Einführung in die Physik I: Mechanik und Thermodynamik Universität Basel Herbstsemester 2022 Due to Friday 7.10.2022, 1 pm

Exercise Sheet 1

Remember to specify your name, the number of your group and the name of the assistants in your group on the sheet that you hand in.

Question 1 (3 points)

An angstrom (Å) is a unit of length, defined as 10^{-10} m, which is the order of the diameter of an atom. Indicate which conversion is correct (more than one answer is possible).

1.0 Å is equivalent to:

- (a) 10 nm
- (b) 10^5 fm
- (c) 10^{-1} nm
- (d) 10^{-5} fm
- (e) $10^{-4} \ \mu m$
- (f) $10^3 \ \mu m$

Question 2 (4 points)

The speed of an object is given by the equation $v = At^3 - Bt$ where t refers to time.

- (a) What are the dimensions of A and B?
- (b) What are the SI units for the constants A and B?

Question 3 (3 points)

When an object moves with constant velocity, does its average velocity during any time interval differ from its instantaneous velocity at any instant? Explain.

Problem 1 (10 points)

A point mass moves as a function of time following the representation

$$\begin{cases} x = 2t^2 \\ y = 2t + 1 \\ z = 4 \end{cases}$$

Evaluate:

- (a) The average velocity within the time interval $t_1=0$ s and $t_2=5$ s specifying the components and the magnitude of the vector (4 points)
- (b) The momentary velocity specifying the components and the magnitude of the vector (3 points)
- (c) The momentary acceleration specifying the components and the magnitude of the vector (3 points)

Problem 2 (10 points)

The position of a car moving along a straight path as a function time is plotted in Figure 1.

- (a) What is the instantaneous velocity at t = 10 s and at t = 30 s? (3 points)
- (b) What is the average velocity between $t_1 = 0$ s and $t_2 = 5$ s and between $t_1 = 40$ s and $t_2 = 50$ s? (3 points)
- (c) During which time interval is the velocity constant? (1 point)
- (d) At what time is the velocity greatest? (1 point)
- (e) At what time is the velocity zero? (1 point)
- (f) Is the car moving in one direction or in both directions during the time shown? (1 point)



Figure 1: Position of a car as function of time