[00:08:05.00] Sign and date consent form

[00:08:36.01] How is this semester going?
Busy

[00:08:47.05] And P152?
Busy

[00:08:53.17] How does P152 compare w/ P151?
Pretty similar - biggest difference is that there is less community; people now have other stuff to do, and people left physics

[00:09:43.19] What kind of work are you doing?
Blommer library

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[00:09:48.22]
-Tell me about 151, I guess... What would you tell someone about the class considering whether to take it or not?
[00:10:05.20] Felix: It gets a good foundation for understanding physics in the future. It goes on, just basic principles and keeps stressing those principles and having at it until you have it lodged in your brain.
[00:10:34.09] Um, it's a lot of work, but physics seems a lot less intimidating afterwards.
[00:10:43.00] It's taught very well.
[00:11:02.28] I think it's very rewarding, because it's very difficult stuff that you're trying to get a grasp of, but they like, show you how to understand it. But like, a major problem I had with the class is we always seemed like we were catching up on what we were learning before. Like, the thing we did...
[00:11:21.26] Our tutorials, like, Tutorials is when I feel like I really get a grasp of it. But I always felt like that was a week behind everything. LIke, we would do our homework on a subject, and I was like, oh, that's fine. I did it, I think I got it. But I didn't really get it until we did a tutorial on that subject like a week later. So like, I did the homework, and I understood it, but I feel like, I got a deeper understanding from the tutorial and I thought it would be a lot better if I did the tutorial before the homework.
[00:12:04.07] I: OK, I want to revisit all those awesome things that you just said, starting with, your saying about them having kind of the same concepts and drilling it into your brain. Can you give some examples of that, can you elaborate on that point a little bit?
[00:12:15.24] F: Well, we learned things on like, we learned the same concepts but like, on different fronts. Lectures, going over practice problems, doing homework on it, tutorials, going through tutorials where they show you like, an actual physical representation and they do it live, uh, labs. We're just learning the same thing, but from different angles, I guess, would be the best way to describe it.
[00:12:40.03] I: OK, I see, so like you have, like a given chapter, or like a given topic

[00:12:45.27] F: Yeah, like let's say linear momentum. We first learn it in lecture, then I would try to read the chapter, so that's the second time going over it,
[00:12:54.08] then we do, like homework on it, then we do Tutorial, then we do lab, all on the same stuff
[00:13:01.25] I: All on linear momentum
[00:13:02.25] F: Yeah. I think that's very good. I really like that, because I miss stuff in other ways. I might maybe not catch something in lecture, and then
[00:13:16.18] through the Tutorial, I'd really understand it, or through homework I'd realize something that I didn't get before
[00:13:22.15] I: Right
[00:13:24.23] F: I feel like that was really helpful
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[00:13:32.26] Is that the same as P152?
It's the same, but we're just behind b/c of all the snow days?

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[00:13:36.25] Interviewer: So, think back a little bit to before this year, back to high school - you were taking physics classes then? What physics did you take in high school?
[00:13:48.07] Felix: I took AP physics, it wasn't B or C, I think it might have been, it was like, everything
[00:13:54.09] I think it might have been AB.
[00:13:59.19] I: So electromagnetism was in there as well?
F: Yeah
[00:14:03.17] I: Uh, so there, did you similarly have, like, a given topic and then you'd have a lab and a lecture and a homework and all these things for the same topic, was that structure
[00:14:11.25] similar to 151?
[00:14:14.15] F: Uh... my high school physics class was a joke pretty much
[00:14:16.29] I: Really?
F: Yeah, it was just like, um, slightly go over it and slightly write on the board about it
[00:14:23.19] but not really talk about it much. Just pretty much watch youtube videos
[00:14:27.04] during class, just like joke around.
[00:14:33.20] I: Oh, I see
[00:14:37.02] F: It was AP physics, and he gave us actual AP physics tests, but no took it seriously. Everyone got 20's.
[00:14:41.12] But, he still
[00:14:44.06] I: Like 20%'s ?
F: On like, yeah, because the test was like AP problems, but no one read the chapter or did the work

