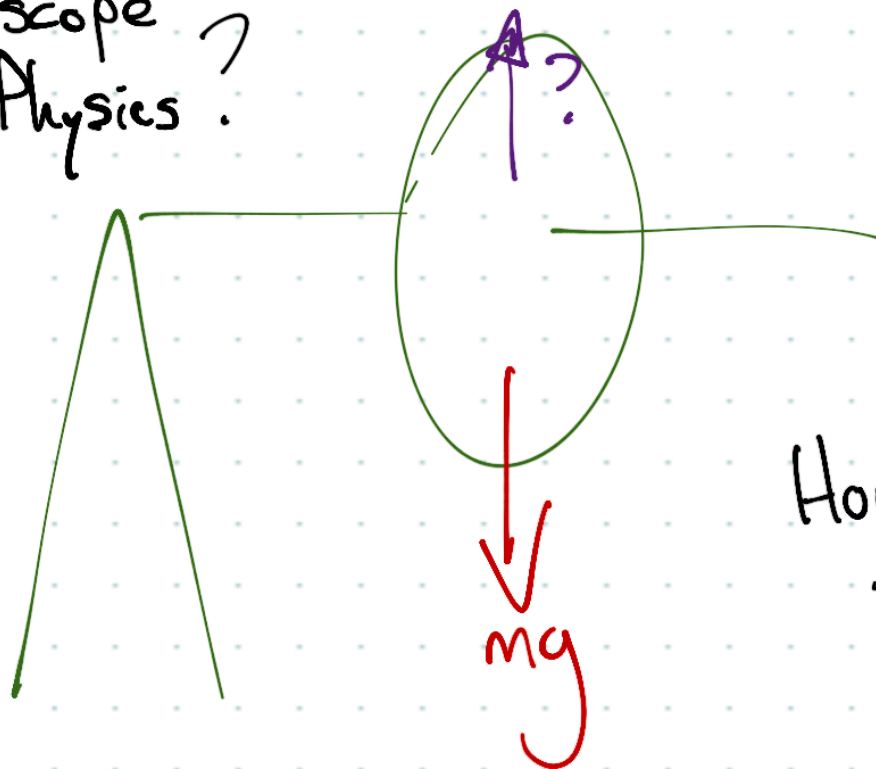
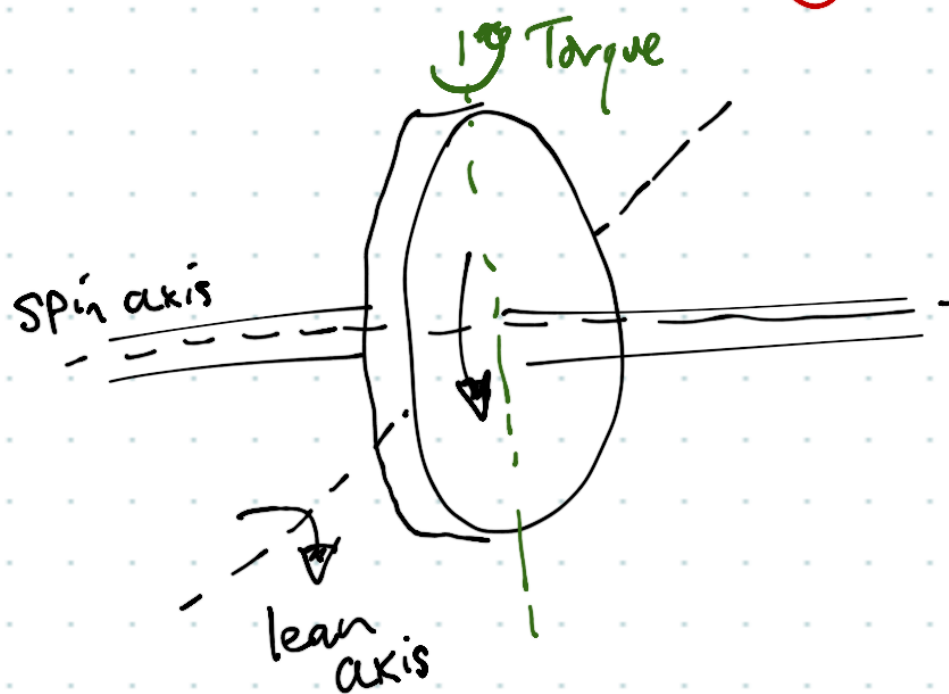


Gyroscope ?
Physics ?



