Cellular Biophysics
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Tutorial: 04
Week: 02
Part: 01

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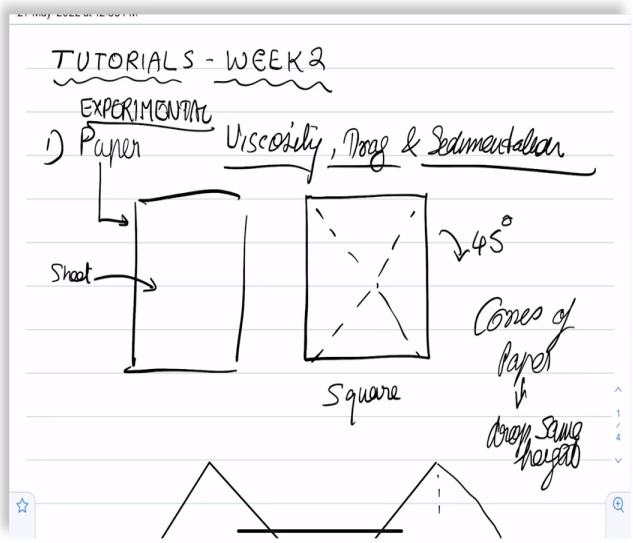

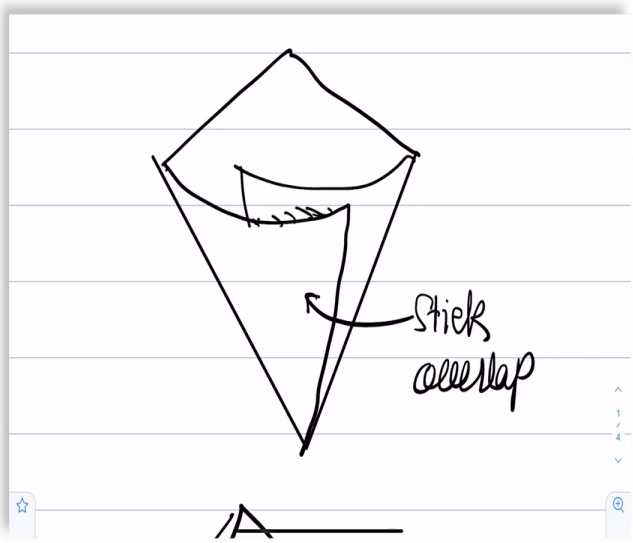

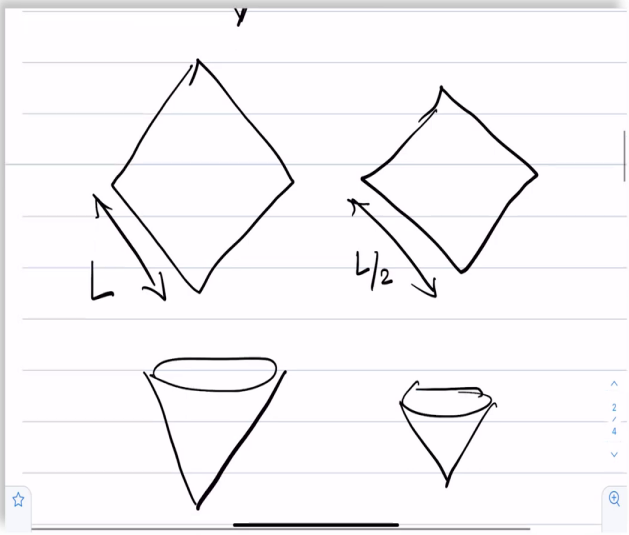
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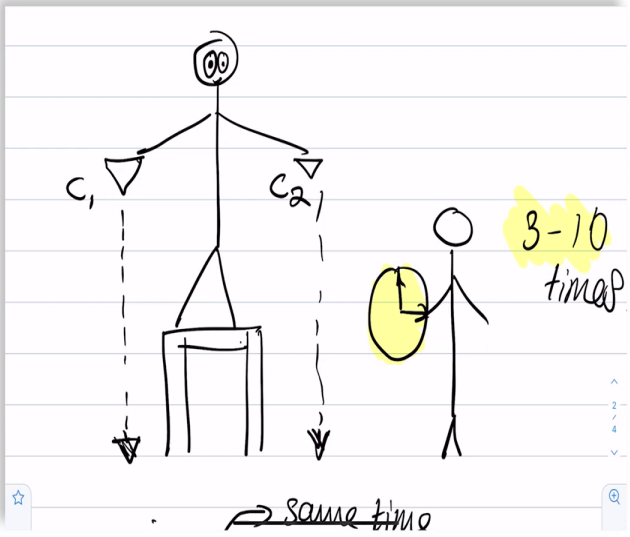
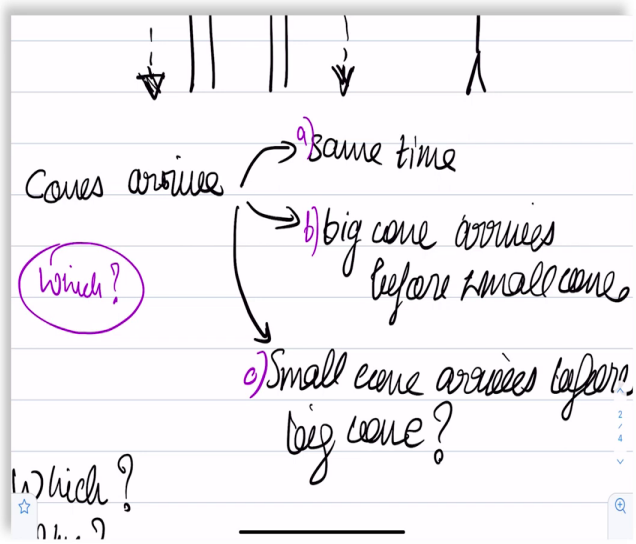

