1. a) greater b) smaller

2. a) three b) one fourth c) one ninth d) sixteen

3. $$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q_1 \cdot Q_2}{r^2} = \frac{1}{4\pi \cdot 8.85 \cdot 10^{-12}\ \frac{\mathrm{C}^2}{\mathrm{N \cdot m^2}}} \cdot \frac{1.6 \cdot 10^{-19}\ \mathrm{C} \cdot 1.6 \cdot 10^{-19}\ \mathrm{C}}{\left(2.0 \cdot 10^{-15}\,\mathrm{m}\right)^2} = \underline{\underline{58\ \mathrm{N}}}$$

4. $$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q_1 \cdot Q_2}{r^2} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q^2}{r^2}$$

$$Q = \sqrt{4\pi\varepsilon_0 \cdot F \cdot r^2} = r \cdot \sqrt{4\pi\varepsilon_0 \cdot F} = 0.025\ \mathrm{m} \cdot \sqrt{4\pi \cdot 8.85 \cdot 10^{-12}\ \frac{\mathrm{C}^2}{\mathrm{N \cdot m^2}} \cdot 0.046\ \mathrm{N}} = \underline{\underline{5.65 \cdot 10^{-8}\mathrm{C}}}$$

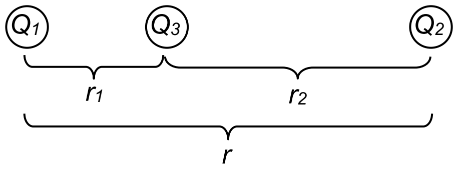
5. a) $$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q_1 \cdot Q_2}{r^2}$$

$$r = \sqrt{\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q_1 \cdot Q_2}{F}} = \sqrt{\frac{1}{4\pi \cdot 8.85 \cdot 10^{-12}\ \frac{\mathrm{C}^2}{\mathrm{N \cdot m^2}}} \cdot \frac{3.0 \cdot 10^{-8}\ \mathrm{C} \cdot 2.0 \cdot 10^{-8}\ \mathrm{C}}{0.0078\ \mathrm{N}}} = \underline{\underline{2.6\ \mathrm{cm}}}$$

b) The total charge amounts to +1.0 C. This charge is being distributed at equal parts between the two spheres (because they are the same size). Hence both spheres carry a charge of $+0.50 \cdot 10^{-8}$ C, repelling each other.

$$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q_1 \cdot Q_2}{r^2} = \frac{1}{4\pi \cdot 8.85 \cdot 10^{-12}\ \frac{\mathrm{C}^2}{\mathrm{N \cdot m^2}}} \cdot \frac{0.50 \cdot 10^{-8}\ \mathrm{C} \cdot 0.50 \cdot 10^{-8}\ \mathrm{C}}{\left(0.026\ \mathrm{m}\right)^2} = \underline{\underline{3.3 \cdot 10^{-4}\ \mathrm{N}}}$$

6. a)



For Q_3 to be at equilibrium, the Coulomb force between Q_1 und Q_3 needs to be of the same magnitude as the Coulomb force between Q_2 und Q_3. Let's assume all three charges to be positive:

$$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q_1 \cdot Q_3}{r_1^2} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q_2 \cdot Q_3}{r_2^2} \quad \Rightarrow \quad \frac{Q_1}{r_1^2} = \frac{Q_2}{r_2^2} \quad \Rightarrow \quad \frac{Q}{r_1^2} = \frac{4Q}{r_2^2} \quad \Rightarrow \quad \frac{1}{r_1^2} = \frac{4}{r_2^2}$$

$$4 \cdot r_1^2 = r_2^2 \quad \Rightarrow \quad 2 \cdot r_1 = r_2$$

We use $r_1 + r_2 = r$ hence $2 \cdot r_1 = r - r_1 \quad \Rightarrow \quad \underline{\underline{r_1 = \frac{1}{3} r}}, \ \underline{\underline{r_2 = \frac{2}{3} r}}$