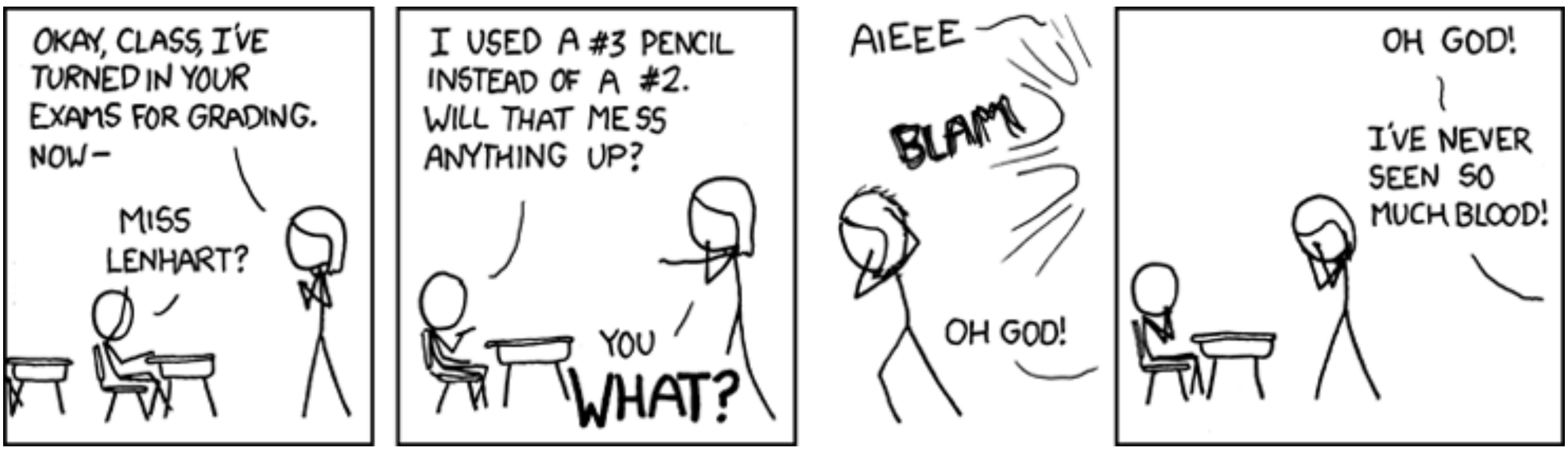
Physics 4601

Physics GRE exam

James C. (JC) Gumbart

http://simbac.gatech.edu/phys4601/



What is the GRE?

- The Graduate Record Examination (GRE) is a set of standardized tests often used for entry to graduate school
- The **General** GRE test, which is required by most schools, has three parts, quantitative (*math*), verbal (*words and stuff*), and analytical writing (*can you combine words into sentences*)
- Subject GRE tests are used for specific fields (*Biology, Chemistry, Literature*, *Math*, *Physics*, *Psychology*) and are used more or **less** often, depending on the area

Why GRE?

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GREs don't predict grad school success. What does?

By Beryl Lieff Benderly | Jun. 7, 2017 , 8:30 AM

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Student performance measures that don't perform

By Maggie Kuo | Jan. 11, 2017 , 5:00 PM

EDUCATION

The Problem With the GRE

The exam "is a proxy for asking 'Are you rich?' 'Are you white?' 'Are you male?'"

VICTORIA CLAYTON MARCH 1, 2016

Why GRE?