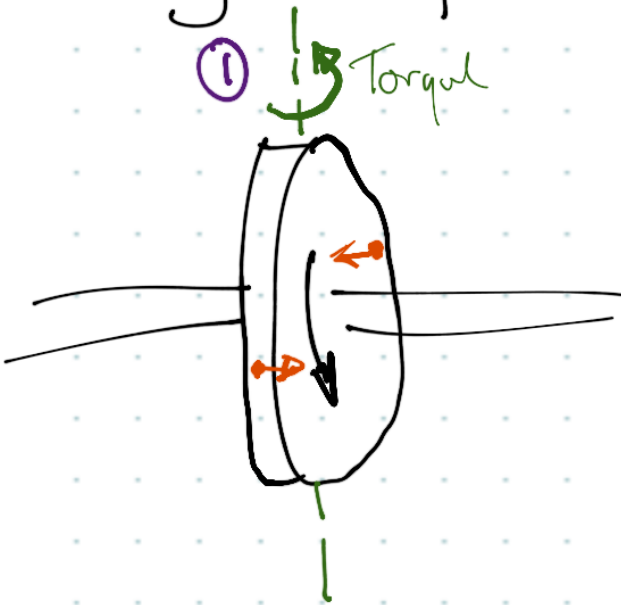
How does
this work?



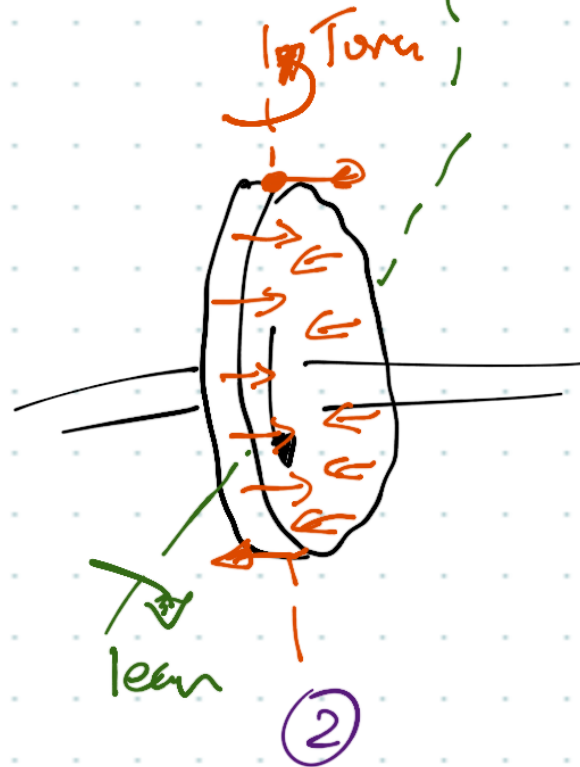
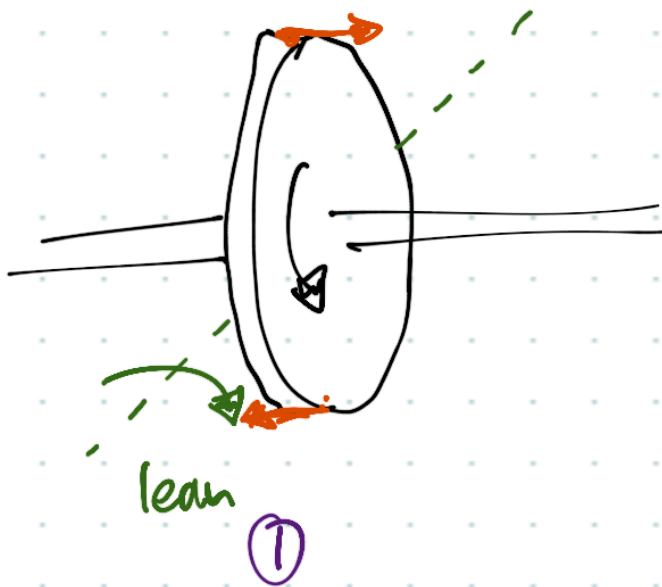
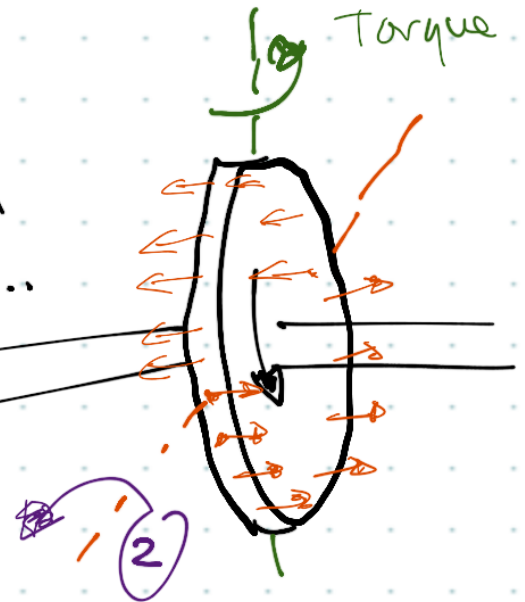
How can we
understand
this?

Imagine a particle ...

① Torque

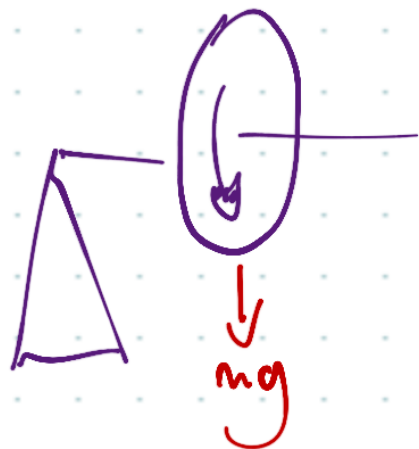


As the wheel rotates ...



