In the figure shown, particles 1 and 2 are held at a separation distance of 1.5 meters. Particle 3 is positioned so as to complete an equilateral triangle. Each of the 3 particles has charge 20 microCoulombs. What is the magnitude of the net electrostatic force on particle 1 due to particles 2 and 3?

**Solution:**

We must find the components of the force upon particle 1 from each of particles 2 and 3. To add the vectors of the force, we need to decompose the magnitudes of the force into the relevant directions, then add along the directions separately. The magnitude from each particle is the same, since they are the same distance away, and the charges are the same. This magnitude is found from Coulomb’s Law:

\[ F_{21} = k_e \frac{q_1 q_2}{r_{12}^2} = 9 \cdot 10^9 \frac{20 \cdot 10^{-6} \cdot 20 \cdot 10^{-6}}{1.5^2} = 1.6 \]

\[ F_{31} = k_e \frac{q_1 q_3}{r_{13}^2} = 1.6 \]

Any coordinate system can be used to find the components. The one in the video is such that the -x axis is aligned with \( \mathbf{F}_{31} \), so it has components:

\[ \mathbf{F}_{31} = (-1.6, 0) \]

On the other hand, \( \mathbf{F}_{21} \) is not aligned with any coordinate axis. Decomposing it as shown in the video gives:

\[ \mathbf{F}_{21} = (-1.6 \cos 60, 1.6 \cos 30) = (-1.6 \cos 60, 1.6 \sin 60) \]
\[ = (-0.8, 1.39) \]

Adding these two forces gives a net force upon particle 1 of:
\[ \mathbf{F}_{1,\text{net}} = (-1.6, 0) + (-.8, 1.39) = (-2.4, 1.39) \]

The magnitude of the force is the length of this vector:

\[ |\mathbf{F}_{1,\text{net}}| = \sqrt{(-2.4)^2 + (1.39)^2} = 2.77 \]

The net force is 2.77 Newtons.