[00:14:51.29] but he just curves it like regular, so everyone still got a good grade
[00:14:56.10] and I just studied a lot for the AP test and I got a 5 on it, so it worked out I guess.
[00:15:02.14] But I don't feel like I got a lot out of it
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[00:15:13.28] Was coming into P151 difficult?
I wouldn't say difficult - my biggest surprise was that I was able to handle the work despite not knowing much about the content. There were physics majors who dropped because she learned how intimidating physics is.
I was considering dropping physics, because I wasn't sure I'd be able to handle it.
It made me scared and intimidated
[00:17:42.26] I didn't know how smart everyone else was - when everyone else that I thought was smarter than me couldn't handle physics, I was nervous

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[00:18:08.14] Interviewer: OK, so you were saying that the class was taught very well. Is that the lab, the tutorial, the
[00:18:13.04] lecture, can you elaborate on what was good about the teaching?
[00:18:19.23] Felix: Um... lecture teaching, Professor Liu was very good. She
[00:18:27.02] wrote down the major points of the topic before the class started and then went through it step by step,
[00:18:34.10] and showed good examples and good clicker questions, different, like, where it applies, and like tricks you need to know for it.
[00:18:48.01] Clicker questions were very good for understanding concepts.
[00:18:55.18] Tutorials was also very good, just because you had the thing in front of you, and it was step-by-step, and sometimes there were students that were like... The part where you had three students and you see which ones right and which one's wrong...
[00:19:11.11] I: Oh, like the discussions inside the Tutorial?
[00:19:14.22] F: Yeah. Those were very helpful. It was very helpful that you had, like, such, the TA and the teacher going around and asking if you needed any help, if you had any questions, trying to explain anything.
[00:19:37.18] I: So, let's see, you mentioned... ok, cool. And how about the lab?
[00:19:43.26] F: The lab? Um, I don't know, I never did anything like computer science, actually, before, so it was interesting getting the hang of that
[00:19:54.20] I didn't feel like it was as useful as Tutorial or lecture, but I feel like
[00:20:03.06] as a physics major you need to know some computer science, right?
[00:20:06.16] I: yeah, it's pretty helpful
[00:20:08.22] F: Yeah, it's helpful for that, and just, learning computer science in general is pretty cool and it helps you understand
[00:20:15.08] other things; it helps you organize your thoughts better.
[00:20:16.29] I: Huh. Really? Can you elaborate on that a little bit? Like, how so?

[00:20:23.03] F: Just like, um, you have different ideas and you see how they affect one another and
[00:20:35.05] how you need, like, just so that your reasoning isn't like,
[00:20:41.12] so you just connect different parts of your reasoning better.
[00:20:46.17] Like, when you're making arguments, I feel.
[00:20:49.05] Just because everything needs something to cause it, and you can't just write something down and expect it to happen. [00:20:55.09] You need to go by everything step by step so I feel like you become more thorough with your thinking
[00:21:13.26] Did that thoroughness of thinking help you with other aspects of the class?
F: I don't know. I can't think of anything specific
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[00:21:56.03]
-Example of a concept that tutorial helped make more clear
-Definitely linear [angular] momentum. I had, during the homework for linear [angular] momentum, I didn't really have a grasp on it. But the tutorial was what really helped me understand the concept. And after I figured out the concept, I wondered, how the hell did I do the homework? Like, linear [angular] momentum in itself is just a hard thing to get a grasp of, and I'm pretty sure no one really understood it until the tutorial.

[00:23:14.25] Do you remember what it was about that Tutorial that really helped you make sense of it?
Not really... could I get a physical copy?

[00:24:54.26] It was linear momentum, and not angular momentum?
I meant angular momentum.

