We first derive a partial differential equation describing the shape of the drop. It is well known that the shape is determined by the Laplace equation of capillarity:

$$\Delta p = \gamma\left(\kappa_1 + \kappa_2\right). \tag{1}$$

Here Δp denotes the pressure jump across the drop/air interface, γ denotes the liquid/air surface tension coefficient, and κ_1 and κ_2 are the principal curvatures of the drop surface. Since the drop is in equilibrium, pressures are hydrostatic and so

$$\Delta p = \Delta p_0 + g\left(\Delta\rho\right)\left(h - z\right) \tag{2}$$

where Δp_0 is the pressure jump at the apex of the drop $(z = h)$ and $\Delta\rho$ is the density difference between the drop and the surrounding air. For convenience we will henceforth work with dimensionless quantities, scaling lengths by R_0, the average value of the function $R\left(\theta\right)$. Using (2), we can rewrite (1) in dimensionless form as

$$\kappa_1 + \kappa_2 = 2\kappa + \alpha\left(h - z\right) \tag{3}$$

where κ is the dimensionless mean curvature at the drop apex and $\alpha = g\left(\Delta\rho\right)R_0^2/\gamma$.