Concepts of Physics: Homework 2

Due: 6 September 2024

1 Scientific notation

Some numbers in physics are too large or too small to express in ordinary decimal form. Consider the numbers 500000 and 400000.

a) If you multiplied these two numbers do you expect that the result will have more than, fewer than or exactly 10 digits (the maximum that my calculator can show)? Explain your answer.

b) Express each number in the form: $\text{number} \times 10^{(\text{power})}$ where, in each case, the "number" is a decimal number and "power" is a whole number (integer).

c) Use the powers of ten multiplication scheme to multiply the numbers. How many digits would it take to write the number in the usual form?

2 Multiplication and division with powers of ten

The usefulness of powers of ten is illustrated via an example on page 38 of Hobson, *Physics: Concepts and Connections.* The aim of this exercise is to follow that method. Consider the numbers 534 and 165.

a) Multiply 534 and 165, using your calculator.

b) Express each of 534 and 165 in the form: $\text{number} \times 10^2$ where, in each case, the number is a decimal number.

c) Use the method of multiplying with powers of ten to multiply 534 and 165 and check that your answer is the same as that of part (a).

d) Divide 5340 by 1335, using your calculator.

e) Use the method of dividing with powers of ten to divide 5340 by 1335 and check that your answer is the same as that of part (d).

3 Hobson, *Physics, Concepts and Connections, 5ed*, Ch. 2. Conceptual Exercise 32, page 52.

4 Number of water molecules

A single water molecule has mass 2.99×10^{-26} kg. A bottle holds on liter of water; this has mass 1.0 kg. Determine the number of water molecules in the bottle. If you paid \$0.02 for each water molecule in the bottle how much would it have cost? Explain your answers.

5 Estimating number of atoms

A bacterium has width approximately $1.0\,\text{micrometer} = 1.0 \times 10^{-6}\,\text{m}$. An atom has width approximately 10^{-9}m. Estimate the number of atoms that span the width of the bacterium. Explain your answer.

6 Space cannon

A spacecraft, that is very distant from any other objects, fires a cannonball, which leaves the spacecraft with speed 200mph. Which of the following is true (choose one) after the cannonball leaves the spacecraft? Explain your answer.

 i) The cannonball travels with a constant speed of 200mph.
 ii) The cannonball loses speed rapidly and eventually travels with a smaller constant non-zero speed.
 iii) The cannonball loses speed gradually and eventually travels with a smaller constant non-zero speed.
 iv) The cannonball loses speed constantly and eventually comes to a stop.

7 Physics videos

Find a physics video from one of the following YouTube channels:

MinutePhysics

Physics Girl

Steve Mould

MinutePhysics

You can choose any video provided that it: a) is about physics or related to physics and b) you find it interesting.

 a) Provide the video location and title.
 b) Briefly describe as best as you can what physics the video tried to describe and what it said about this. *Note that some of these videos can go into some depth. You don't need to understand or describe anything that the video covered. Just provide a rough idea of the video content and why you found it interesting.*
 c) Go to D2L. In the Physics Videos discussion forum, find the Physics Videos: Homework 2 topic. Provide a link to your video there and a one sentence description of the video content (everyone in the class will eventually see this).