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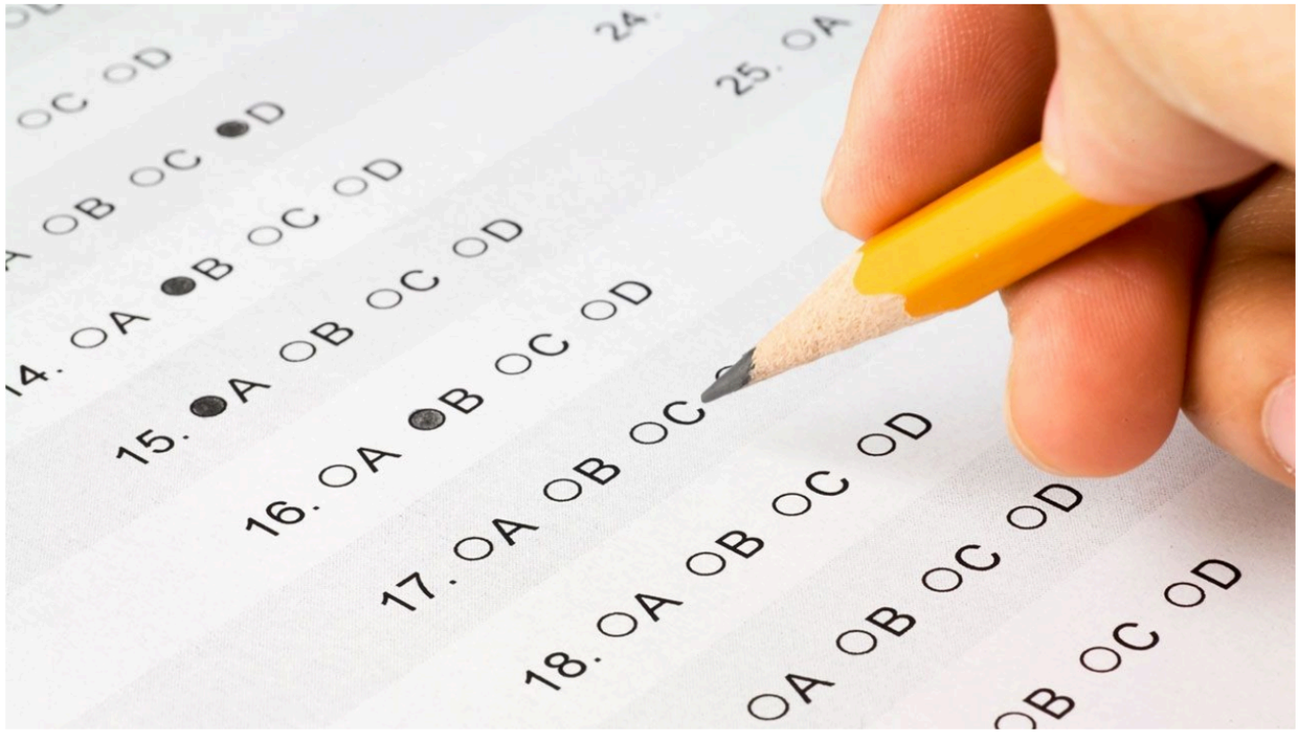


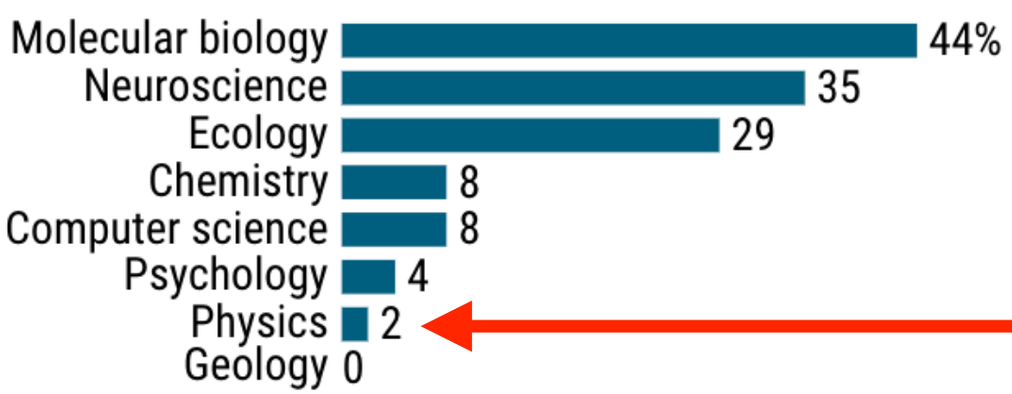
ISTOCK.COM/BLUESTOCKING

A wave of graduate programs drops the GRE application requirement

By Katie Langin | May. 29, 2019 , 4:25 PM

GRExit snapshot

Percent of programs at 50 top-ranked U.S. research universities that didn't require GRE general scores in 2018. (Programs in some disciplines weren't offered at all universities.)



Change can be slow!

https://www.sciencemag.org/careers/2019/05/wave-graduate-programs-drop-gre-application-requirement

What is the Physics GRE?

- The Physics GRE is **170 minutes** and has **100 multiple-choice (five-option) questions**
- It spans practically all of physics with the following breakdown:
  - Classical mechanics (20%)
  - Electromagnetism (18%)
  - Optics and wave phenomena (9%)
  - Thermodynamics and statistical mechanics (10%)
  - Quantum mechanics (12%)
  - Atomic physics (10%)
  - Special relativity (6%)
  - Laboratory methods (6%)
  - Specialized topics (9%)

https://en.wikipedia.org/wiki/GRE_Physics_Test

https://www.ets.org/gre/subject/about/content/physics

What is the Physics GRE?