[00:28:08.02] Do you remember what helped clarify it?
The TA was really helpful. I don't remember what specifically he said.

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[00:29:05.16]
-What is the kinetic energy of this electron?
-Okay, well the first thing I think of is to see the velocity, see whether gamma would be necessary, and since it's like, four magnitudes lower than the speed of light I don't think it would be. And, so I would just use the K=1/2mv squard equation, and that would be it. Is there another kinetic energy equation for this kind of subject? No, right?
-When you think of kinetic energy, what comes to mind? Like, if someone were to ask you what is kinetic energy...
-Energy of motion.
-Okay. So, I don't know. Does that help answer your question?

-Yeah. I'd just do the 1/2 mv squared equation.

********CYCLOID PROBLEM*****
[00:30:28.25] Interviewer: And I have another question for you here. So, suppose that I have an object and it's traveling at a constant speed, and it's traveling in the plane of this paper. So it's just going like
[00:30:43.08] this and like this and like this and so we have five points here, a -> e, that are in order of its motion, so these arrows
[00:30:51.28] just show the direction that it's going on this curve, so for each of these points, can you draw the direction of the acceleration
(He writes)
[00:31:19.22] Can you tell me what you're doing, right now?
[00:31:20.22] Felix: For each part of the curve, they have, since it's turning, it has a center-seeking acceleration. An acceleration tangent to it's path, an acceleration going along it's path. But since it's at a constant speed, this wouldn't be here.
[00:31:35.26] I: Sorry, what are you thinking... right now?
[00:31:58.00] F: Um... that since it's at a constant speed, all the acceleration would just be acceleration associated with its changing direction.
[00:32:10.21] So they all should be tangent... They all should be... Hm.
[00:32:28.21] I: OK, so, I feel like right now at this moment, you have one idea, which is saying that the acceleration is all due to the changing direction, and so it should be tangent, but I feel like there's another idea that's kind of conflicting with that that you're kind of thinking as well. What's the other idea? What's the other thing that you're thinking right now?
[00:32:44.25] F: The other idea is just pointing to the center of the circle.
[00:32:57.09] I: OK
[00:33:00.09] F: Like you know how you would have like a kissing circle or whatever, or actually, that wouldn't change it, because the center of that would be tangent.
******END CLIP HERE*****

[00:33:25.18] I: OK. Can you say anything about the magnitudes of these accelerations?
F: I want to say that the bigger the kissing circle, the bigger the magnitude of accleration. But, I feel that's wrong.
[00:33:58.16] I: OK, and why? I mean, what's the counter-voice to that?
F: Just because that kind of goes against... logic
[00:33:59.16] cuz, you would be accelerating more just the faster you make a complete turn. Like the smaller the arc, it seems like you would accelerate more.
[00:34:19.23] I: OK
[00:35:22.13] I: What are you thinking now?
F: Just pretty much the same thing
[00:35:24.17] I: OK, which one of those two ideas is the right one? Yeah, OK.

