BPB02 – The difference between Math and Physics questions

[00:25:25.26] [Converting to SI units]
BPB02: It's also ... I'm also not sure that it would really affect the answer, but I would like to convert into seconds and meters per second just because I'm comfortable dealing in SI units.
Interviewer: From .. what? Like from what experience?
BPB02: Well as a ... uh I mean ... I'm a physics major so physics problems are very important to me. And I just find that it's always a pleasant experience when you get a problem and the answers are in SI units.
Interviewer: Ah ok so it's just like a comfort thing?
BPB02: Yeah, it means/
Interviewer: /so, oh I'm sorry I don't mean to inturrupt you.
BPB02: Oh it's okay.

[00:26:07.28] [math vs. physics problem]

Interviewer: Do you not view it as a physics problem already then?
BPB02: Um ... I suppose I view it more as a math problem. Because uh .. I'm used to on math assignments getting problems that are physics related but not ... uh they don't require the same type of analysis of the situation.
Interviewer: Can you think of an example, so I can understand a little bit better?
BPB02: Yeah, (long pause)

[00:26:58.04] [Writing physics and math problems]

BPB02: I suppose if you get a problem with a car driving down a hill at a constant velocity, [draws] ... lets say it's a stretch limo. [a joke - because picture is of a sort of long car]
Interviewer: Sure it can be fancy. (laughing)
BPB02: Anyway, and I'm thinking that if I got that as a problem on a math assignment, it would probably ask me... well, let's say the hill is a certain .. is at a certain incline, and is a certain height, and the car is traveling at a certain constant velocity. How long would the car be traveling on the hill? [00:27:58.02] Whereas if it's a physics problem, they'd say the car is traveling on a hill at a certain incline at a constant speed and has a certain mass. What is the coefficient of friction on the hill?

[00:28:16.20] [Those problems, explained]

Interviewer: So can you just sort of summarize, what's the difference in those two scenarios to you?
BPB02: The difference is in the first scenario the length of the hill is just, well... h over l equals sin(theta).
Interviewer: What is 'l', sorry?
BPB02: 'l' is the length of the hill.
Interviewer: Ah, got it, ok. Just wanted to make sure.

BPB02: Thats alright. And then um, so, you have l equals h over sin(theta). And I said how long it takes, and it's traveling at a constant velocity. So t equals l over v. I always memorize ... I always remember that result because of dimensional analysis, because you have distance and you divide that by distance over time, and that gives you time.
Interviewer: You got it.
BPB02: Yea
Interviewer: So that is what you would so if you were solving the math problem?

[00:29:28.08] [now the physics problem]

BPB02: Yeah, Where as with the physics problem... it's a force diagram which /
Interviewer: / It's okay you don't have to worry about doing it. You can if you want to.
BPB02: I'm just thinking, I remember that the force in this direction is m*g*cos(theta), and then the force of friction is mu f_n and the normal force is m*g*sin(theta) Because it opposes this force.

[00:30:13.16] [Danielle steers back to the question he posed]

Interviewer: I think what you were getting at, at some point, was that the nature of what you would do would be different.
BPB02: Yeah
Interviewer: What I'm wondering is, is it just the calculations that would be different or is it something more than that?
BPB02: Um, I just... I get the sense that math and physics might give you a similar situation, but then ask you to find different things in that situation. Ask you to perform different analyses.
Interviewer: Okay. Are they just different, or is one... I mean are they just different but roughly, like you know, the same sorts of stuff you'd be doing? Or do they require you to do entirely different things to answer the different types of questions?
BPB02: Uh...

[00:31:14.06] [how are these different?]

Interviewer: In other words, I could change the problem but you just have to do a different calculation, right? Or is it more than that?
BPB02: I find that they tap into different concepts, like you usually won't see a problem in math that deals in friction even though it comes up all the time in physics. Off the top of my head the only real example of friction coming up in math class is when you do the second order differential equations. And so you are talking about a pendulum with damped oscilations./
Interviewer: /Yeah, you get some kind of damped oscillation.
BPB02: Or an electric circuit with a resistor. Which is the same thing just in a different context.

Interviewer: I see, so you're seeing like, when you talk about damping or something in differential equations, or in a math class, that is physics in a math class.
BPB02: Yeah, essentially. But even then, I get the impression that the questions that they ask you in the math problem, they will give you more information in a math problem. Like in the case of an LRC circuit, if its a math problem they will tell you the resistance whereas in a physics problem they might tell you the initial voltage and then ... the impedence of the whole circuit and then you can find the resistance based on that.
Interviewer: Okay, so they also give you different information?
BPB02: Yeah

[00:33:02.15] [return to driving]
Interviewer: Okay, and so back to this one, you said this one was more mathy, is that what you originally had said?
BPB02: Yeah, and um ...
Interviewer: Even though its in the context of velocity and distance?
BPB02: Yea, It just reminds me a lot of ... makes me think of a problem I might have seen in the section of the math 1B book on approximate integrals.
Interviewer: Oh I see, Can you think of any other way you might have solved this problem, besides left/right mid point, you know.

