1. a) $F = q \cdot E = 1.0 \cdot 10^{-9}\ \text{C} \cdot 300\ \frac{\text{N}}{\text{C}} = \underline{3.0 \cdot 10^{-7}\ \text{N}}$

   b) B to A: $W = F \cdot s = 3.0 \cdot 10^{-7}\ \text{N} \cdot 1.0\ \text{m} = \underline{3.0 \cdot 10^{-7}\ \text{J}}$
   A to C: perpendicular to the direction of the field: $W = 0$
   B nach C: $\underline{3.0 \cdot 10^{-7}\ \text{J}}$

   c) Work does not depend on the path: $\underline{3.0 \cdot 10^{-7}\ \text{J}}$

   d) between A and B: $U = \frac{W}{q} = \frac{3.0 \cdot 10^{-7}\ \text{J}}{1.0 \cdot 10^{-9}\ \text{C}} = \underline{\underline{300\ \text{V}}}$

   between A and C: $U = \frac{W}{q} = \frac{0}{1.0 \cdot 10^{-9}\ \text{C}} = \underline{\underline{0}}$

   between C and B: $U = \frac{W}{q} = \frac{3.0 \cdot 10^{-7}\ \text{J}}{1.0 \cdot 10^{-9}\ \text{C}} = \underline{\underline{300\ \text{V}}}$

2. a) $F = Q \cdot E = 5.0 \cdot 10^{-9}\ \text{C} \cdot 3.5 \cdot 10^{5}\ \frac{\text{N}}{\text{C}} = \underline{1.75\ \text{mN}}$

   b) $W = F \cdot s = 1.75 \cdot 10^{-3}\ \text{N} \cdot 0.03\ \text{m} = \underline{5.25 \cdot 10^{-5}\ \text{J}} = \underline{52.5\ \mu\text{J}}$

   c) $U = \frac{W}{Q} = \frac{5.25 \cdot 10^{-5}\ \text{J}}{5.0 \cdot 10^{-9}\ \text{C}} = \underline{\underline{10'500\ \text{V}}} = \underline{\underline{10.5\ \text{kV}}}$

3. a) $E = \frac{U}{d} = \frac{1'000\ \text{V}}{0.060\ \text{m}} = \underline{\underline{16.7 \cdot 10^{3}\ \frac{\text{N}}{\text{C}}}} = \underline{\underline{1.7 \cdot 10^{4}\ \frac{\text{N}}{\text{C}}}}$

   b) $F = q \cdot E = 3.0 \cdot 10^{-9}\ \text{C} \cdot 16.7 \cdot 10^{3}\ \frac{\text{N}}{\text{C}} = \underline{5.0 \cdot 10^{-5}\ \text{N}}$

4. a) $E = \frac{F}{q} = \frac{5.0 \cdot 10^{-4}\ \text{N}}{2.0 \cdot 10^{-9}\ \text{C}} = \underline{\underline{2.5 \cdot 10^{5}\ \frac{\text{N}}{\text{C}}}}$

   b) $d = \frac{U}{E} = \frac{1'500\ \text{V}}{2.5 \cdot 10^{5}\ \frac{\text{V}}{\text{m}}} = \underline{\underline{0.006\ \text{m}}} = \underline{\underline{6.0\ \text{mm}}}$

5. a) $m = \rho \cdot V = 0.973 \ \frac{g}{cm^3} \cdot 1.5 \cdot 10^{-11} \ cm^3 = \underline{1.4595 \cdot 10^{-11} \ g}$

b) $E = \frac{U}{d} = \frac{1'000 \ V}{0.0056 \ m} = \underline{\underline{178'571 \ \frac{N}{C}}}$

c) $m \cdot g = Q \cdot E \qquad Q = \frac{m \cdot g}{E} = \frac{1.4595 \cdot 10^{-14} \ kg \cdot 9.81 \frac{N}{kg}}{178'571 \ \frac{N}{C}} = \underline{\underline{8.02 \cdot 10^{-19} \ C}}$

d) $8.02 \cdot 10^{-19}$ C = **5** $\cdot 1.6 \cdot 10^{-19}$ C, i.e. <u>5 electrons</u>

6. a) lower positive, upper negative

b) $U = \frac{m \cdot g \cdot d}{Q} = \frac{0.02 \cdot 10^{-3} \ kg \cdot 9.81 \ \frac{N}{kg} \cdot 0.07 \ m}{5 \cdot 10^{-8} \ C} = \underline{\underline{275 \ V}}$

c) $a = \frac{F_{res}}{m} = \frac{F_{el} - F_G}{m} = \frac{Q \cdot E - m \cdot g}{m} = \frac{Q \cdot \frac{U}{d} - m \cdot g}{m} = \frac{Q \cdot U}{d \cdot m} - g$

$= \frac{Q \cdot U}{d \cdot m} - g = \frac{5 \cdot 10^{-8} \ C \cdot 300 \ V}{0.07 \ m \cdot 0.02 \cdot 10^{-3} \ kg} - 9.81 \ \frac{m}{s^2} = \underline{\underline{0.904 \ \frac{m}{s^2}}}$ <u>up</u> (F_{el} ist larger)

d) $= \frac{Q \cdot U}{d \cdot m} - g = \frac{5 \cdot 10^{-8} \ C \cdot 265 \ V}{0.07 \ m \cdot 0.02 \cdot 10^{-3} \ kg} - 9.81 \ \frac{m}{s^2} = \underline{\underline{-0.346 \ \frac{m}{s^2}}}$ <u>down</u> (F_{el} ist smaller)

7. a) left: cathode, right: anode

b) to the right

c) $W_{acc} = U \cdot Q = 300 \ V \cdot 1.6 \cdot 10^{-19} \ C = \underline{4.8 \cdot 10^{-17} \ J}$ <u>(= 300 eV)</u>

d) $E_{kin} = W_{acc} = \underline{\underline{4.8 \cdot 10^{-17} \ J}}$

e) $E_{kin} = \frac{1}{2} \cdot m \cdot v^2 \qquad v = \sqrt{\frac{2 \cdot E}{m}} = \sqrt{\frac{2 \cdot 4.8 \cdot 10^{-17} \ J}{9.1 \cdot 10^{-31} \ kg}} = \underline{\underline{10.3 \cdot 10^6 \ \frac{m}{s}}}$