

## ADVANCED PHYSICS CLUB

FEBRUARY 3, 2019

### TODAY'S MEETING

In the beginning of the class we discussed one of the homework problems from last week.

We discussed three inter-connected topics and solved some problems to help understand the material.

1.) We studied the notion of angular momentum conservation:

$$\sum_i \vec{r}_i \times m_i \vec{v}_i .$$

We discussed the choice of “origin” and explained why the total angular momentum is conserved as long as all the forces are central. We showed that changing the choice of origin shifts the value of the angular momentum by  $\Delta \vec{r} \times \vec{P}$  where  $\vec{P}$  is the total (conserved) momentum.

We explained the notation  $\vec{a} \times \vec{b}$  and gave its components. We showed that for planar motion this reduces to  $|a||b|\sin(\theta)$ . We proved this with the identity  $a_x b_y - a_y b_x = ab \sin(\theta)$ . We learned the right-hand rule.

2.) We discussed ellipses. Defined: vertices, co-vertices, major axis, minor axis, semi-major axis, semi-minor axis, the two focal points, and two properties of the focal points, i.e. that sum of distances to every point on the ellipse is a constant and that every light ray from  $F_1$  goes to  $F_2$ . The former was given as a homework problem. We discussed the ellipse equation.

3.) We gave the 3 Kepler laws and Newton's law of gravity. We proved as an exercise the 2nd Kepler law (the one about the area) from angular momentum conservation.

### HOMEWORK

The main homework exercise today is, using the ellipse equation

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 ,$$

with  $a^2 > b^2$ , given that the focal points distance from the origin satisfies

$$c^2 = a^2 - b^2 ,$$

prove that for any point  $P$  on the ellipse,  $|PF_1| + |PF_2| = 2a$ , where  $F_1, F_2$  are the two focal points. Note that the focal points lie symmetrically around the origin on the major axis.

### FOR THE NEXT MEETING

The next club's meeting is at 2:40pm, room P-131, on Sunday, **February 10**. Next time we will apply the formalism learnt today to solve physics problems. You can read more about ellipse on wikipedia page: “<https://en.wikipedia.org/wiki/Ellipse>”.