

LSU-PHYSICS IQ TEST

3 STRIKES YOU'RE OUT

For Physics Block Party on 9 September 2016:

This was run where all ~70 people start answering each question, given out one-by-one. Every time a person missed an answer, they made a 'strike'. All was done with the Honor System for answers, plus a fairly liberal statement of what constitutes a correct answer. When the person accumulates three strikes, then they are out of the game. The game continue until only one person was left standing. Actually, there had to be one extra question to decide a tie-break between 2nd and 3rd place.

The prizes were:

FIRST PLACE: Ravi Rau, selecting an Isaac Newton 'action figure'

SECOND PLACE: Juhan Frank, selecting an Albert Einstein action figure

THIRD PLACE: Siddhartha Das, winning a Mr. Spock action figure.

1. What is Einstein's equation relating mass and energy?

$E=mc^2$

OK, I knew in advance that someone would blurt out the answer loudly, and this did happen. So this was a good question to make sure that the game flowed correctly.

2. What is the short name for the physics paradox depicted on the back of my Physics Department T-shirt?

Schroedinger's Cat

3. Give the name of one person new to our Department. This could be staff, student, or professor.

There are many answers, for example with the new profs being Tabatha Boyajian, Kristina Launey, Manos Chatzopoulos, and Robert Parks.

Many of the people asked 'Can I just use myself?', with the answer being "Sure".

4. What Noble Gas is named after the home planet of Kal-El?

Krypton. Yes, "Kal-El" is the birth name of Superman.

Prof. Sheehy correctly questioned the phrasing of the question, as the planet was actually named after the gas. Knowing in advance that this was coming, I used this as an opportunity to let it be known that my question/answers were not bound by rules-lawyermanship.

5. What is Einstein's *first* name?

Albert.

6. What is Einstein's *middle* name?

NO MIDDLE NAME.

I suppose that this is a 'trick question', but technically it isn't a trick. Or rather, my phrasing is such that people's expectations could play them false. In any case, I allowed people who said something like 'I don't know' to get full credit.

- 7. A few months ago, LIGO made the awesome announcement of the discovery of Gravitational Waves. The events reported are the collisions of two astronomical bodies. What is the type of bodies that collided?**

Black Holes.

- 8. Here is a pendulum with a one meter string, what is its period?**

Correct answer **TWO SECONDS** ($2\pi\sqrt{L/g}=2.007$ seconds). Accept anything **from 1.5-2.5 seconds.**

I demonstrated an actual 1-m pendulum for one swing, so anyone could have seen the answer to adequate accuracy without doing the equation.

- 9. What is the color of the Sun when viewed with it high up in the sky?**

Correct answer **WHITE**. Accept no other answer.

When I run this question through Google, seven of the top ten hits give the wrong answer. This is a horrible comment on the 'Information Age' that we are so proud to be in, because what should our society do when much of the 'information' is wrong?

I have done the calculation of the Sun's color from its spectrum (passed through a standard atmosphere) as folded through the eye's sensitivity and put onto a CIE color diagram, and the Sun is very close to what is defined as white.

But here is a quick experimental proof. Take a white sheet of paper, go into a dark closet, shine a red light on the paper and it looks red, shine a green light on the paper and it looks green, and shine a blue light on the paper and it looks blue. Now take the same piece of paper and go outside on a sunny day, and see what color the paper looks like.

- 10. Here is a full Coke can and an empty Coke can, when I roll them down this ramp simultaneously, which reaches the bottom first, or do they get to the bottom simultaneously?**

Correct answer **FULL CAN REACHES BOTTOM FIRST.**

I rolled a pair of coke cans down a table nearby that was lift up to form a ramp. The full can reaches bottom first.

The physics is that the full can has a small specific moment on inertia (more of its mass is close to its rotational axis), so it takes less energy to spin it up, so its potential energy goes into linear motion instead of rotational motion. Here are three ****wrong**** answers (well, they are real effects, just negligible or incomplete) that you can consider':

***The full can 'wins' because its larger inertia overcomes air resistance

***They reach bottom at the same time, as ramps are just slowed down falling (or imagine a vertical ramp), and everything falling accelerates equally under gravity. Recall that Galileo himself did this experiment.

***The empty can 'wins' because there is no sloshing to steal the energy.

(Recall, how uncooked eggs spin down so fast, while boiled eggs keep spinning.)

- 11. What is the element just below Argon in the Periodic Table?**

Correct answer **Krypton** or **Kr**

12. What physicist could win *both* the Academy Award for Best Science Content and the Nobel Prize for Physics?

Kip Thorne, for LIGO and for the movie *Interstellar*

OK, OK, there is no Academy Award for Best Science Content.

13. Name one practicing physicist represented in a major movie?

Nicholas Tesla, Albert Einstein, Richard Feynmann, Mr. Spock, Doc Emmitt Brown....

14. What Croatian physicist has a physical unit and a car named for him?

Nicholas Tesla

15. Name the lead guitarist of one of the all-time biggest rock bands who *earned* a PhD in astrophysics?

Brian May

Band = Queen. Thesis title = *Survey of Radial Velocities in the Zodiacal Dust Cloud*

This question is the one that gave the third strike to Prof. Dowling. This is also the question that gave Prof. Rau one of his two strikes.

16. Over the history of the Nobel Prize in Physics, there have been five families that have each earned multiple prizes. These are for the usual nuclear family relations, including parent-offspring and by marriage. One family has four Prize winners sharing five Prizes. Name one of the families.

