

**Mestrado Profissional em Ensino de Física
Universidade Federal do Rio de Janeiro
Processo seletivo – Turma 2017**

Exame de Proficiência em Língua Inglesa

Nome: _____

Assinatura: _____

Prezada candidata, prezado candidato:

Este exame é composto por um texto em inglês e 4 questões. O texto é de um artigo publicado na revista *The Physics Teacher*, volume 53, setembro de 2015, pg. 375, escrito por Gerd Kortemeyer.

Leia-o com atenção e, com base no que consta no texto, responda em português às questões apresentadas em seguida.

É permitida a consulta a dicionários impressos. É vedada a utilização durante o exame de quaisquer equipamentos eletrônicos.

Todas as páginas deste exame devem ser assinadas pelo candidato.

Perguntas

- 1) O autor menciona uma ferramenta escondida do Google, a calculadora. É mencionado um motivo para esta ferramenta estar escondida. Qual é esse motivo?

- 2) O que é calculado no exemplo da Figura 1?

- 3) Por que o entusiasmo pela ferramenta diminuiu, após uma demonstração bem sucedida em sala de aula?

- 4) A ferramenta consegue calcular uma expressão que não esteja dimensionalmente correta? Que exemplo no texto você pode utilizar para justificar sua resposta?

The Google calculator

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There is a little gem hidden in Google: the calculator. This gadget is capable of assisting students and teachers in a lot of the otherwise tedious calculations in introductory physics.¹ Figure 1 gives a little example of what the calculator can do, determining the Bohr radius based on a number of other physical constants.

The reason this tool is hidden is that it only comes up when correct mathematical expressions are entered, which is something that people rarely even try. Figure 2 shows another example from a typical undergraduate physics problem where a proton is accelerated from an initial speed in a potential difference. As can be seen, the calculator only “kicks in” if the expression has the correct mathematical form and physical dimensions; otherwise, Google “silently fails” and just delivers related search results.

Students tend to be surprised when this little gem is first demonstrated in class, and they might even start using it for homework. Unfortunately, this initial enthusiasm quickly fades, and students appear to revert to their clunky graphing calculators, which are neither capable of handling units nor have any built-in physical constants. Why is that?

The reason cannot be availability since the vast majority of students have smartphones, so Google is even more readily available than their calculator bricks. A valid argument may be that they would not have their smartphones in exams, so they might feel the need to practice using their allowed 1980s technology. However, the same behavior was observed in a class where all exams were symbolic, no calculations involved anyway.

The deeper reason may be discomfort or lack of practice entering formulas as algebraic expressions. While graphing calculators are capable of evaluating expressions such as $3.6 \times \sqrt{((0.3048 \times 3000)^2 + 2 \times 1.602 \times 10^{-19} / 1.673 \times 10^{-27} \times 35000)}$ (for the example Fig. 2), many of the students appear to have problems entering this, and instead work with a graphing calculator as if it was a 1970s pocket calculator: $.3048 \times 3000$, Enter, x^2 , ... (see Fig. 3). Needless to say that errors can quickly occur using this approach.

A worthwhile exercise may well be to ask students to consistently use the Google calculator for awhile. This approach encourages students to develop solutions to problems in the way that expert physicists do, namely, arriving at a closed symbolic solution first and only plugging in numbers as the very last step. It fosters a better understanding of physical dimensions, since Google will not calculate anything that is not dimensionally correct. In addition, correctly using units along the way is more convenient than just entering numbers, since Google automatically takes care of all conversions. But wait:

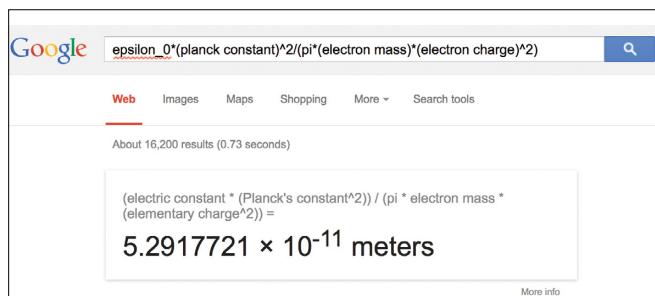


Fig. 1. Calculating the Bohr radius using Google.