C1
C2
3-10
times
Same time



Hi, this is the tutorial related to Week 2 of the lectures. So, we are going to start with a question that summarizes many of the things you should have learned by now about viscosity, drag and sedimentation. Now, these are important concepts, not just in the biophysics but in cell biology. And one of the approaches am I take is experimental.

So, the experiment is the following. You need to make cones out of paper and drop them from the same height. And ask the question and answer it, whether the cones of different sizes reach the bottom of the height from which you drop it at the same time. So, simple way to make a cone is take a square paper, turn it around diagonally, like a rhombus and fold it in this manner.

So, that you end up with an overlapping part, stick the overlap. Now, you can make them in slightly more elegant ways. But whatever you do, you must make it the same way such that you take two pieces of paper and make one which is half the size of the other, giving you cones of two different sizes which are half in diameter.

When you then stand on an elevated platform, and drop these two cones C_1 being the bigger, C_2 being the smaller up to you and use a timer or a clock to measure how long it takes. So, you may need an assistant or a helper to do this. You must of course repeat this experiment 3 to 10 times because we are scientists, we want to make sure that the numbers are reproducible.

And that if we do the same thing the same way we get the same result. So, the possible outcomes are the following that the two cones arrive either the same time or the big cone arrives before the

small cone or the small cones arrives before the big cone which is it, is it same time? Is it bigger, is coming faster than smaller or smaller is coming faster than bigger? These simply simple questions and I urge you to try the experiment out because you will find that sometimes some things are very easily answered by just trying things out.

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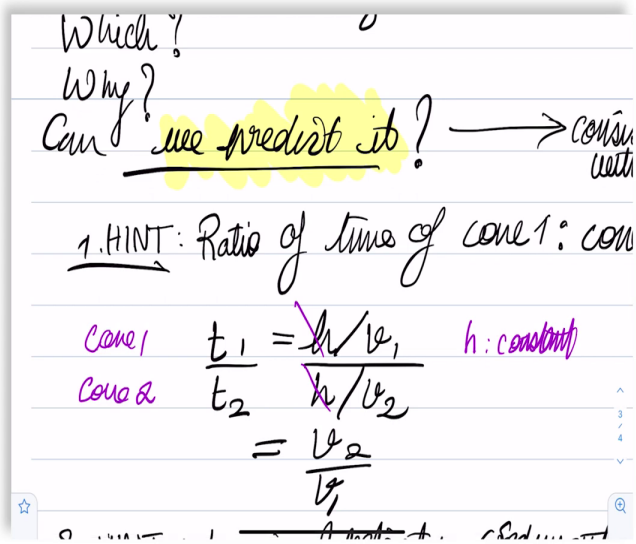

