

## Homework No. 01 (Spring 2023)

### PHYS 205A-001: UNIVERSITY PHYSICS

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

Due date: Monday, 2023 Jan 23, Noon, 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 and are available at

<http://sphics.com/tc/202101-SIU-P205A/>.

- 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 Assessments → 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  $R$ .
2. (10 points.) What can you deduce about the physical quantity  $c$  in the famous equation

$$E = mc^2, \quad (1)$$

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

$$[c] = M^\alpha L^\beta T^\gamma, \quad (2)$$

determine  $\alpha$ ,  $\beta$ , and  $\gamma$ .

3. (10 points.) Consider the mathematical expression

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

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

$$[b] = M^\alpha L^\beta T^\gamma, \quad (4)$$

determine  $\alpha$ ,  $\beta$ , and  $\gamma$ .

4. (10 points.) Consider the mathematical expression

$$x = Ae^{-\omega t}, \quad (5)$$

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  $\omega A$ . That is, given

$$[\omega A] = M^\alpha L^\beta T^\gamma, \quad (6)$$

determine  $\alpha$ ,  $\beta$ , and  $\gamma$ .

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

(a)  $345 \times 72$

(b)  $55 \div 11$

(c)  $34.3456 + 42.1$

(d)  $46.32 - 56.92345$

(e)  $15600 - 12$