Greetings,

I have had a great time writing the physics questions for the UIL contests for the last two years. I think the level of the physics questions was much more appropriate this last year, and I appreciate all the feedback that I have received about the tests – that helps me to make them better. Not that everything was perfect… there was that beautiful question on the state test that didn't have enough information to be solved (oops), and there were a few that I simply made too hard. That leads me to this upcoming year: I am implementing some changes that I think will improve the physics section and make it more accessible to students who may currently be afraid to tackle anything from the physics part.

Once again, I will endeavor to write some fun and challenging physics questions. Below is the usual outline of physics topics, but you will want to note that there is a little more specific reference information there. There is also a more rigid structure to the content of the test, also noted below. The directed reading questions will come first, but there will only be three of them on each test and then topics for each question will be absolutely set.

I have reduced the book questions down to three per test, but it is still an important 18 points, so don't ignore it. The book for this year is a brand-new publication: "Astrophysics for People in a Hurry" by Neil DeGrasse Tyson. Anything written by Tyson is excellent and this one is no exception. It is a small book, but it is packed with information, so don't wait until the last minute to read it. It is accessible to students at all levels, so I encourage everyone to read it even if you haven't had physics yet. There are twelve chapters, so I'll break it down this way: questions for the Invitational A&B tests will come from Chapters 1-4, while questions for the District test will come from Chapters 5-6, questions for the Regional test will come from Chapters 7-9, and questions for the State test will come from Chapters 10-12. Even if you don't make it past District, I would encourage you to read the entire book – it is good, and worth your time even if you aren't taking a test about it.

The remainder of the test will focus of core physics concepts, but each question number on each test will always be about the same topic (see below if that doesn't make any sense). Like last year, there will be a few conceptual questions, but most of the questions will be mathematical problems. At the Regional and State level, don't be surprised to see some problems involving Calculus, complex numbers, and vector notation. What is described below will give you the exact topics for each question and the chapters for those topics in three popular references.

Physics Questions P1 – P3 will always be from the reading material. This year that is from "Astrophysics for People in a Hurry" by Neil DeGrasse Tyson. Questions for the Invitational A&B tests will come from Chapters 1-4, while questions for the District test will come from Chapters 5-6, questions for the Regional test will come from Chapters 7-9, and questions for the State test will come from Chapters 10-12.

Physics Question P4 will always be from the field of **Astronomy**. I'll stick to major concepts such as star formation, evolution, and death; planetary systems (including our solar system); stellar processes; the structure of the universe (galaxies, clusters, superclusters, filaments and voids); and exotic objects such as quasars and pulsars. Recommended texts include "Foundations of Astronomy" by Seeds and Backman, and "21st Century Astronomy" by Kay and Palen.

Physics Question P5 will always be about **Measurement/Dimensional Analysis/Significant Figures/Order of Magnitude**. This is always the first thing in a Physics text and the foundation of experimentation and calculation. I've ignored this set of topics in the past and should not have done so. References: Chapter 1 in Giancoli (7th ed), Chapter 1 in Hewitt (12th ed), Chapter 1 in Serway and Vuille (10th ed).

Physics Question P6 will always be about **Uniformly Accelerated Motion**. Describing displacement, velocity and acceleration in both one and two dimensions is always a staple of physics studies. This will include free-fall and projectile motion. References: Chapters 2-3 in Giancoli (7th ed), Chapters 3, 10 in Hewitt (12th ed), Chapters 2-3 in Serway and Vuille (10th ed).

Physics Question P7 will always be about **Forces**. This is another major physics concept, with Newton's Laws at the forefront. Again, I'll have both one dimensional and two dimensional problems, friction, and specific forces such as those due to springs or gravitation. References: Chapters 4-5 in Giancoli (7th ed), Chapters 2,4,5,9,10 in Hewitt (12th ed), Chapters 4,7 in Serway and Vuille (10th ed).

Physics Question P8 will always be about **Work/Energy/Power/Momentum**. Certainly, I cannot ignore two of the most important conservation laws in the field of physics: Conservation of Energy and Conservation of Momentum. This question may involve a single conservation law, be a combined energy-momentum problem, a power problem, or a work (force over a distance) problem. References: Chapters 6-7 in Giancoli (7th ed), Chapters 6-7 in Hewitt (12th ed), Chapters 5-6 in Serway and Vuille (10th ed).

Physics Question P9 will always be about **Circular and Rotational Motion/Equilibrium**. Simple problems include uniform circular motion, centripetal force, or balanced torques. This question could include rotational momentum or rotational energy. More advanced problems involve calculating rotational inertia, unbalanced torques, and rolling motion. References: Chapters 5, 8-9 in Giancoli (7th ed), Chapter 8 in Hewitt (12th ed), Chapters 7-8 in Serway and Vuille (10th ed).

Physics Question P10 will always be about **Waves/Sound/ Harmonic Motion**. This is a wonderfully broad subject, and not particularly difficult. I will include wave concepts such as superposition, waves on a string, standing waves, and wave motion. Sound topics include resonance, intensity, and the Doppler Effect. Simple harmonic motion includes systems such as masses on springs or the simple pendulum. More advanced questions may include damped or forced oscillations. References: Chapters 5, 11-12 in Giancoli (7th ed), Chapters 19-21 in Hewitt (12th ed), Chapters 13-14 in Serway and Vuille (10th ed).