This is the basic effect.

So what about-

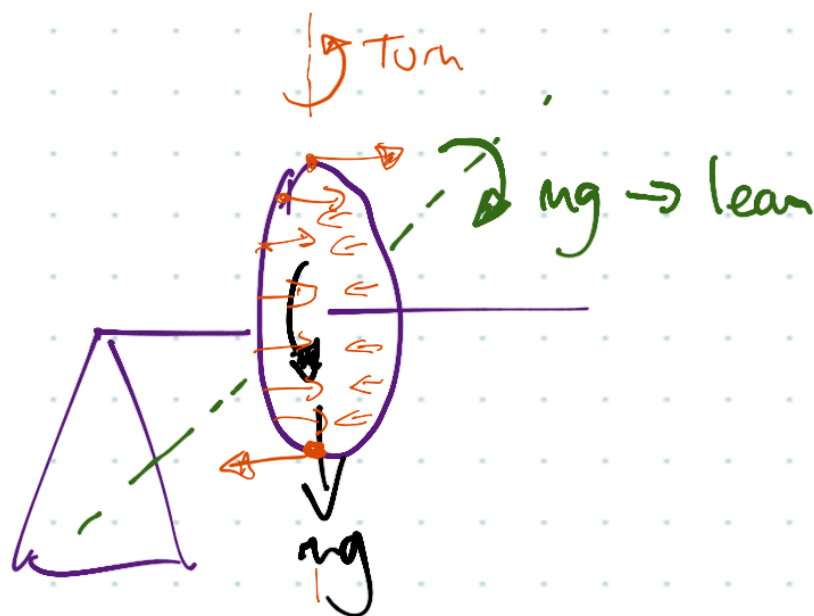


What happens :

2 Things,

① Precession
(it turns round)

② Up stays up!!

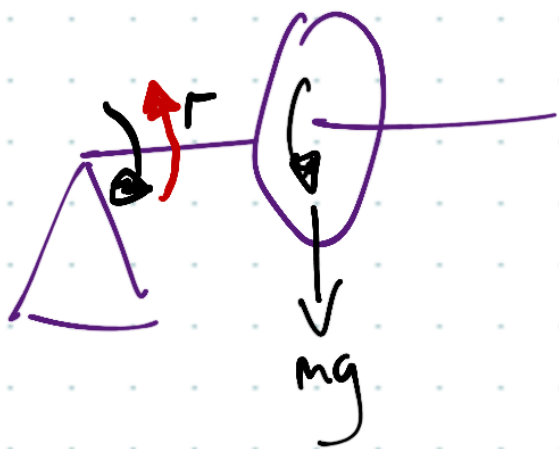


gravity tries to
lean it, but the
disk wants to turn



So we get

we need to consider torque



$$\begin{aligned}\text{Applied torque} &= F \times d \\ &= mg \times r \\ \text{Gyroscopic torque} &= G_m\end{aligned}$$

Can we come up with an equation: ~

$$G_m = \omega$$

x = position

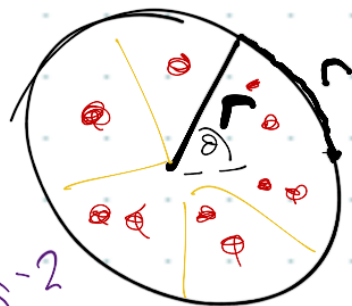
$$= \theta$$

V = Velocity

$$= \frac{\theta}{s} = \omega$$

a = acceleration

$$= \frac{\omega}{s} = \frac{\theta/s}{s} = \theta s^{-2}$$



$$V = r\omega$$

$$\left(\frac{m}{s} = m \times \frac{1}{s} \right)$$

$$\text{acc}^n (s^{-2})$$

$$G_m = I \omega \Omega$$

$$\left(\begin{array}{l} I = m r^2 \\ I = \text{kg m}^2 \end{array} \right)$$

We need Inertia

Inertia is the rotational equivalent of mass

Angular momentum?

What is momentum? Mass x Vel

$$\text{kg} \times \frac{\text{m}}{\text{s}}$$

Angular momentum? $L = \text{Inertia} \times \text{Ang Vel}$

$$\text{kg m}^2 / \text{s}$$

So $G_m = I \omega \Omega$

or $G_m = L \Omega$

So lets look at units again

$$G_m = I \omega \Omega$$

Moment = Inertia $\times$ ang vel $\times$ ang vel

$$Nm = kg m^2 \times 1/s \times 1/s$$

$$Nm = kg m^2 / s^2$$

What is a Nm? force $\times$ dis = N $\times$ m

Newton $F = ma$

$$\text{So } Nm = \overset{\text{mass}}{M} \times \overset{\text{metres}}{M}$$

$$= kg m^2 / s^2$$