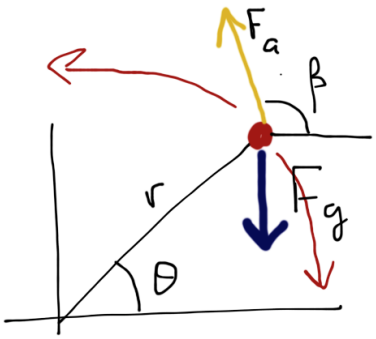
Math 275 : In-class exercise #3

Assume that a moment arm $\mathbf{r}$ is acted upon by two counteracting forces, a force due to the acceleration of gravity $\mathbf{F}_g$ and an applied force $\mathbf{F}_a$. At the point 10m along the moment arm, a 5kg mass is attached.



Answer the following :

1. For what applied force, at a given angle β is the torque on the lever arm exactly zero? Write this force as a function of β. Sketch a graph of $A(\beta)$ over $\theta < \beta < \theta + \pi$ and over $\pi + \theta < \beta < 2\pi + \theta$. What does the sign of A mean?
2. When the torque is zero, is there an angle β for which the magnitude of the applied force is a maximum? Is there a maximum value?
3. Again, when the torque is zero, when is the magnitude of this applied force a minimum?
4. Is there a value of β (and hence a magnitude of the applied force) which is sufficient to keep the torque zero, independent of the value of θ?
5. For which values of the β does the applied force vector point towards the lever? Away from the lever?
6. Suppose the applied force $\mathbf{F}_a = (-100, 0)$. That is, the lever arm is being pulled back towards to y-axis with a force of 100 N. What is the smallest value of θ for which this applied force is sufficient to keep the lever arm from falling down?