1. **CLASSICAL MECHANICS — 20%**
   (such as kinematics, Newton's laws, work and energy, oscillatory motion, rotational motion about a fixed axis, dynamics of systems of particles, central forces and celestial mechanics, three-dimensional particle dynamics, Lagrangian and Hamiltonian formalism, noninertial reference frames, elementary topics in fluid dynamics)
2. **ELECTROMAGNETISM — 18%**
   (such as electrostatics, currents and DC circuits, magnetic fields in free space, Lorentz force, induction, Maxwell's equations and their applications, electromagnetic waves, AC circuits, magnetic and electric fields in matter)
3. **OPTICS AND WAVE PHENOMENA — 9%**
   (such as wave properties, superposition, interference, diffraction, geometrical optics, polarization, Doppler effect)
4. **THERMODYNAMICS AND STATISTICAL MECHANICS — 10%**
   (such as the laws of thermodynamics, thermodynamic processes, equations of state, ideal gases, kinetic theory, ensembles, statistical concepts and calculation of thermodynamic quantities, thermal expansion and heat transfer)
5. **QUANTUM MECHANICS — 12%**
   (such as fundamental concepts, solutions of the Schrödinger equation (including square wells, harmonic oscillators, and hydrogenic atoms), spin, angular momentum, wave function symmetry, elementary perturbation theory)
6. **ATOMIC PHYSICS — 10%**
   (such as properties of electrons, Bohr model, energy quantization, atomic structure, atomic spectra, selection rules, black-body radiation, x-rays, atoms in electric and magnetic fields)
7. **SPECIAL RELATIVITY — 6%**
   (such as introductory concepts, time dilation, length contraction, simultaneity, energy and momentum, four-vectors and Lorentz transformation, velocity addition)
8. **LABORATORY METHODS — 6%**
   (such as data and error analysis, electronics, instrumentation, radiation detection, counting statistics, interaction of charged particles with matter, lasers and optical interferometers, dimensional analysis, fundamental applications of probability and statistics)
9. **SPECIALIZED TOPICS — 9%**
   Nuclear and Particle physics (e.g., nuclear properties, radioactive decay, fission and fusion, reactions, fundamental properties of elementary particles), Condensed Matter (e.g., crystal structure, x-ray diffraction, thermal properties, electron theory of metals, semiconductors, superconductors), Miscellaneous (e.g., astrophysics, mathematical methods, computer applications)

In each category, the subtopics are listed roughly in order of decreasing importance for inclusion in the test.

What is the Physics GRE?

- It's offered only three times per year: September, October, and April
- You register at least a month in advance, but don't wait until the deadline as **testing centers fill up!** (*some student have had to travel to, e.g., Athens because Atlanta test centers were full*)
- Scores take another month to become available
- Many students register for both September and October test dates to increase their chances of getting a good score
- Each test costs $150, which includes sending the scores to **four schools**
- Sending to additional schools costs $27 each
- The *ScoreSelect* option allows you to send only your best score to a school (although **some** schools may ask for all scores anyway)

Why physics GRE?

Science Advances

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RESEARCH ARTICLE | SCIENTIFIC COMMUNITY

Typical physics Ph.D. admissions criteria limit access to underrepresented groups but fail to predict doctoral completion

Casey W. Miller[1,*], Benjamin M. Zwickl[2], Julie R. Posselt[3], Rachel T. Silvestrini[4] and Theodore Hodapp[5]

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– Hide authors and affiliations

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"…despite a large sample size and wide dynamic range, we do not find a statistically significant relationship between GRE Physics (GRE-P) Subject Test scores and Ph.D. completion."

https://advances.sciencemag.org/content/5/1/eaat7550

Why physics GRE?

Physics GRE requirements & admissions fees for US/Canadian Astronomy & Physics Progra...

