

University Physics III Practice Test I

This practice test should give you a rough idea of the format and overall level of the Physics 313 exams. The actual exams will have different questions and problems, and may cover a different selection of topics. Individual questions and problems on the actual exams may be either harder or easier than those in this practice exam.

Formulas and constants:

$$\vec{F} = q\vec{E}$$

$$\oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0}$$

$$m_{electron} = 9.11 \times 10^{-31} \text{ kg}$$

$$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2} \hat{r}$$

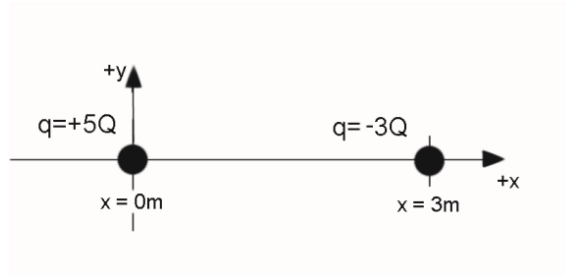
$$k = \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \frac{Nm^2}{C^2}$$

$$e = |q_{electron}| = 1.60 \times 10^{-19} \text{ C}$$

1. (a) When two charges are held a distance d apart, they experience a repulsive force of 24.0 N. If these charges are held 4 times farther apart, what force do they experience?

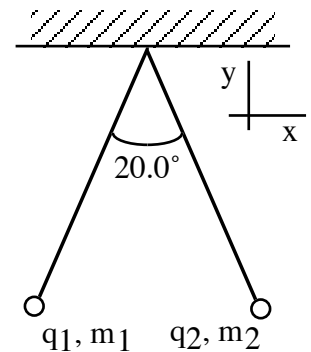
(b) Two charges are placed on the x axis as shown. Where along the x axis could the net electric field be zero?

- (A) only for $x < 0$
- (B) for $0 < x < 3\text{m}$
- (C) only for $x > 3\text{m}$
- (D) for $x < 0$ and $x > 3\text{m}$
- (E) no where along the x axis

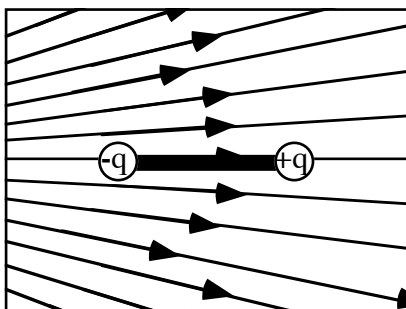


(c) What are the units of electric flux?

(d) Two small spheres of charge, $q_1 = 3.4 \mu\text{C}$ and $q_2 = 2.6 \mu\text{C}$, with masses $m_1 = 12.0 \text{ g}$ and $m_2 = 15.0 \text{ g}$, are suspended from massless strings of length $L = 1.50 \text{ m}$. These strings hang from one point making an angle of 20.0° from each other. The force of q_1 on q_2 is $0.333 \text{ N } \hat{i}$. What is the force, magnitude and direction, of q_2 on q_1 ?



(e) In each diagram, we see an electric dipole (equal positive and negative charges separated by a distance D) in an electric field indicated by the arrows.



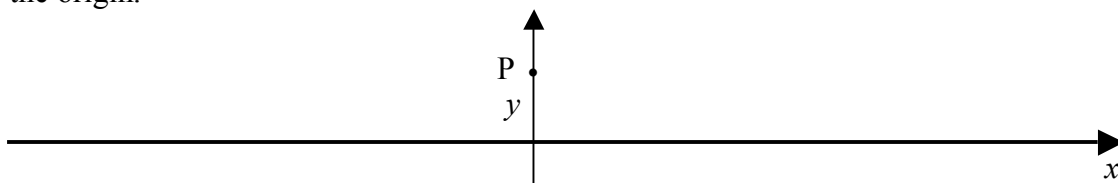
Is the net force on the dipole in this diagram zero?

yes **no** (Circle one.)

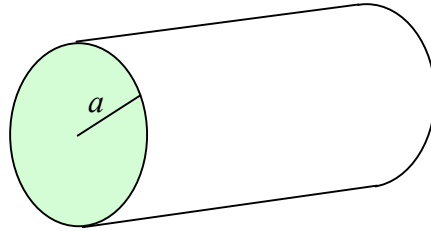
Why or why not? Explain carefully why the net force is/is not zero.

(2) I have two charges, $Q_1 = +300 \mu\text{C}$ and $Q_2 = -500 \mu\text{C}$. Q_1 is placed at $3\text{m} \hat{\mathbf{i}}$ and Q_2 is placed at $2\text{m} \hat{\mathbf{j}}$. Where could I place a single $+100 \mu\text{C}$ charge to make the net electric field at the origin zero?

(3) An infinite line of charge lies on the x axis as shown. It has linear charge density $+\lambda$ for positive values of x , and $-\lambda$ for negative values of x . Find the electric field that it produces at point P a distance y above the origin.



(4) The figure shows a cross-section of an infinitely-long solid cylinder with radius a and volume charge density $\rho = \rho_0 r$ where ρ_0 is a constant.



(a) What is the charge per unit length of the cylinder?

(b) Use Gauss' Law to determine the electric field for $r < a$.

(5) In a different lab experiment from the one you did in class, you take data to determine how the force between two identical electrical charge distributions is related to the separation of the distributions.

(a) Using all of the rules of good graphing, plot the following data on the attached log-log graph paper to create a graph representing force as a function of separation.

Separation (cm)	Force (mN)
2	15
3.5	10
7	6
15	3
40	1.5

(b) Can you conclude, from your graph, that the force and separation are related by a power law of the form $F = kr^n$, where F is the force between the two charge distributions, r is the separation of the two distributions, and k is an unknown constant?

Yes **No** (Circle one.)

Explain why or why not. Be certain to include a derivation showing how the value of n is related to the graph. If you answer “yes”, also determine the value of n from your graph.