[00:35:45.06] F: I feel like the greatest acceleration would be at a, but I can't think of anything outside to justify that
[00:35:50.10] just because that's like, where the biggest change in direction is
[00:36:00.05] I: OK, so you have the two ideas, you have the idea that you have a bigger change in direction so it's going to
[00:36:04.10] more acceleration, and you also have the idea that if it's a bigger kissing circle, you'd have a bigger acceleration, and you're not quite confident which one of those two ideas is right, but you're going to go with the first one...
[00:36:19.13] any thoughts on why you're going to choose that one over the other one?
[00:36:23.05] F: Um, I'm thinking to myself like, I'm maybe in a car that's trying to do this direction, and I'm just like trying to think, where I would experience the most acceleration force... and that would be where I make a sharper turn.
[00:36:38.12] I: OK, and so you're going to go with that experience.
[00:36:58.02] I: Uh, OK, let me... I want to go back to this question here, actually... can you tell me the, uh... I don't want to do that...
[00:37:22.03] OK, I'm going to give you a different question. Imagine that I'm driving around a circular track, and suppose that the radius of my track is 10 km and suppose I'm going at a constant speed of 30 m/s.
[00:37:52.10] Can you tell me the acceleration of my car?
[00:37:59.17] F: OK. For these equations you use delta p over delta t, which is mv^2 over r and
[00:38:23.25] whatever the mass is times 30^2 over 10, which would just be 90 mass m^2/s^2
[00:38:43.01] Actually, I have to change the km to m, so that's 10,000 m...
[00:39:13.25] and the dp dt equals the f_net
[00:39:24.25] and since it's like, cut up into instantaneous change in momentum, you can use the equals ma equation, because that would just be the instantaneous acceleration. Equals ma... m's cancel out, and the acceleration would be 9 over 100 m/s?
[00:39:45.20] I: OK
[00:40:00.08] F: Yeah
[00:40:02.10] I: OK, thanks. And you made it squared, you just wrote that in. Uh... would the acceleration be more or less if it were a larger circle?
[00:40:12.08] F: It would be less
[00:40:13.26] I: It would be less. OK, can you show me what would happen with your equation if it were a larger circle?
[00:40:28.29] F: Well, the radius would go up, and since mass and velocity in that stays the same, since radius goes up, this entire body goes down,
[00:40:34.00] and so if this goes down, the entire, this side must go down, and since mass is constant the acceleration has to go down.
[00:40:43.23] I: OK, I see. OK, cool. Does that help you with this problem at all?
[00:40:54.23] F: Yes, because the big circle would just be small acceleration. I feel like, if i, like had the equation mv^2/r in my head, I would have gotten that.
[00:41:08.05] I: OK

[00:41:10.08] F: Actually, the acceleration is just that without m, so I should have just remembered it from there.
[00:41:17.01] I: OK, so even in the case of these kissing circles, you can still use this
F: Yeah
[00:41:18.14] I: OK, OK. OK, great, thank you very much.
[00:41:28.21] F: Did I get the idea of the kissing circle confused with something else?
[00:41:31.19] I: Umm... so, I'm actually going to maybe make you a little bit frustrated and ask you to hang on to that question about the questions until after the inteview, and we can talk about it then, if you want to check if your answers are
[00:41:46.01] correct and things like that. Thank you.
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[00:41:50.25] Interviewer: So one thing that I do want to ask you, this is kind of going back now to questions about 151 -- did you feel like,
[00:42:04.05] ok, so you said that, you would have a given chapter, and you would have a given topic, like angular momentum.
[00:42:07.14] And that would be covered in lecture, in lab, and in Tutorial and it would all be consistent.
[00:42:12.12] Um, do you feel like, across topics, that there were, like, I guess, common things? So in other words, in a given week, you'd have a common topic. Do you feel like there were things in common across topics as well?
[00:42:31.29] Felix: Well, besides the fact that some stuff's just like, built off each other?
[00:42:43.00] I: Well, let's talk about that a little bit - You felt like stuff was built off other stuff?
[00:42:47.25] F: Well, a lot of questions on the homework were definitely formed that way, where you'd use something from momentum to solve an energy equation, a lot of, especially, those were pretty much the questions on the test. That, you would use stuff you previously know
[00:42:58.19] to just answer questions on the test for later subjects. Subjects weren't necessarily that related, but professor X connected them so we saw, we were able to connect the dots.
[00:43:15.15] I: I see. So, like, from momentum to energy for example
[00:43:19.20] F: Yeah
[00:43:23.09] I: Is this something that your high school teacher did as well? Kind of connecting the...
[00:43:28.11] F: No. Just finish one topic; start another. The order didn't really make sense. Sometimes switch back and forth between subjects. Didn't really connect it to anything else we previously learned.
[00:43:49.28] I: OK. Um, so of those two styles, do you have a preference of having it all be connected, or having it be discrete, or both are fine?
[00:44:14.12] F: Um, definitely having it connected, definitely being able to see, like, just see like, where the connections are.

