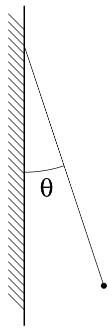
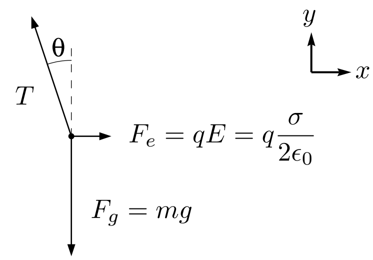
Hanging from a charged wall

Geometry diagram:



Force diagram:



In equilibrium, the forces sum to zero so

$$\begin{aligned} T_x = T\sin\theta &= \frac{q\sigma}{2\epsilon_0} \\ T_y = T\cos\theta &= mg. \end{aligned}$$

Dividing one equation by the other eliminates the uninteresting quantity T to produce

$$\tan\theta = \frac{q\sigma}{2\epsilon_0 mg}$$

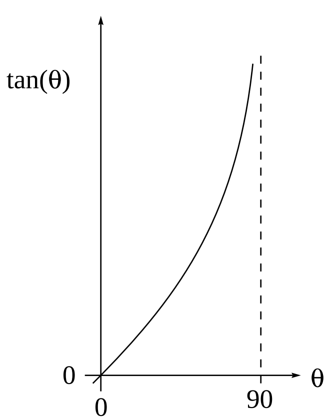
or, solving for the charge density,

$$\sigma = \frac{2\epsilon_0 mg}{q}\tan\theta.$$

Plugging in the numbers supplied, $\sigma = 5.0 \times 10^{-9}$ C/m^2.

Grading: 2 points for sketch; 2 points for finding the electrical force $F_e = q\sigma/(2\epsilon_0)$; 2 points for finding the equation for $\tan\theta$; 1 point for solving for σ; 1 point for the numerical answer; 2 points for two significant figures.

Extra: By the way…does the result for $\tan\theta$ make sense?



If q or σ increases, then θ increases.
If m or g increases, then θ decreases.
If $q = 0$, then $\theta = 0°$.
If $g = 0$, then $\theta = 90°$.