Name: KEY

Period: ____
Pre-AP Physics

# Electric Charges and Fields

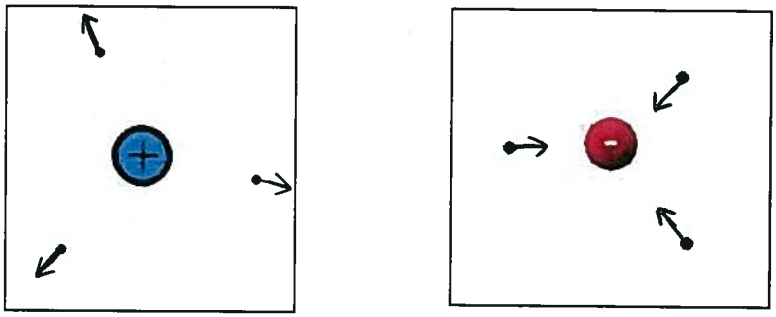
*Answer each question in the space provided. When applicable, show all work and box your answer(s).*

1. A negatively charged balloon has 3.5 μC of charge. How many excess electrons are on this balloon?

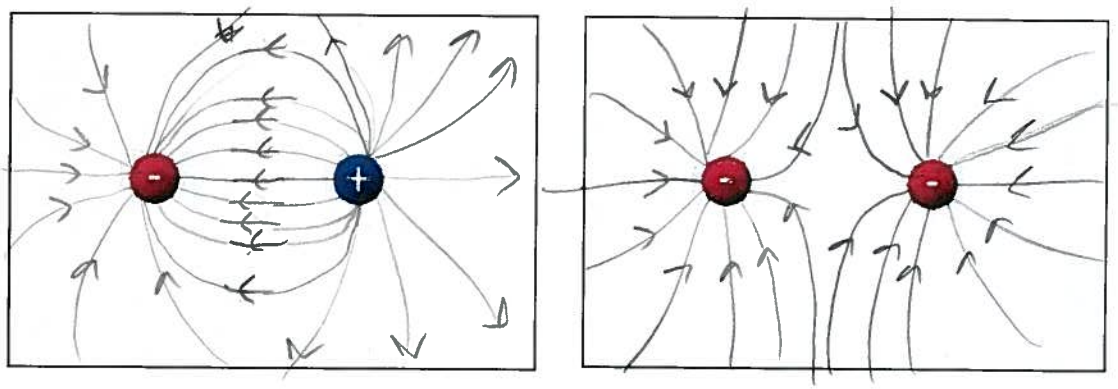
$e = 1.6 \times 10^{-19} C$ (charge of one electron)

$$\#electrons = \frac{3.5 \times 10^{-6}}{1.6 \times 10^{-19}} = \boxed{2.2 \times 10^{13} electrons}$$

2. Draw a vector to represent the direction of the electric field at each point indicated on the diagrams below.



3. Draw electric field lines for each system of charges below. Be sure to use arrows indicate the direction of the field along the lines.



4. Two identical metal spheres are given electrical charges and then brought together so that the charges can balance. For each of the following initial charges below, state what the resulting charges on each will be after the spheres are brought together.

a. 0 and -4 $\boxed{-2}$

b. 0 and +12 $\boxed{+6}$

c. +16 and -2 $\boxed{+7}$

d. -9 and -1 $\boxed{-5}$

e. +4 and -8 $\boxed{-2}$

f. -20 and -44 $\boxed{-32}$

5. A proton is flying through an electric field of unknown magnitude and it experiences a force of $5.00 \times 10^{-17}$ Newtons. Calculate the strength of the electric field.

$q = e = 1.6 \times 10^{-19} C$

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

$$E = \frac{5.00 \times 10^{-17}}{1.6 \times 10^{-19}} = \boxed{312.5 N/C}$$

6. A charged particle of 6.5 μC is placed in an electric field with a magnitude of $9.0 \times 10^5$ N/C. How much force is exerted on the particle?

$E = \frac{F}{q}$ → $F = (6.5 \times 10^{-6})(9 \times 10^5)$

$F = qE$ → $F = 5.85\,N$

7. A Van de Graff generator produces an electric field around it with a magnitude of $10 \times 10^4$ N/C. If an electron is placed in this field, how much force will be exerted on it?

$q = -e = -1.6 \times 10^{-19}\,C$ → $F = (1.6 \times 10^{-19})(10 \times 10^4)$

$F = qE$ → $F = 1.6 \times 10^{-14}\,N$

8. What is the magnitude of the electric field at a point 50 cm from a metal sphere that contains a charge of 3 μC?

$E = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(3 \times 10^{-6})}{(.5)^2} = 1.08 \times 10^5\,N/C$

$(108{,}000\,N/C)$

9. $6.0 \times 10^{10}$ excess electrons are placed on a conductor. What is the magnitude of the electric field at a point 1.5 meters from the conductor?

$Q = 6.0 \times 10^{10}\,\text{electrons} \times 1.6 \times 10^{-19}\,C = 9.6 \times 10^{-9}\,C$

$E = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(9.6 \times 10^{-9})}{(1.5)^2} = 38.4\,N/C$

10. How much charge is needed to generate an electric field strength of 890 N/C at a distance of 25 cm?

$E = \frac{kQ}{r^2}$ → $Q = \frac{(890)(.25)^2}{(9 \times 10^9)}$

$Q = \frac{Er^2}{k}$ → $Q = 6.18 \times 10^{-9}\,C$

11. It is determined that the electric field strength is 7,500 N/C at a certain point from an object with a net charge of $7.9 \times 10^{-9}$ C. What is the distance from the object to this point?

$E = \frac{kQ}{r^2}$ → $r = \sqrt{\frac{(9 \times 10^9)(7.9 \times 10^{-9})}{(7500)}}$

$r = \sqrt{\frac{kQ}{E}}$ → $r = 0.097\,m$

$$F_E = \frac{kq_1q_2}{r^2} \qquad E = \frac{F}{q} = \frac{kQ}{r^2}$$

$$k = 9.00 \times 10^9 \frac{Nm^2}{C^2} \qquad e = 1.60 \times 10^{-19}C$$