Worksheet rotation: angular conservation solutions

**1.** You are spinning in a chair with hands outstretched. You then quickly pull your hands close to your chest.

**a)** Has your inertia increased, decreased, or remained constant?

Decreased.

Inertia is geometry dependent, that means the shape mattes.

In this case, you’ve shortened the distance of some of matter making you up from your axis of rotation while maintaining a constant mass, thus decreasing your inertia.

**b)**  Has your angular momentum increased, decreased, or remained constant?

 Remains constant.

The angular momentum of an object is conserved even if it’s velocity changes due to the proportionally balanced change in inertia.

**2.** At time $t=0s,$ a 2.75kg air pocket fluctuation of sound, dust, and musical energy has a position vector $\vec{r}=7m\hat{i}-2m\hat{j}$ relative to the vocaloid projector emitting it. The air pocket fluctuation travels around the vocaloid source on its musical trajectory with a linear velocity of $\vec{v}=\left(-1.76t^{2}\right)\hat{i}$ , t being in seconds.

**a)** When $t=10.8s,$ what is the air pocket fluctuation's angular momentum?

$$L=r×p=\left(r×v\right)m=\left(-3.52t^{2}\hat{k}\right)\left(m\right)=\left(-3.52\left(10.8s\right)^{2}\hat{k}\right)\left(2.75kg\right)=-1129kg\frac{m^{2}}{s}\hat{k}$$

**b)** When $t=10.8s,$ what is the torque musically acting on the air particle's fluctuation?

$$τ=F×r=m\left(a×r\right)=m\left(\frac{dv}{dt}×r\right)=\left(2.75kg\right)\left(-76.032\frac{m^{2}}{s^{2}}(-\hat{k})\right)=209.1Nm\hat{k}$$