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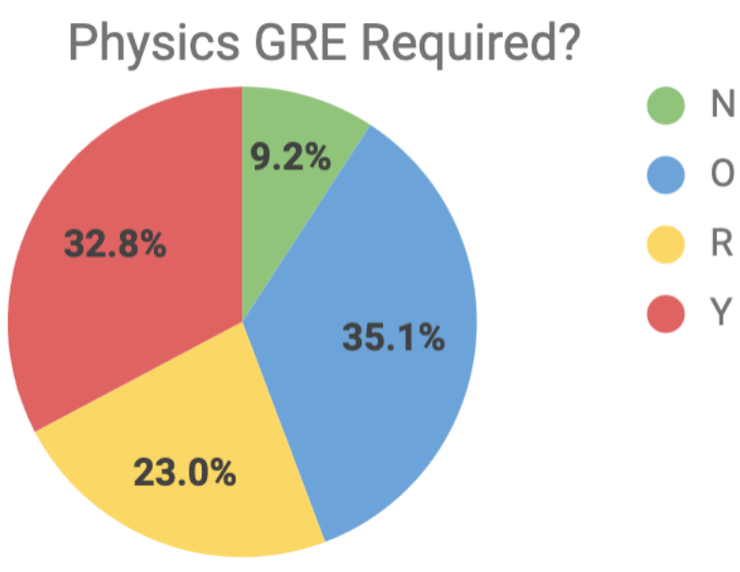
100% View only Share

The following programs are sorted by Physics GRE score acceptance policy, where the programs that have completely abandoned the Physics GRE are listed on top and those with policies are listed towards the end (otherwise listing is alphabetical). The AAS council's recommendation is "that graduate programs eliminate or make optional the GRE and PGRE applicants," but the author of this spreadsheet believes all depreciations of the test are positive developments and should be encouraged. For more info on the rationale for such a c the table.

Please send e-mails to guillochon@gmail.com to propose edits to this list.

Program		Physics GRE *			Application Fee §		
University	Department †	Req.	Policy	Verified by	Dom.	Intl.	Verified by
Arizona State	Earth & Space	N	URL	S. Starrfield	$70	$115	S. Starrfield
Cal State Northridge ᵐ□	Phys. & Ast.	N	URL	J. Barranco	$70	$70	J. Guillochon
Case Western Reserve	Astronomy	N	URL	C. Mihos	$50	$50	J. Guillochon
Georgia State □□	Astronomy	N		M. Bentz	$50	$50	M. Bentz
Michigan □	Ast. & Astrophys.	N	URL	E. Rauscher	$75	$90	J. Guillochon

* Key:
N = Does not accept PGRE
O = Optional, no impact if not submitted ‡
R = Reporting recommended ‡
Y = Still required



Only 1/3 of schools require it and 1/4 recommend it

Nearly half of schools don't want/need it

https://docs.google.com/spreadsheets/d/19UhYToXOPZkZ3CM469ru3Uwk4584CmzZyAVVwQJJcyc/edit

Scores

- Every Subject Test yields a total score on a 200 to 990 score scale, in 10-point increments.
- Scores get assigned a percentile representing what fraction of people for which you scored higher (this will vary a bit from year to year)
- For 20,700 people who took the Physics GRE between July 2015 and June 2018, the average score was 712 +/- 160

Scaled Score	Physics[b]
980	94
960	91
940	89
920	86
900	83
880	80
860	77
840	74
820	70
800	67
780	63
760	60
740	56
720	52
700	48
680	45
660	40
640	36
620	32
600	28
580	23
560	19
540	15
520	12
500	9
480	6
460	4
440	2
420	1
400	1
380	

https://www.ets.org/s/gre/pdf/gre_guide_table2.pdf

Scores

- The number of correct answers will determine your score for a given test
- Incorrect answers are **NOT** penalized (this wasn't always the case - beware outdated advice!)
- For the 2013 practice exam, getting 84/100 was good enough for a perfect score (990)
- getting 50/100 correct on this test is a 650 - a respectable score (but not competitive for top schools)

TOTAL SCORE			
Total Correct	Scaled Score	Total Correct	Scaled Score
84-100	990	43	590
83	980	42	580
82	970	41	570
81	960	40	560
80	950	38-39	550
79	940	37	540
78	930	36	530
77	920	35	520
76	910	33-34	510
75	900	32	500
74	890	31	490
73	880	30	480
72	870	28-29	470
71	860	27	460
70	850	26	450
69	840	25	440
68	830	23-24	430
67	820	22	420
66	810	21	410
65	800	20	400
64	790	18-19	390
63	780	17	380
62	770	16	370
61	760	14-15	360
60	750	13	350
59	740	12	340
58	730	11	330
57	720	9-10	320
56	710	8	310
55	700	7	300
54	690	6	290
53	680	5	280
52	670	4	270
51	660	1-3	260
50	650	0	250
49	640		
48	630		
47	620		
46	610		
44-45	600		