[00:35:47.18] [return to the problems he wrote]

Interviewer: Or anything else about this [car on hill] problem? You sorta wrote a couple of problems too, which is good.
BPB02: Oh yeah I was just ... here I was just solving for the coeficient of friction. Because um ... Well if you ... well you have the force m*g that goes down like this, and I don't remember exactly how, becuase I'm not really a fan of geometry ... But I think you can show that this angle is also theta. Well actually no this angle is ... Yeah it's just, um I distinctly remember the result you get that when you are on a hill and when you are on an incline this is m*g*cos(theta) and this is m*g*sin(theta).
Interviewer: Okay.
BPB02: Actually, uh... it's the other way around.
Interviewer: Okay.
BPB02: And so this is tangent theta. I think it's the other way around? I should/
Interviewer: /well it would be one way or the other, you would have roughly the same kind of work right?
BPB02: Yeah
Interviewer: I see, so this was the way you were solving the physics problem that you posed, and this was the way you were solving the math problem that you posed?
BPB02: Yeah
Interviewer: Okay

BPB02: And the thing is, thats what was saying ... interestingly the sorts of analyses that I did in the math problem were very much like what I would do in my high school physics class.
Interviewer: Oh interesting.

[00:37:43.06] [further you are in physics, farther it moves away from math]

BPB02: It seems to me like the further I get into physics, the further it moves away from traditional math practices.
Interviewer: Can you say maybe a little bit more by that, like what you mean by that.
BPB02: It's just... (long pause)
Interviewer: I think it's an interesting observation, I just wanna know more.
BPB02: It just seems like ... It seems like, in a math ... When you deal with physical problems you have these sorts of ... you have these idealizations of these physical probems. And when you do that in physics in high school you have these idealizations as well, but once you get into college level physics you start to break down these idealizations and consider issues in the real world like ... You start out considering motion over frictionless surfaces, but then you start, you introduce friction and you start considering how that affects it. So the force on the car is no longer just m*g*sin(theta), but rather it's that minus mu*m*g*cos(theta).
Interviewer: Because you had to add in this thing now, is that right?
BPB02: Yeah, and that equals f, which equals m*a. The m's cancel out and a equals g*sin(theta) minus mu*cos(theta)
Interviewer: Got it, I see
BPB02: I'm pretty sure it's m*g*cos(theta) into the plane, m*g*sin(theta) down the hill.
Interviewer: Okay, I don't have any more about that one if you don't.
BPB02: Alright
Interviewer: I'll trade you though becuase I have another one. So again read the whole thing before you answer but you don't have to read it out loud.

BPB01 – Physics is an approximation, pretty much

[01:22:45.21]

BPB01: These questions are really interesting because they introduce.. or rather they uncover a lot of concepts covered in calculus and physics. I think more into calculus rather than physics. For example the pendulum you can make it into problem 3, which is purely mathematical.
Interviewer: So you don't think a mathematician and a physicist would battle about this problem? you think they might be harmonious?
BPB01: I think that they would be pretty harmonious.
Interviewer: Do you find that you do approximations in ... you said that you do it in calculus, but in physics?
BPB01: Yeah, we actually do a lot of approximations in physics. I keep noticing that a lot of what we learn is actually an approximation. Basically everything, in my whole physics knowledge is an approximation pretty much.
Interviewer: Wow.
BPB01: Yea, well maybe not all of it, like f=ma, but I think that in a lot of the problems you do approximations without knowing it. Part of the reason could be that the 'what they give you' could be an approximation to begin with, but they don't explicitly say so.
Interviewer: Can you think of an example?
BPB01: In magnetism, a lot of times you have to assume that the magnetic field is uniform in order to simplify a problem, and in order for you to solve it in the first place. For example, when you have two bar magnets, and you have the north and south pole next to each other, you approximate that ... Can I draw?
Interviewer: Absolutely, in fact let me give you a blank piece of paper.
BPB01: So for example you would say, we know the magnetic field between the two magnets is going to be like this, but then it kind of curves outward here. It doesn't really go fully straight on. So it's not completely uniform. But then in a lot of problems you say just ignore the fringing effects on the sides in order to solve the problem, so you get a uniform magnetic feild. Problems like that involve approximation because it's not truly uniform. In a lot of physics problems, sometimes the situations aren't even realistic any more to real life, /
Interviewer: in physics problems?/
BPB01: In physics problems because of how complicated things get eventually. A lot of times it's frustraiting that you can't solve the actual real life problem at the stage of physics you're learning because of all those factors you have to introduce and consider. And a lot of times, the GSI or professor will mention something that you will learnin the future. Sometimes it's frustrating because it's kind of like 'why am I doing this if it's not realistic?' But then it's understandable that sometimes you have to teach like that to get fundamental concepts down, and in order to have a starting point. So I guess it's understandable to use approximations in that sense. Also, some approximations we use are really good approximations. For example, in the physics textbook it will say that it's an approximation and they give the actual value. And a

lot of times when you compare the 2 they are pretty similar. Sometimes other physical phenomena that really happen can be negligible in terms of what you are actually looking for. So back to the physics vs. math argument. I guess it kind of shows like ... Since physics is applied math, it uses the same mathematical concepts but then it goes back to what the purpose of the problem is.

[01:27:38.16]

Interviewer: Did you have anything else that you thought about during that? I have nothing else to ask, but you might have something else to say.
BPB01: I thought the problems were interesting, and I think it's really nice to reflect on what you use in physics and how math and physics are interconnected, but they can be different based on the purpose.
Interviewer: That's fair. cool.
BPB01: I had fun.