_{\text{elec}} > 0$ is X is negative,
 - iii) $\Delta U_{\text{elec}} > 0$ regardless of X's charge.
 - iv) $\Delta U_{\text{elec}} < 0$ regardless of X's charge.

/10

Question 6

Two charged particles are held fixed as illustrated. Which of the following (choose one) correctly ranks the electric potentials at the indicated points? Note that negative is always less than positive.

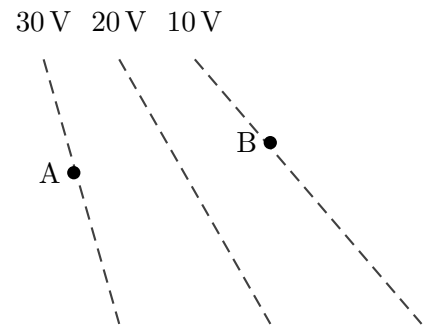


- a) $V_1 = V_2 = V_3$
- b) $V_1 > V_2 > V_3$
- c) $V_1 = V_2 > V_3$
- d) $V_3 > V_1 > V_2$
- e) $V_2 > V_1 > V_3$

/5

Question 7

Hidden source charges produce the illustrated equipotentials. Another charged particle of mass 0.50 kg and charge -4.0 C moves through the location labeled A with speed 20 m/s . The particle reaches the location labeled B.



a) Determine the speed of the particle when it reaches B.

b) Indicate the direction of the electric field produced by the sources at B **and** of the force acting on the particle when it is at B.

/14