Physics 139B Reference Guide with Gweonisms

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Abstract

This paper aims to help me understand quantum mechanics part II. Throughout the course I have written down a funny comments (some with context some without) that Professor Gweon has made. I have come to refer to them as Gweonisms. They are original and clever remarks made in lecture that made the class very enjoyable. They have also had a nice consequence of helping me remember some of the material. Although, this review is made purely for myself, I hope that you will enjoy and learn from it as well. Throughout the paper, I will introduce the context of the Gweonism first then state the Gweonism. Enjoy!

Contents

Definition 0.1. *A Gweonism is a jocose saying or explanation of physical phenomena made by Gey-Hong Gweon in his natural habitat. The natural habitat consists of anywhere physics is being discussed, especially in the classroom and office hours. Gweonisms are defined as a mapping from the pop culture hilbert space to the physics hilbert space,* $G : \{\mathbb{P}^c \longmapsto \mathbb{P}\}$

The first Gweonism is in response to having no conflicts for the time of office hours.

Gweonism 0.2. *No conflicts ...? Wow this is a really beautiful class!*

The next Gweonism is the on the importance of pertubation theory

Gweonism 0.3. *GRE problems or graduate quals- these will all be a peice of cake. [later in conversation] If you truly understand pertubation theory you can get into Princeton.*

Addressing the current takeover of youtube and other video sites for explaining ideas.

Gweonism 0.4. *People generally don't like to read.*

1 Lecture 1: Formalism

A student recites the time dependent schroedinger ($i\hbar\frac{d}{dt}|\Psi\rangle = E|\Psi\rangle$) equation and the reply is a gweonism

Gweonism 1.1. *Nobody is perfect. But this is perfect.*

2 Lecture 2

I didn't write the context down for this next one, but I remember laughing really hard.

Gweonism 2.1. *As time goes by you can interesting stuff .... or bad stuff.*

While deriving the time evolution operator:

$$\begin{aligned}
\mathcal{U}(dt) =& 1 - \frac{i\hat{H}}{\hbar} \longrightarrow \mathcal{U}(\Delta t) = (1 - \frac{i\hat{H}}{\hbar}) \cdots (1 - \frac{i\hat{H}}{\hbar}) && (1)\\
=& (1 - \frac{i\hat{H}}{\hbar})^N && (2)\\
=& (1 - \delta)^{\Delta t/dt} && (3)\\
=& (1 - \delta)^{1/\delta \cdot \frac{i\hat{H}}{\hbar}\Delta t} && (4)\\
=& \boxed{e^{-i\frac{\hat{H}\delta t}{\hbar}}} && (5)
\end{aligned}$$

When he change $\frac{i\hat{H}}{\hbar}$ to δ is when he says

Gweonism 2.2. *I am going to do a courageous thing and call this delta.*

While getting class participation for he says

Gweonism 2.3. *Yell out the answer, I will write down whatever you say because I am a robot.*

In introducing Dirac notation he began describing Paul Dirac by stating

Gweonism 2.4. *Dirac was a silent psychopath genius.*

3 Lecture 3

After mixing up some of the notation he says

Gweonism 3.1. *I like the notation in my notes, but sometimes I don't follow my notes.*

Emphasizing the importance of 1st order pertubation theory he states

Gweonism 3.2. *If you don't know this, you will be despised!*

Discussing quantum level repulsion he draws how the levels change $\left(\boxed{\textbf{Remember: } \Delta^2_{n=0} < 0}\right)$. He accidentally drew the ground state level going above the 1st excited state, quickly realizes it then says

Gweonism 3.3. *I can't go that high! That is not pertubation- that is evolution!*

4 Lecture 4

Suspecting that we don't read his homework solutions:

Gweonism 4.1. *There will be quizzes from now on because I want you to go read my homework solutions.*

Asks a student a question. Student says he doesn't remember. He replies:

Gweonism 4.2. *You sound so innocent...*

Discussing when pertubation theory is good. Specifically when degenerate pertubation theory fails:

Gweonism 4.3. *If the states remain degenerate, then pack up and go home.*

I didn't record what the secret was be he definitely let us in on the "secret"

Gweonism 4.4. *Since you are very sophisticated students, I will let you in on a secret.*

5 Lecture 5

Referring to "useful" states of degenerate system

Gweonism 5.1. *We don't count bad people.*

Apparently we were complaining at the sight of a problem

Gweonism 5.2. *You guys tricked me into thinking this was hard!*

When investigating the two level system we used the classic ammonia molecule as our system.

Gweonism 5.3. *This is that stinky ammonia molecule- [students agree] well lets give it a break, one molecule wouldn't stink*

Discussing parity symmetry and it's intuitive nature

Gweonism 5.4. *We can never go into a mirror- so how would know about reflection?*

I don't remember this one but I wrote "normaliztion constants" next to this Gweonism:

Gweonism 5.5. *This one (problem 1) is the same problem (as problem 2)- exactly. But this (problem 1) was made up and so is good for nothing. And this one (problem 2) is nobel worthy.*

A student asks about limits on an equation on the whiteboard and Gey-Hong replies

Gweonism 5.6. *That is a typo. I don't know what I am writing when I lecture. Maybe you can use that as an excuse on the exam.*

6 Lecture 6

In regards to all fundamental particles being the same:

Gweonism 6.1. *You and termites are the same.*

On the importance of experiments

Gweonism 6.2. *If theorists don't pay attention to experiments then they just write fantasy paper after fantasy paper.*

