Homework No. 01 (Fall 2023)

PHYS 205A-002: UNIVERSITY PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale

Due date: Monday, 2023 Aug 28, 2:00 PM, on D2L

Instructions

- You are encouraged to use any of the resources to complete this homework. However, the extent to which you depend on resources while doing this homework is a measure of how much extra work you need to put in to master the associated concepts. Solutions should be the last resource.
- Describe your thought process in detail and organize it clearly. Make sure your answer has units and the right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (under Assesments → Assignments).

Problems

1. (**10 points.**) The corners of a square lie on a circle of radius R. Find the area of the square as a function of R.

   Solution

2. (**10 points.**) What can you deduce about the physical quantity c in the famous equation

$$E = mc^2, \tag{1}$$

   if the energy E has the dimensions ML^2T^{-2} and mass m has the dimension M. In particular, what is the dimension of c? That is, given

$$[c] = M^\alpha L^\beta T^\gamma, \tag{2}$$

   determine α, β, and γ.

   Solution

3. (**10 points.**) Consider the mathematical expression

$$x = vt + \frac{1}{2!}at^2 + \frac{1}{3!}bt^3 + \frac{1}{4!}ct^4, \tag{3}$$

where x is measured in units of distance and t is measured in units of time. Determine the dimension of the physical quantity represented by the symbol b. That is, given

$$[b] = M^{\alpha} L^{\beta} T^{\gamma}, \tag{4}$$

determine α, β, and γ.

Solution

4. (**10 points.**) Consider the mathematical expression

$$x = Ae^{-\omega t}, \tag{5}$$

where x is measured in units of distance and t is measured in units of time. Evaluate $\frac{dx}{dt}$. Then, determine the dimension of ωA. That is, given

$$[\omega A] = M^{\alpha} L^{\beta} T^{\gamma}, \tag{6}$$

determine α, β, and γ.

Solution

5. (**10 points.**) Complete the operations and express your answer in scientific notation with correct number of significant digits.

   (a) 345×72

   (b) $55 \div 11$

   (c) $34.3456 + 42.1$

   (d) $46.32 - 56.92345$

   (e) $15600 - 12$

Solution