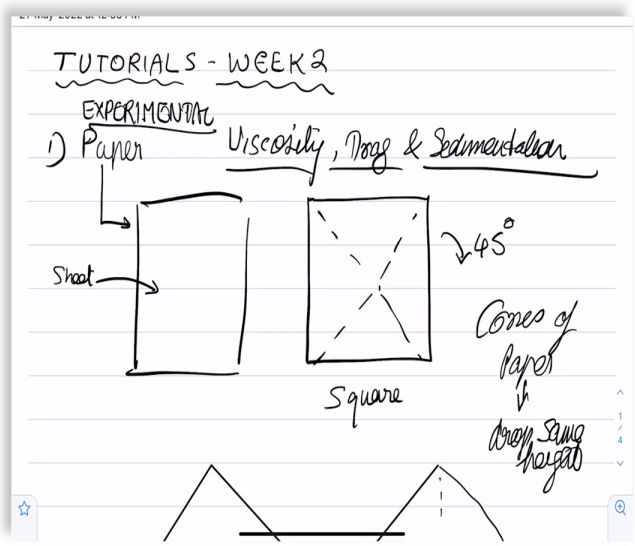

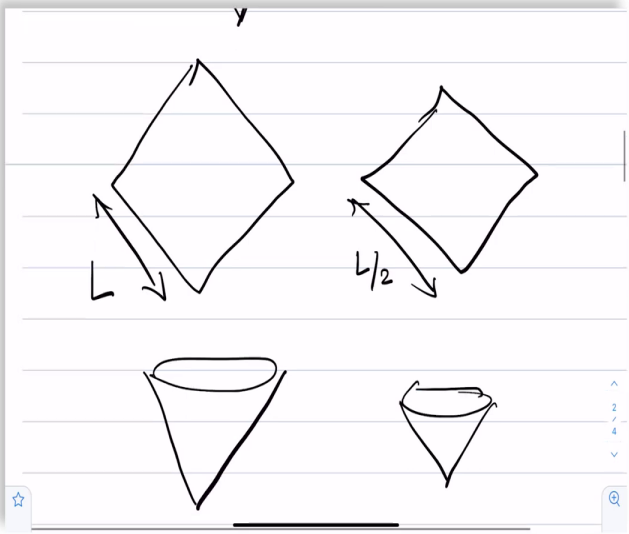

2. HINT : terminal velocity (Sedimentation)

3. HINT : mass, drag force

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Shape of cones same

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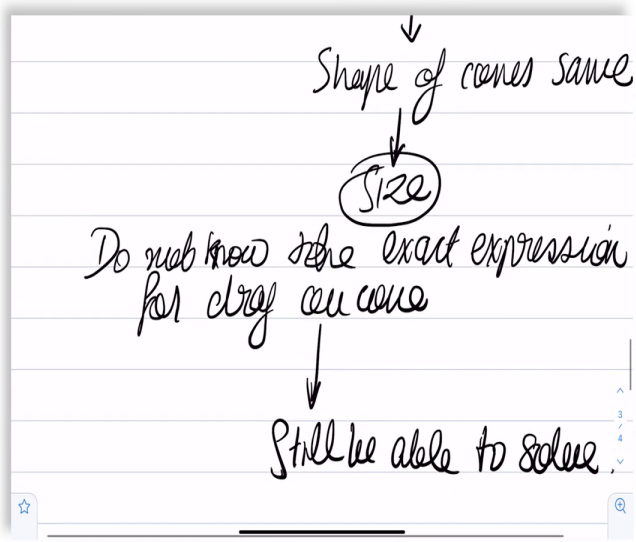
Size

Do not know the exact expression



There is a second part, which is can we predict it? Can we tell beforehand? What is going to happen? And this allows us to know whether the results you obtain are consistent and theory and whether we can get a handle on it. So, just think about this, how are you going to tell whether the cone arrives at the same time or different times.

Now one way to think of this, and this is the first hint I am going to give you, is that we need to basically consider the ratio of the times of cone 1 and cone 2. So, how do we think to ratio of time. So, time in any motion is nothing but when something is moving time is equal to the height through which the particle travels or the object travels upon the velocity.

Yes, we agreed which is in terms of length upon length time inverse, so we end up with time. So, this should be quite easy.

$$\frac{t1}{t2} = \frac{\frac{h}{v}1}{\frac{h}{v}2}$$

So, if you want the ratio between t1 and t2 that is the time for cone 1 and time for cone 2 to arrive then it is simply h upon v1 divided by h upon v2. Why? Because h is constant. If h is constant and common we can get rid of it and we end up with v2 by v1, so, t1 by t2 is equal to v2 by v1 that is the First Hint.

Think about this look at this you understand this simple. The Second Hint is that what is V? V is nothing but the terminal velocity something like what we discussed in the sedimentation problem. Which means that at some point the upward and downward forces are equal and opposite are can be equated and they are opposite and that there is a net velocity but no acceleration.

Constant Velocity that is what terminal velocity means. The last part is that we want to consider mass and drag force in this entire arithmetic because the shape of the cone remains the same. Only the size changes. We do not know the exact expression for drag cone but we can cancel out terms. So, these are the three hints that I want you to keep in mind when you try to solve this problem.