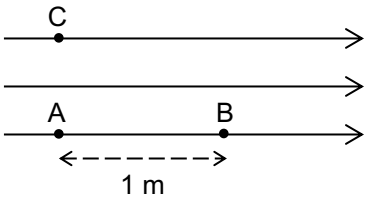
1. A test charge (q = + 1.0 · 10^{-9} C) is located in a uniform electric field (E = 300.0 $\frac{N}{C}$), see picture below.

a) What is the force (magnitude and direction), acting on the test charge?
b) What is the work done on the test charge, if it is moved from
   - B to A?
   - A to C?
   - B to C?
c) What is the work done on the test charge, if it is moved first from B to C, and then from C to A?
d) What is the voltage betweent the points
   - A and B
   - A and C
   - C and B?



2. A test charge (q = + 5.0 · 10^{-9} C) is placed into a uniform electric field of magnitude E = 3.5 · 10^{5} $\frac{N}{C}$.

a) What's the magnitude of the force acting on the test charge?
b) How much work is done on the charge, if it is moved against the direction of the field between two points spaced 3.0 cm apart?
c) What is the voltage between these two points?

3. A test charge (q = 3.0 · 10^{-9} C) is located in the electric field of a plate capacitor. The plates are spaced d = 6.0 cm apart and the voltage is U = 1.00 kV.

a) What's the electric field strength between the plates?
b) What's the magnitude of the force acting on the test charge?

4. The voltage on a plate capacitor is U = 1.50 kV. The force acting on a test charge q = 2.0 · 10^{-9} C has a magnitude of F = 5.0 · 10^{-4} N.

a) What is the electric field strength between the plates?
b) What is the distance between the plates?

5. A charged oil drop (ρ = 0.973 $\frac{g}{cm^3}$, V = 1.5 · 10^{-8} mm^3) is hovering between the horizontal plates of a plate capacitor. The voltage is 1.00 kV and the plates are spaced 0.56 cm apart.

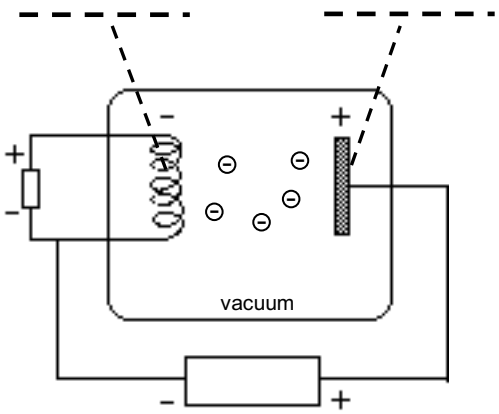
a) What's the mass of the oil drop?
b) What's the electric field strength between the plates?
c) How much charge does the oil drop carry?
d) How many extra electrons does the oil drop carry?

6. Charles is trying to make a cotton ball (m = 0.0200 g; q = + 5.00 · 10^{-8} C) hover between the horizontal plates of a plate capacitor (d = 7.00 cm).

a) Which one of the plates needs to be positively charged, which one negatively?
b) How much voltage is needed?
c) What's the acceleration (magnitude and direction) of the cotton ball, if Charles is using a voltage of 300.0 V?
d) What's the acceleration (magnitude and direction) of the cotton ball, if Charles is using a voltage of 265.0 V?

7. If a wire is heated until it glows, the wire will emit electrons (thermionic effect).
A hot cathode (negative) and a cold anode (positive) are located in a vacuum tube. Electrons are emitted by the cathode. These free electrons are accelerated by the electric field, towards the anode (see picture).
The voltage between anode and cathode is 300.0 V.

a) Write the words *anode* and *cathode* on the dotted lines at the correct spots.
b) Drawing arrows, illustrate the direction of the electron movement.
c) What's the magnitude of the work done by the electric field, when an electron is accelerated from the cathode to the anode?
d) What is the kinetic energy of an electron when it reaches the anode?
e) What is the velocity of an electron when it reaches the anode?



electron mass	$m_e = 9.11 \cdot 10^{-31}$ kg
elementary charge	$e = 1.602 \cdot 10^{-19}$ C

Solutions:

1. a) $3.0 \cdot 10^{-7}$ N b) B to A: $3.0 \cdot 10^{-7}$ J, A to C: 0, B to C: $3.0 \cdot 10^{-7}$ J
   c) $3.0 \cdot 10^{-7}$ J d) between A and B: 300 V, between A and C: 0, between C and B: 300 V
2. a) 1.75 mN b) $5.25 \cdot 10^{-5}$ J c) 10.5 kV
3. a) $1.7 \cdot 10^{4}\ \frac{N}{C}$ b) $5.0 \cdot 10^{-5}$ N
4. a) $2.5 \cdot 10^{5}\ \frac{N}{C}$ b) 6.0 mm
5. a) $1.46 \cdot 10^{-11}$ g b) $1.79 \cdot 10^{5}\ \frac{N}{C}$ c) $8.02 \cdot 10^{-19}$ C d) 5
6. a) lower ⊕, upper ⊖ b) 275 V c) 0.904 $\frac{m}{s^2}$, up d) 0.35 $\frac{m}{s^2}$, down
7. c) $4.8 \cdot 10^{-17}$ J (= 300 eV) d) $4.8 \cdot 10^{-17}$ J e) $10.3 \cdot 10^{6}\ \frac{m}{s}$