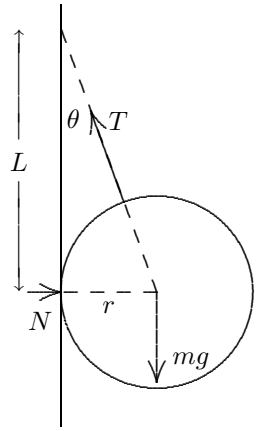
7.

Three forces act on the sphere: the tension force $\vec{T}$ of the rope (acting along the rope), the force of the wall $\vec{N}$ (acting horizontally away from the wall), and the force of gravity $m\vec{g}$ (acting downward). Since the sphere is in equilibrium they sum to zero. Let θ be the angle between the rope and the vertical. Then, the vertical component of Newton's second law is $T\cos\theta - mg = 0$. The horizontal component is $N - T\sin\theta = 0$.



(a) We solve the first equation for the tension: $T = mg/\cos\theta$. We substitute $\cos\theta = L/\sqrt{L^2 + r^2}$ to obtain $T = mg\sqrt{L^2 + r^2}/L$.

(b) We solve the second equation for the normal force: $N = T\sin\theta$. Using $\sin\theta = r/\sqrt{L^2 + r^2}$, we obtain

$$N = \frac{Tr}{\sqrt{L^2 + r^2}} = \frac{mg\sqrt{L^2 + r^2}}{L}\,\frac{r}{\sqrt{L^2 + r^2}} = \frac{mgr}{L}\ .$$