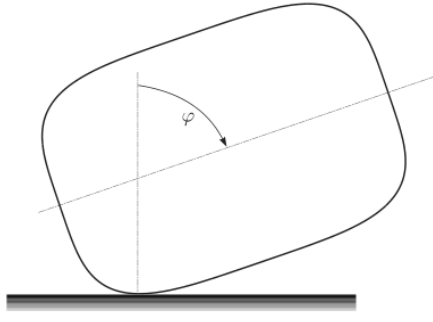
5. 4th order ellipse (6 pts)

4th order ellipse is defined by equation $\frac{x^4}{a^4}+\frac{y^4}{b^4}=1$, where a and b are the lengths of the half-axes. Consider an homogeneous cylinder, the cross-section of which is 4th order ellipse. The position of the cylinder is measured by the angle $0 \leq \varphi \leq \pi/2$ between the vertical direction and a longer half-axes, see figure.



1) What are the equilibrium positions of the cylinder laying on an horizontal surface (3.5 pts)?

2) Sketch on graph the net torque of gravity and surface reaction forces with respect to the contact point of the cylinder and surface as a function of φ ($0 \leq \varphi \leq \pi/2$). For the axis of torque, you do not need to indicate any quantitative scale (1.3 pts).

3) Which equilibrium positions are stable and which are not? Motivate your answer (1.2 pts).