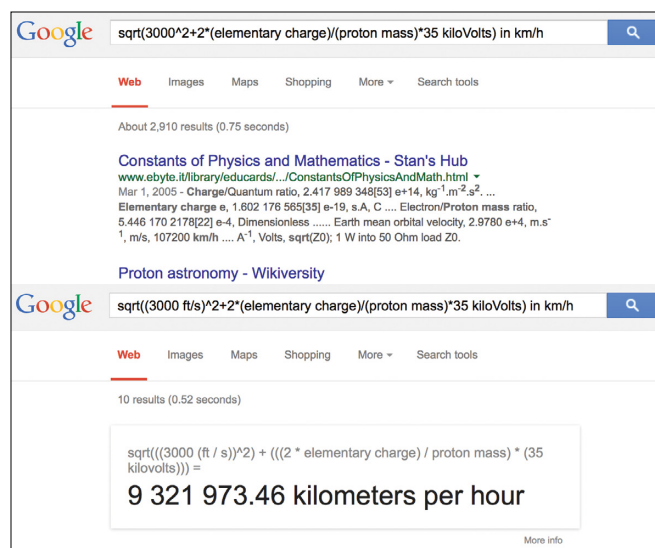


Fig. 2. Expression for accelerating a proton in a potential difference, entered incorrectly (without units for the initial speed, top panel) and correctly (bottom panel).

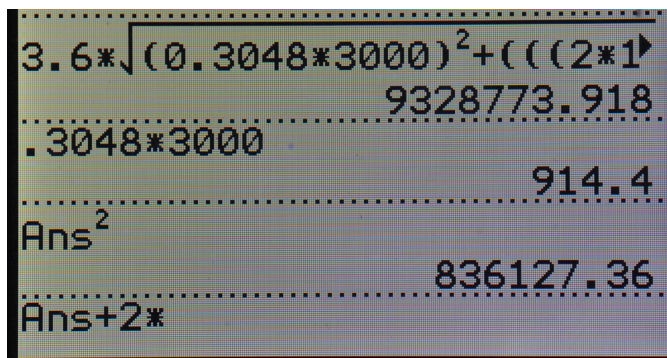


Fig. 3. Entering the expression in Fig. 2 into a graphing calculator, using a one-line algebraic formulation (top calculation) and step-wise “plug-and-chug” calculations (lower series of operations).

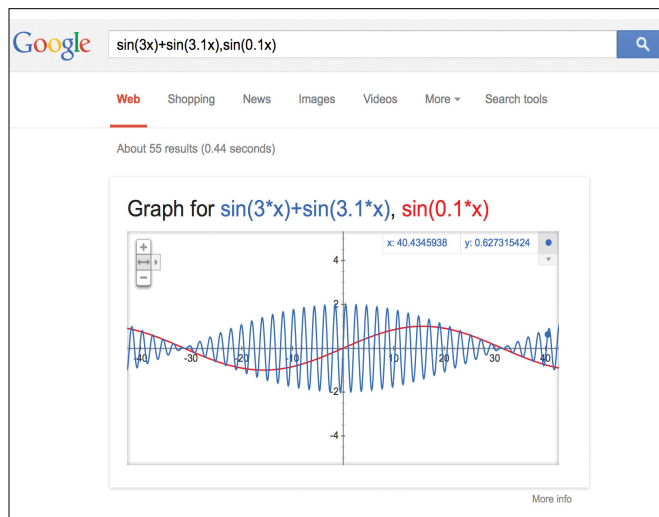


Fig. 4. Graphing in Google, beat frequencies.

what about the “graphing” in graphing calculators? Well, it can do that, too (see Fig. 4).

Reference

1. David W. Ward, “Physics the Google way,” *Phys. Teach.* **43**, 381 (Sept. 2005).

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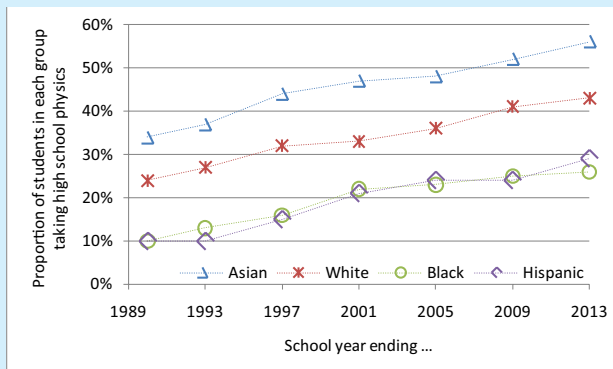
And the Survey Says ...

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Minority participation in high school physics

In the May 2014 issue of *The Physics Teacher*, we reported that 39% of high school seniors in the 2013 class took at least one high school physics course prior to graduation. (See *TPT* 52, 214–15.) This month we take a closer look at participation in high school physics by racial/ethnic group. As we see below, Asian students are most likely to take a high school physics course, while the participation of African-Americans and Hispanics remains below 30%. As we will see over the next few months, the lower participation can be explained, at least in part, by socioeconomic factors. About half of Hispanic seniors and almost 45% of African-American seniors were enrolled in schools where the student body was deemed as “worse off” than their peers by principals and teachers, and these “worse off” schools were less likely to offer physics. In October, we will look at high school physics enrollment by socioeconomic status of the student body.

Proportion of Students Taking High School Physics in the U.S. in Each Racial/Ethnic Group



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If you have any questions or comments, please contact Susan White at the Statistical Research Center of the American Institute of Physics (swhite@aip.org).

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