Physics Question P11 will always be about **Fluid Statics and Dynamics/ Thermodynamics.** Fluid Statics includes Pascal's principle, pressure at depth, and density while Fluid dynamics will usually involve Bernoulli's principle. Thermodynamics includes thermal expansion, thermodynamic laws, and heat transfer as well as more advanced concepts such as entropy, thermodynamics processes (adiabatic, isobaric, etc…) and heat engine cycles. References: Chapters 10, 13-15 in Giancoli (7th ed), Chapters 13-18 in Hewitt (12th ed), Chapters 9-12 in Serway and Vuille (10th ed).

Physics Question P12 will always be about **DC Circuits/Resistors/Capacitors**. My favorite topic is circuits, so you know it will show up everywhere. Topics include Ohm's Law, and resistors (or capacitors) in series and parallel. More advanced concepts include Kirchhoff's Rules and RC circuits. References: Chapters 18-19 in Giancoli (7th ed), Chapter 23 in Hewitt (12th ed), Chapters 16-18 in Serway and Vuille (10th ed).

Physics Question P13 will always be about **Electric Fields and Forces/Electric Potential/Gauss' Law**. Fields are abstract, so they are naturally more challenging. This question could include one dimensional and two-dimensional Coulomb's Law, electric field, or electric potential problems as well as Gauss' Law at the advanced level. References: Chapters 16-17 in Giancoli (7th ed), Chapter 22 in Hewitt (12th ed), Chapters 15-16 in Serway and Vuille (10th ed).

Physics Question P14 will always be about **Magnetic Fields and Forces/Magnetic Materials/Ampere's Law**. Similar to Electric fields, magnetic field problems can get challenging, but who doesn't love the right-hand-rule. Topics include magnetic materials, charges and currents in magnetic fields, and magnetic fields due to long straight wires and in solenoids. Advanced topics include both Ampere's Law and the Biot-Savart Law. References: Chapter 20 in Giancoli (7th ed), Chapter 24 in Hewitt (12th ed), Chapter 19 in Serway and Vuille (10th ed).

Physics Question P15 will always be about **Faraday's Law/Induction/EM Oscillation and Waves/AC Circuits**. Dealing with changing magnetic fields, and oscillating currents and fields can be challenging. Faraday's Law is very important here, as is Lenz' Law. Oscillating EM fields provide the basis for electromagnetic waves and our understanding of the EM spectrum, as well as light wave effects such as radiation pressure, polarization, and wave refraction. AC circuits, LC oscillations, RMS, RLC resonance, reactance and impedance will not show up prior to Regionals. References: Chapters 21-22 in Giancoli (7th ed), Chapters 25-27 in Hewitt (12th ed), Chapters 20-21 in Serway and Vuille (10th ed).

Physics Question P16 will always be about **Geometric Optics/Wave Optics**. Lenses of all shapes, and curved and plane mirrors are fair game, as well as spherical refracting surfaces. There are many concepts to understand such as the difference between Real or Virtual images, knowing when images are Inverted or Upright, and calculating magnification. Advanced topics will include multiple element optical systems as well as wave optics concepts such as diffraction and interference. References: Chapters 23-24 in Giancoli (7th ed), Chapters 28-29 in Hewitt (12th ed), Chapters 22-24 in Serway and Vuille (10th ed).

Physics Question P17 will always be about **Modern Physics/Quantum Physics**. There are a host of Modern topics including Spectroscopy, the Photoelectric effect, and Special relativity. At the advanced levels are Quantum questions involving the Heisenberg Uncertainty Principle, normalization, expectation values, the wave function and the correspondence principle. References: Chapters 26-29 in Giancoli (7th ed), Chapters 30-32, 35 in Hewitt (12th ed), Chapters 26-28 in Serway and Vuille (10th ed).

Physics Question P18 will always be about **Nuclear Physics/Particle Physics**. All competitors should know about radioactivity (alpha, beta, and gamma), decay chains, and half-lives as well as particle ideas such as the Standard Model, fundamental forces, conservation laws, and the properties of quarks and leptons. More advanced topics include binding energy, nuclear reactions (fission, fusion) and the interaction of radiation with matter (including living matter), as well as particle decay chains and rates, unification, spin, color, and early-universe cosmology. References: Chapters 30-32 in Giancoli (7th ed), Chapters 33-34 in Hewitt (12th ed), Chapters 29-30 in Serway and Vuille (10th ed).

Physics Question P19 will always be a wildcard question from the topics traditionally covered in a Physics 1 course. That is from the topics covered in questions P5-P11. The wildcard questions will generally be more challenging than those from earlier in the test. References: Chapters 1-15 in Giancoli (7th ed), Chapters 1-21 in Hewitt (12th ed), Chapters 1-14 in Serway and Vuille (10th ed).

Physics Question P20 will always be a wildcard question from the topics traditionally covered in a Physics 2 course. That is from the topics covered in questions P12-P18. The wildcard questions will generally be more challenging than those from earlier in the test. References: Chapters 16-32 in Giancoli (7th ed), Chapters 22-35 in Hewitt (12th ed), Chapters 15-30 in Serway and Vuille (10th ed).

I hope this gives you some idea as to my thinking while I write these tests, and helps you build a study strategy that will maximize your success on the physics section. No test is perfect, but I will do my best to ensure a fair and reasonable competition. Good luck to you and safe travels to all.

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