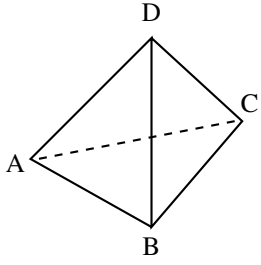


Books, watches, notes or cell phones are **not** allowed. The **only** calculators allowed are the Sharp EL-531***. You **must** show all your work, the correct answer is worth 1 mark the remaining marks are given for the work.

Question 1. (5 marks) Show that the volume of the pyramid with vertices A , B , C , and D is $\frac{1}{6}|\vec{AB} \cdot (\vec{AC} \times \vec{AD})|$.

Hint: The volume of a pyramid with base area A and height h is $\frac{1}{3}Ah$.



Question 2. (5 marks) Find the distance between the following skew lines $\mathcal{L}_1 : \begin{cases} x = 4 + 2t \\ y = 2 + 3t \\ z = 2 + t \end{cases}$, and $\mathcal{L}_2 : \begin{cases} x = -3 + 2s \\ y = 1 - s \\ z = 1 + s \end{cases}$, $s, t \in \mathbb{R}$.

Question 3. Consider the set

$$V = \{(x, y) \mid x \geq 0 \text{ and } y \geq 0\}$$

under the following operations:

$$(x_1, y_1) + (x_2, y_2) = (x_1 + x_2, y_1 y_2) \quad k(x, y) = (kx, y)$$

- a. (2 marks) Does V contain a zero vector? If so find it. Justify.
- b. (2 marks) Does V contain the additive inverse (negative of the vector in the sense of a vector space) of $\vec{v} = (3, 2)$? If so find it. Justify.
- c. (1 mark) Is V a vector space? Justify.

Question 4. (5 marks) Let $W = \{f \mid f(-x) = f(x)\}$. Determine whether W is a subspace of $V = \{f \mid f : \mathbb{R} \rightarrow \mathbb{R}\}$.

Bonus. (3 marks) Sketch $r(t) = (\sin t, \cos t, t)$ where $t \in \mathbb{R}$.