

PHYS1120  
Summer 2025

Show all work for credit!  
Due Date: 18 July

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- How many electrons are needed to generate  $-1$  C of charge?
- Two electrons are positioned a distance  $r$  apart. The electron has a mass  $m_e = 9.11 \times 10^{-31}$  kg and charge  $e = -1.60 \times 10^{-19}$  C.
  - Find the ratio of the electrostatic force to gravitational force.
  - Will the electrons attract or repel?
- An infinitely long, charged wire has a linear charge density of 5 C/m. Calculate the electric field 8 cm above the wire.
- 10 C of charge are equally distributed through a sphere of radius 5 cm. Calculate:
  - The electric field inside the sphere ( $0 < r < 5$  cm).
  - The electric field in the region outside of the sphere ( $r > 5$  cm).
  - Sketch a graph of the Electric field as a function of distance  $r$ .
- Charge 1 is placed  $a$  meters left of the origin along the  $x$ -axis and has charge  $Q$ . Charge 2 is placed  $a$  meters up on the  $+y$ -axis and has charge  $2Q$ . Where should charge 3, having charge  $-3Q$ , be placed to ensure the electric potential at the origin is 0 V? Draw a picture.
- A parallel-plate capacitor is designed using plates of radius  $r$ , separated by a distance of 5 mm, and a dielectric material having  $\kappa = 233$ . What radius plates will yield a capacitance of 1  $\mu\text{F}$ ? (1  $\mu\text{F} = 10^{-6}$  F.)

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<p>Answer key: (1) <math>6.25 \times 10^{18}</math> e<sup>-</sup>; (2a) <math>4.16 \times 10^{42}</math> (2b) Repel; (3) <math>1.12 \times 10^{12}</math> N C<sup>-1</sup>;          (4a) <math>E = \frac{\rho r}{3\epsilon_0}</math>; (4b) <math>E = \frac{Q}{4\pi\epsilon_0 r^2}</math>; (4c)...; (5) <math> \vec{r}  = a \rightarrow (0, -a), (a, 0), (-\frac{\sqrt{2}}{2}a, -\frac{\sqrt{2}}{2}a), \dots</math>;          (6) 0.879 m</p>
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How many hours (approximately) did it take you to complete this assignment?