PROBLEM 3

A \( m = 2 \) g ball is suspended by a \( l = 20 \) cm long string as in Fig. in a constant electric field of \( E = 1000 \) N/C. If the string makes an angle of \( \theta = 15^\circ \) with respect to the vertical, what is the net charge on the ball?

**Solution:**

We first examine in Fig. the forces present on the ball.

In equilibrium the net force on the ball is zero; we thus have, in the \( y \) direction,

\[
T \cos \theta - mg = 0 \Rightarrow T = \frac{mg}{\cos \theta},
\]

and in the \( x \) direction,

\[
qE \cdot T \sin \theta = 0 \Rightarrow q = \frac{T \sin \theta}{E} = \frac{mg \tan \theta}{E}.
\]

With the numbers given, we find

\[
q = \frac{0.002 \cdot 9.8 \cdot \tan 15^\circ}{1000} = 5.2 \times 10^{-6} \text{ C}.
\]

Thus, the charge on the ball is 5.2 \( \mu \) C.