There has to be connections because all of this stuff is pretty much related.
[00:44:25.25] I: This might be a weird question, but I wonder if you can expand on that. Like you said that stuff is related - can you give an example, like even the momentum and kinetic energy, or something?
[00:44:32.22] F: Well, you know, like, change in values... change in, like, kinematic values, velocity, stuff like that
[00:44:40.07] change kinetic energy, which has to do with, which is connected to work, which is connected to other stuff.
[00:44:49.25] You can see, the differences between angular and linear momentum,
[00:44:57.06] see how, see how when something has linear momentum, it has a different total energy than something that just has angular momentum.
[00:45:08.20] that just has linear momentum.
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[00:45:31.27] Was that a difficult thing to get used to?
No, because we had just learned the stuff that we were connecting it to. It made it easier to learn the material this way.

[00:46:18.19] What was difficult about math in the class?
Just the dot and cross product, but it wasn't a huge barrier in learning about the material

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[00:46:52.02] Were you given a list of equations?
Yeah
Was that helpful?
[00:47:02.02] We had it, but it wasn't as much help as I would like it to be. You were supposed to understand the concepts. You would have it, but you could not base your answers off that.
[00:47:37.02] If you had photographic memory, would that have helped?
No, because we'd have a sheet on the test, and it was all conceptual anyway
[00:48:01.23] In high school?
It would have been helpful - the test was just "what equation do you use?"
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[00:49:31.06]
-What if someone wanted to learn physics conceptually but not computationally?

-She shouldn't memorize it, but she should be familiar with the equations, because they're fundamental relationships. Something that... If you see the equation, and you know the specific relationship, say for momentum, gamma mv. You know higher mass is greater momentum, more velocity greater momentum, and you know where gamma fits into that. You would have a good understanding of it, just knowing what the relationships mean. Because if you just memorize it as symbols, it's kind of useless, but if you have a conceptual understanding of what momentum is, or what potential energy is, that's what would really help you.

[00:51:05.23]
-How do you know when you really understand an equation?
-Probably when you can use that knowledge to solve a very difficult or tricky problem. I feel like a good example of that is one of the tutorial ones, it's like a firecracker, and you shoot it up, and the firecracker splits into two separate pieces. That would be a good example to see if you understand the concept.
-Would that also be a good example to see if you understand the equation?
-I guess, physically seeing the actual relationship. Like, maybe in a lab. Just see what you're talking about and make measurements, and through the different variables you have, you see the specific relationship that you're having trouble with and you see how it works out.

[01:00:19.27]
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[01:00:30.21] Does it make sense for an airplane going in a straight line to have angular momentum?
Angular momentum is relative to a point
[01:03:29.25] You can't just think about the airplane - you need to think about a lever attached to the airplane and that fixed point

[01:05:08.20] What would you say angular momentum is?
It's momentum relative to t apoint, and that point could be outside of the object itself
[01:05:28.18] That is very difficult to understand, but I can't think of a way to explain it where people would just immediately understand. It's really weird, because the angular momentum would be in the z direction, and that makes no sense
[01:06:05.27] It's hard to describe, because anyone seeing it the first time would not be able to understand angular momentum

[01:06:23.26] Is there some other example you might use to explain angular momentum for the first time?
You have two spinning disks - one is just going straight, while one is going straight and spinning at the same time. Actually, that's just K_linear and K_rotational. Angular momentum was really tricky.

[01:08:08.23] If I have a puck that is spinning more quickly than the other, would one of them have more angular momentum?
Well, one of them has more torque, but I'm not sure how to relate that to angular momentum

[01:08:40.28] Why does this one have more torque?
Because it's spinning faster

[01:09:30.04] Do you have any questions?
No, not really.

[01:10:25.24] Debriefing: