Gordon Burgin's Puzzles

Scientific and Engineering notation

Scientific Notation, also known as 'standard form' or 'exponential notation', is a way of writing 'ordinary' decimal numbers that accommodates values very large or very small so that they may be conveniently written in standard decimal notation (i.e., '$a \times 10^b$). The coefficient digit '*a*' being any real number that can be between 1 and up to 10 (but never 10) and the power of 10 digit or exponent '*b*' can either be positive (+) for very large numbers or negative (-) for very small numbers depending on the position of its decimal point.

examples: $86{,}000{,}000 = 8.6 \times 10^{+7}$
$0.00000086 = 8.6 \times 10^{-7}$

Engineering Notation is like Scientific Notation, except that you only use powers of ten that are multiples of 3 (such as 10^3, 10^{-3}, 10^6 , 10^{-12}, 10^{-15}, etc). The coefficient digit '*a*' being any real number that can be between 1 and up to 1000 (but never 1000). This allows you to replace the **×10**s with 'Metric Numbers' so that you can use standard words (such as thousand, million, billion, etc.) as prefixes (such as kilo-, Mega-, Giga-, Tera-, Peta-, etc.) or the symbol (k, M, G, T, P, etc.) for very large numbers and for very small numbers (such as one-thousandth, one-millionth, one-billionth, etc.) as prefixes (such as milli-, micro-, nano-, picro-, etc.) or the symbol (m, μ, n, p, etc.).

examples: $86{,}000{,}000 = 86 \times 10^{+6} = 86$ Mega $= 86$ M
$0.00000086 = 860 \times 10^{-9} = 860$ nano $= 860$ n

The following mathematical problems require the use of these two types of notations in order to solve them. You may want to review the mathematical operations of the powers on 10.

Problem 1. The speed of light is approximately 3×10^8 meters/second. If the planets Earth is approximately 1.5×10^{11} meters from the sun and Pluto is approximately 6×10^{12} meters, how many seconds does it take light to reach Earth and Pluto. Express your answer in ordinary, scientific and engineering notations (see examples above).

Earth:			
Pluto:			

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Problem 2. As a major piece of his Theory of Relativity, Einstein derived his famous equation $E = mc^2$, which simply reveals the relationship of energy (E) in terms of the product of mass (m) and the speed of light (c) squared and equating how a very large amount of energy is locked up in even the smallest amount of mass or matter. If m = 1 kilogram and $c = 3 \times 10^8$ meters/second, find the value of E expressed in joules. Express your answer in ordinary, scientific and engineering notations (see examples above).

Answers:

Note: One joule of energy is not very much really. If you pick up a large apple and raise it above your head, you will have used around one joule of energy in the process. On the other hand, we use up huge amounts of energy every time we switch on a light. A 100 watt light bulb uses 100 joules of energy every second (i.e., one watt is one joule per second).