Scores

- While some schools publish minimum scores, they aren't always strictly enforced (GT did not enforce its own minimum)
- To get an idea, you can look at the physicsgre.com forum, e.g.: https://physicsgre.com/viewtopic.php?f=3&t=181795

Resources for preparation

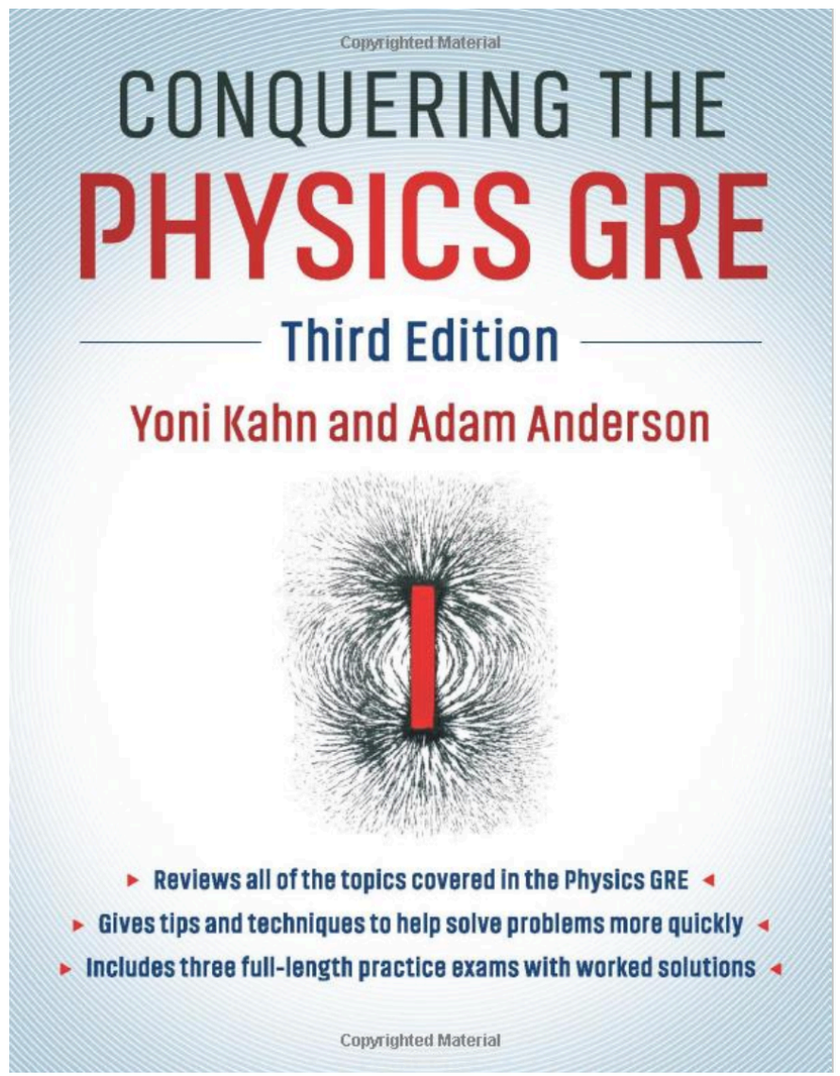
GRE RESOURCES

Physics GRE details

Important Dates:
Spring reg. deadline: Fri. March 5, 2021
Late deadline: Fri. March 12, 2021
Spring exam: Sat. April 10, 2021

How to ace the GRE
Web Forum
Practice Exams
Solutions (most)
Conquering the Physics GRE (book)
Ohio State problem sets and solutions
List of schools and Physics GRE requirements

links to various content on the course website, including old tests for practice with solutions



- practice tests are most representative but to supplement, a book like this one can be helpful

http://simbac.gatech.edu/phys4601/

https://jaan.io/how-to-ace-the-gre-and-physics-gre/

Strategies

- READ all the sources I have provided/linked to
- Do **ALL** 500 practice exam problems **AND** understand them
  - ***Note***: older practice exams are harder than current ones!
- Time is short (~100 seconds/question)! Look for/learn shortcuts for solving problems
- If you have taken sufficient courses, consider taking the April test - then you can decide if you still want to take a second test in October
- Next class, you will take a sample (1/3) Physics GRE

https://jaan.io/how-to-ace-the-gre-and-physics-gre/