A moving electron passes near the nucleus of a gold atom, which contains 79 protons and 118 neutrons. At a moment the electron is at a distance of 7.5e-9m from the gold nucleus. What is the magnitude of the electric force?

$$\vec{F}_{ele} = 9e9 \frac{Q_1 Q_2}{|\vec{r}|^2}$$

$$= 9e9 \frac{(1 \cdot -1.6e\text{-}19)(79 \cdot 1.6e\text{-}19)}{(7.5e\text{-}9)^2}$$

$$= -3.236e\text{-}10 \ C$$

A proton is located at ⟨0, 0, -2e-9⟩m, and an alpha particle (containing two protons and two neutrons) is located at ⟨4.5e-9, 0, 4.0e-19⟩m. Find the force the proton exerts on the alpha particle.

$$\vec{F}_{p\,on\,a} = 9e9 \frac{Q_1 Q_2}{|\vec{r}|^2} \hat{r}$$

$$\hookrightarrow \vec{r}_{p\,to\,a} = \vec{r}_a - \vec{r}_p$$

$$= \langle 4.5e\text{-}9, 0, 6e\text{-}9 \rangle m$$

$$\hookrightarrow |\vec{r}| = 7.5e\text{-}9$$

$$\hookrightarrow \hat{r} = \langle 0.6, 0, 0.8 \rangle m$$

$$\vec{F}_{p\,on\,a} = 9e9 \frac{(1 \cdot 1.6e\text{-}19)(2 \cdot 1.6e\text{-}19)}{(7.5e\text{-}9)^2} \langle 0.6, 0, 0.8 \rangle$$

$$= \langle -4.915e\text{-}12, 0, -6.55e\text{-}12 \rangle \ N$$

Use data from the inside back cover to calculate the gravitational and electric forces two electrons exert on each other when they are 1×10^{-10} m apart (about one atomic radius). Which interaction between two electrons is stronger, the gravitational attraction or the electric repulsion? Note that since both the gravitational and electric forces depend on the inverse square distance, this comparison holds true at all distances, not just at a distance of 1×10^{-10} m.

$\frac{|F_{elec}|}{|F_{grav}|} =$ [ ]

If the two electrons are at rest, will they begin to move toward each other or away from each other?

- ○ toward each other
- ● away from each other
- ○ They will remain at rest.

$$|\vec{F}_{elec}| = 9e9 \frac{(1.6e-19)^2}{|\vec{r}|^2}$$

$$|\vec{F}_{grav}| = 6.7e-11 \frac{(1.7e-27)^2}{|\vec{r}|^2}$$

$$\frac{|\vec{F}_{elec}|}{|\vec{F}_{grav}|} = \frac{9e9(1.6e-19)^2}{\cancel{|\vec{r}|^2}} \cdot \frac{\cancel{|\vec{r}|^2}}{6.7e-11(4.14e42)^2}$$

$$= 4.14e42$$