Discussing the pitfalls of classical mechanics, and it's underlying "wrongness" to the real world

Gweonism 6.3. *If you don't like classical mechanics then you are my favorite student.*

7 Lecture 7

I guess I got lazy and only recorded one Gweonism that day. Referring to Feynman's QED:

Gweonism 7.1. *We are just doing some poor man's non-relativistic pertubation theory.*

8 Lecture 8

Referring to the Clebsch-Gordon Coefficients (http://pdg.lbl.gov/1999/clebrpp.pdf)

Gweonism 8.1. *Look it up. Maybe if you want to live longer and exercise your brain then derive them.*

In reference to the hydrogenic atom and first order pertubation due the weak Zeeman effect ($E^{(1)} = \langle n\ell j m_j | \hat{H}_0 | n\ell j m_j \rangle$)

Gweonism 8.2. *I am not going to go through this calculation because the only effect it will have on you is that you will get 10 times more bored.*

Referring to the strong Zeeman effect and it's degeneracy and the degeneracy lifting of pertubations

Gweonism 8.3. *Some levels should be degenerate...uhhhh... that should give you the chills.*

9 Lecture 9

Referring to a dream

Gweonism 9.1. *Lets say your dream is more modest. You only want to know the ground state.*

He explains the variational principle in a sentence

Gweonism 9.2. *If that sounds trivial, well that's because it is trivial.*

Asking for trial wavefunctions to use in the variational principle from students. Makes it a competition

Gweonism 9.3. *If you get the lowest energy then you are the winner!*

Referring to a triangle wavefunction for the trial wavefunction

Gweonism 9.4. *Should we try this one first? Why not!? It's cute!*

A self contained Gweonism

Gweonism 9.5. *Whenever I say WKB, people always think I am referring to the KGB.*

Introducing the WKB action principle ($\psi(x) = A\exp(i\frac{S(x)}{\hbar})$ then plug back into Schroedinger equation and use pertubation $L = R$. Where L is the easy side and R is the complicated small side. Then you get 10.19

$$\psi(x) = \frac{A}{\sqrt{p(x)}} exp\left(\frac{i}{\hbar}\int^x dxp(x)\right) + \frac{B}{\sqrt{p(x)}} exp\left(-\frac{i}{hbar}\int^x dxp(x)\right)$$

Gweonism 9.6. *This is cool! Not, "Oh god" [In response to students reactions]*

Referring to the action $S(x)$

Gweonism 9.7. *S(x) might be some weird beast...*

10 Lecture 10

He was inspiring us by inferring that we were smarter than Newton

Gweonism 10.1. *We are all better than Newton! Because we know what an infinitesimal is.*

Referring to the importance of Pauli exclusion priciple and to earlier conversation

Gweonism 10.2. *With the Pauli exclusion principle there would be no baseball!*

11 Errors in My Records

Due to excessive work, GRE stuff, Graduate applications and my other courses I must have gotten lazy and/or missed class with accuracy so the following Gweonisms are sporadic and with much context.

12 Lecture 12-13

Referring to how he does not only grade based on points but also on effort and understanding and...

Gweonism 12.1. *My grading is not based on points, I just look at you and give you a grade.*

Talking about time dependent pertubation theory

Gweonism 12.2. *You go to school and your mother does not what you did. Just as in QED. We don't what the electron did between $t = 0$ and now.*

Referring to the importance of the probability sum rule ($\sum_n P_n = 1$)

Gweonism 12.3. *If you break the sum rule, then your theory is crap.*

13 Lecture 14

No context...

Gweonism 13.1. *We treated this at higher level than any undergraduate or graduate course does, so you should fell good that you know the untainted truth.*

Referring to spooky action at a distance

Gweonism 13.2. *When physicists say spooky interaction, they mean it!*

14 Lecture 15-20

No explanation necessary, just truth.

Gweonism 14.1. *Minecraft is an excellent game.*

Studying scattering theory

Gweonism 14.2. *We are not including spin here because we don't want to*

Discussing Rayleigh's Formula ($e^{ikz} = \sum_{\ell=0}^{\infty} i^\ell (2\ell+1) j_\ell(kr) P_\ell(\cos\theta)$ Equation 17.18

Gweonism 14.3. *You have standing waves like beautiful patterns on a drum then, when you have a lot of them you get a traveling wave....that's OK [shrugs]*

When explaining the idea of unitarity (the fact that number of particles must be conserved, then we get only a phase shift for outgoing particles after scattering. The $\ell - th$ partial wave is given as

$$\frac{2\ell+1}{2ikr}\left(e^{2i\delta)\ell}e^{ikr} - (-1)^\ell e^{-ikr}\right) P_\ell(\cos\theta)$$

Equation 17.19, as $r \to \infty$) and if it doesn't hold then

Gweonism 14.4. *This means we lost our marbles*

Bragging about quantum mechanics

Gweonism 14.5. *Classical mechanics doesn't have any say in scattering. It just doesn't!*

Once again bragging about QM

Gweonism 14.6. *E& M is learning mickey mouse science, because quantum mechanics is the most fundamental description of nature.*

15 Conclusion

The number of recorded Gweonism's were larger in the beginning of the class, but this does not mean there were actually more of them then. I believe the number stayed relatively constant. I just got lazy and maybe forgot or was absent. All I know is that every class I had at least one good laugh. That's what made it an exceptional class. Professor Gweon's enthusiasm, dedication, clarity, conciseness, and "humor integration" is unparalleled from my experience. If anyone has any other Gweonism's that they would like to share here please let me know.