William Henry Bragg & William Lawrence Bragg (1915, X-ray crystallography)

Karl Seigbahn (1924, X-ray spectroscopy) & Kai Seigbahn (1981 X-ray photoelectron spectroscopy)

Neils Bohr (1922) & Aage Bohr (1975, collective motion in nuclei)

Marie Curie (Physics 1903, Chemistry 1911), Pierre Curie (Physics 1903), Frederic Joliot-Curie (Chemistry 1935), & Irene Joliot-Curie (Chemistry 1935)

J. J. Thomson (1906, electron) & George Paget Thomson (1937 electron diffraction)

17. You are headed exactly north on a flat road riding a bicycle at 10.0 mph. Suddenly a wind springs up exactly from the east at 10.0 mph. Across this transition, you keep exerting the same energy into the pedals. How does your velocity change? Does it speed up, remain constant, or slow down?

Your velocity slows down (wind resistance force goes like the square of the relative velocity)

In the rest frame of the biker, they originally feel a wind from the north at 10 mph. After the east wind springs up, the biker feels a wind of 14 mph from the north-east. Wind forces go roughly as the square of the wind velocity. So originally, the wind force has one-unit to the south, while later the wind force has two-units to the SW. As the biker will lean the bike to counter any E/W force, the only force that matters is the component in the direction of motion. Originally this will be one-unit south, while after the east wind springs up the force N/S component will be 1.4-units to the south. So adding the east wind increases the force acting southward, and the rider must slow down.

18. Name one student who got their degree in our department in the last year?

Lina Chen, Manish Gupta, Chris Johnson, Kevin Macon, Ed Montiel, Jonathan Olson, Erin Chambers, Zachary Edwards, Desmond Fernandez, David Heins, Mojammel Khan, Ed McClain, Emma Bergeron...

This is just the summer graduates. There were many more in Spring and Fall...

19. Who is the author of this book titled "Schroedinger's Killer App?"

Jonathan Dowling I held up the book, although my hand covered the author's name.

And I even handed my own copy of the book to Prof. Dowling for a personal autograph. He signed it with the nice "May all your sign errors come in pairs".

20. Who is the new Chair of our Department of Physics and Astronomy?

John DiTusa.

21. Names of the winners of the Nobel Prize in Physics are often confusing, sometimes simply because their last names are one letter different from that of another winner. Give me both names in such a pair:

Hans **Bethe** - 1967 (energy production in stars)

Walter **Bothe** - 1954 (coincidence methods)

Wolfgang **Pauli** - 1945 (Pauli exclusion principle)

Wolfgang **Paul** - 1989 (ion trap techniques)

Ilya **Frank** - 1958 (Cerenkov effect)

James **Franck** - 1925 (Franck Hertz expt.)

{There are three Wilsons, two Richardsons, two Taylors)

Prof. Rau pointed out the case of Max Born and Niles Bohr. This is real close, but I had formally asked for the last names to be just one letter different. Weirdly, the day before, when Prof. Rau was presenting the Department Colloquium, and he mentioned that Wolfgang Paul invented the ion trap (as an example of a saddle shaped potential), and the Professor next to me leaned over and said "Doesn't he mean Wolfgang Pauli?"

22. Name one professor in our department who speaks fluent Estonian?

Correct answer is **JUHAN FRANK**

23. Name one of our professors working on the T2K experiment that has just announced definitive evidence of muon to electron neutrino oscillations? They have also just announced the discovery of CP violation, as based on the asymmetry between neutrino and antineutrino oscillation

Correct answer **THOMAS KUTTER**, or **MARTIN TZANOV**, or **BILL METCALF**

24. Numerically, what is the inverse of the atomic fine structure constant to three significant digits?

Correct answer is **137** for **137.035999173** or just **137.036**.

This is the question that reduced us from 5 people standing to 3 people standing. Profs Dowling and Rau had many of those significant digits, and they were discussing the philosophical significance of the 5th digit.

- 25. Spock is from the planet Vulcan, but there has long ago been a persistent claim to have a planet in our Solar System that was named Vulcan. Where was this planet supposed to be in our Solar System?**

Correct answer **INSIDE THE ORBIT OF MERCURY** or any variant.

Historically, in the 1800's there were occasional claims to seeing Vulcan transiting the Sun, and Le Verrier hypothesized this planet to account for the precession of Mercury's orbit (later explained by Einstein).

Of the three people still standing, all with two strikes each, only Dr. Rau got this one right. With this, Dr. Rau won the whole event!

- 26. What particle is a flavor-neutral meson consisting of a charm quark and a charm antiquark?**

Correct answer is the **J/Ψ** particle, or even CHARMONIUM for excited states.

The double name was because Burton Richter and Sam Ting both independently discovered it at the same time.

This one separated out the 2nd and 3rd place finishers. (That is, Rau had already won, and 2nd place was decided because Frank knew the right answer, while Das did not.) And with this, we had our three winners.

These are the extra questions that I had in reserve.

- 27. How many editions has the book "Gravitation" by Misner, Thorne, & Wheeler gone through?**

1 edition, 1973.

I would have held up my copy of the book.

- 28. Is Sheldon Cooper for or against Loop Quantum Gravity?**

Against

The 4-minute sequence on Loop Quantum Gravity is devastatingly funny. Try 'googling' "Big Bang Theory Loop Quantum Gravity" for videos.

- 29. The meaning of the mathematical equations of Quantum Mechanics by Neils Bohr is called the 'Copenhagen Interpretation'. The ideas of collapsing wave functions and actions at a distance have long troubled many people of high stature. As an alternative, Professor Pullin and Rodolpho Gambini have another interpretation, named after a city. What is that city?**

Montevideo

- 30. What did Einstein originally want to call what later became known as his 'Theory of Relativity'?**

Correct answer **THEORY OF INVARIANTS**. Max Planck talked Einstein into the new name.