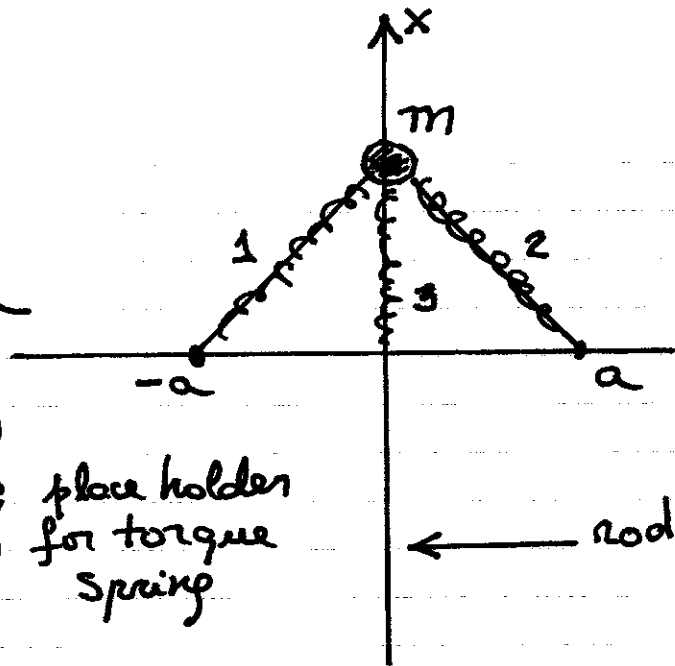


# Model for a switch

- ① Spring: relaxed length  $l > a$
- ② constant  $k$

- ③ Spring: relaxed length  $0$  } place holder for torque spring



$$m \ddot{x} = -v \dot{x} - \zeta x + \underbrace{\frac{x}{\sqrt{x^2 + a^2}} k (l - \sqrt{x^2 + a^2}) - p}_{f(x)}$$

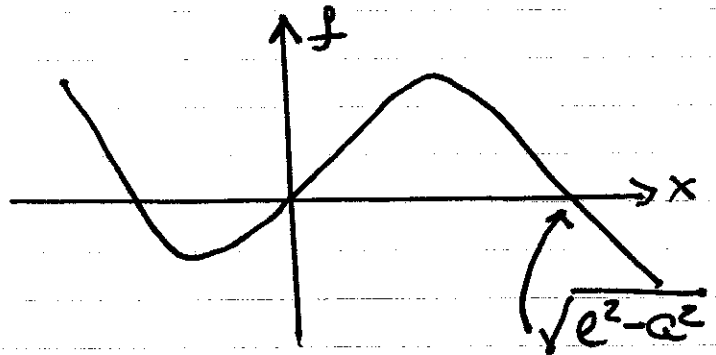
$p$  = push force by finger  
neglect gravity.

If dissipation dominates

$$v \dot{x} = f(x) - (p + \zeta x)$$

Analyze:

{ straight line intersects  $f(x)$ !



$p=0$  Soft pitchfork with par.  $\zeta$

Switch: pick  $\zeta$  so 3 slns. happen for  $p=0$ .

Now increase  $p \rightarrow$  saddle node