Phys 2B Summer 2022

Quiz 1 Practice

Question 1:

A proton is located at the origin, and an electron is located at $x = 0.15\,\text{nm}$, $y = 0.40\,\text{nm}$. What is the force exerted by the proton on the electron, expressed as $\vec{F} = (F_x, F_y)$?

(a) $\vec{F} \approx (-4.3 \times 10^{-9}\,\text{N}, 1.5 \times 10^{-9}\,\text{N})$

(b) $\vec{F} \approx (0.18 \times 10^{-9}\,\text{N}, -4.0 \times 10^{-9}\,\text{N})$

(c) $\vec{F} \approx (-0.44 \times 10^{-9}\,\text{N}, -1.2 \times 10^{-9}\,\text{N})$

(d) $\vec{F} \approx (-4.3 \times 10^{-9}\,\text{N}, -4.3 \times 10^{-9}\,\text{N})$

(e) $\vec{F} \approx (1.3 \times 10^{-9}\,\text{N}, 1.3 \times 10^{-9}\,\text{N})$

Question 2:

A +1 C charge is located at the origin, and a +2 C charge is located at $x = 1$ m. Which of the following statements is/are true?

I Aside from $x = \pm\infty$, there is a single point on the x axis where the net electric field is zero, and it is between the two charges, $0 < x < 1\,\text{m}$.

II Aside from $x = \pm\infty$, any point on the x axis where the net electric field is 0 must be closer to the +2 C charge than to the +1 C charge.

III For all $x < 0$, the net electric field points in the negative x direction.

(a) I only

(b) II only

(c) III only

(d) I and III, but not II

(e) All of I, II, and III

Question 3:

A proton is in a region where the electric field is constant, 13 N/C. What is the proton's acceleration in this region?

(a) $1.2 \times 10^9\,\mathrm{m/s^2}$

(b) $6.0 \times 10^9\,\mathrm{m/s^2}$

(c) $1.9 \times 10^{10}\,\mathrm{m/s^2}$

(d) $8.1 \times 10^{10}\,\mathrm{m/s^2}$

(e) $4.4 \times 10^{11}\,\mathrm{m/s^2}$

Question 4:

A charge $q_1 = 2.5\,\mathrm{nC}$ is at the origin, and a charge $q_2 = 1.0\,\mathrm{nC}$ is at $(x, y) = (2.0\,\mathrm{m}, 0)$. What is the magnitude of the net electric field at the location $(x, y) = (2.0\,\mathrm{m}, 2.0\,\mathrm{m})$?

(a) $2.0\,\mathrm{N/C}$

(b) $4.2\,\mathrm{N/C}$

(c) $4.7\,\mathrm{N/C}$

(d) $8.4\,\mathrm{N/C}$

(e) $22\,\mathrm{N/C}$

Question 5:

A charge $q_1 = 1.0\,\mathrm{C}$ is at $x = 0$ and a second charge $q_2 = -3.0\,\mathrm{C}$ is at $x = 2.0\,\mathrm{m}$. At which value of x is the net electric field 0?

(a) -2.7 m

(b) -0.73 m

(c) 0.33 m

(d) 0.73 m

(e) 2.7 m

Question 6:

The electric field due to a certain point charge at point $\mathcal{P}$ is $\vec{E} = (14, -7.9, 0)$ N/C. If point $\mathcal{P}$ is 2.0 meters from the point charge, what is the magnitude of the charge?

(a) 2.7 nC

(b) 3.5 nC

(c) 6.2 nC

(d) 7.1 nC

(e) 9.7 nC

Question 7:

A proton levitates motionlessly above a plane of charge so large that it can be considered infinite, on Earth ($g = 9.8\,\mathrm{m/s^2}$). What must the charge-per-area σ of the plane of charge be?

(a) $1.6 \times 10^{-19}\,\mathrm{C/m^2}$

(b) $9.0 \times 10^{-19}\,\mathrm{C/m^2}$

(c) $1.8 \times 10^{-18}\,\mathrm{C/m^2}$

(d) $6.5 \times 10^{-16}\,\mathrm{C/m^2}$

(e) $5.9 \times 10^{-15}\,\mathrm{C/m^2}$

Question 8:

An infinite straight line of positive charge is laid out in the east-west direction on a flat table. Assume that this line of charge is the only source of electric field in the area. Which of the following statements is/are true?

I. The electric field at a point on the table to the north of the line of charge points north, away from the line of charge.

II. The electric field at a point on the table 1 meter north of the line of charge is twice as strong as the electric field at a point on the table 2 meters north of the line of charge.

III. An electric charge placed on the table would accelerate in the east or west direction, depending on the sign of its charge, due to the electric force exerted by the line of charge.

(a) I only

(b) II only

(c) III only

(d) I and II, but not III

(e) All of I, II, and III

Question 9:

Protons are not true point charges; they have a radius of about $R_p = 1\,\text{femtometer} = 1 \times 10^{-15}\,\text{m}$. So, an electron can go inside a proton, and when it does, the field it feels from the proton has only a fraction of the magnitude that it would have if the proton were a point charge located at its own center. Let's model a proton as a uniformly distributed sphere of positive charge. What is the ratio of the magnitude of the electric field that an electron 0.5 fm from the center of a proton feels, to the field it would feel if the proton were truly a point charge?

(a) $1/8$

(b) $1/4$

(c) $1/\sqrt{8}$

(d) $1/2$

(e) $1/\sqrt{2}$

Question 10:

The electric field inside a spherically symmetric charge distribution is constant as a function of the radial coordinate, r. If the charge-per-volume is given by $\rho(r) = br^a$ where b is a nonzero constant, what must be the exponent a?

(a) -1

(b) 0

(c) $\frac{1}{2}$

(d) 1

(e) 2