



Supervised work N°0 of Mechanics

Vector analysis

Exercise 1

$\vec{i}, \vec{j}, \vec{k}$ being the unit vectors in the orthonormal frame (Oxyz). Let two vectors $\vec{A}$ and $\vec{B}$ be defined by:

$$\vec{A} = -\vec{i} + \vec{j} - 2\vec{k} \text{ and } \vec{B} = 2\vec{i} + 4\vec{j} - 5\vec{k}$$

- 1- Calculate $(\vec{A} \cdot \vec{B})$ and deduce the angle $\theta = (\vec{A}, \vec{B})$.
- 2- Give $(\vec{A} \wedge \vec{B})$, deduce the area of the parallelogram formed by the two vectors.

Exercise 2

Consider in space, referred to the direct orthonormal reference frame $(O, \vec{i}, \vec{j}, \vec{k})$ the points: A(2, 0, 0), B(2, -2, 0) and C(2, 3, -1).

1. Calculate the vector product $\vec{OA} \wedge \vec{OB}$
2. Calculate the area of triangle OAB.
3. Calculate the mixed product $(\vec{OA}, \vec{OB}, \vec{OC})$, Deduce the volume of the parallelepiped built on the vectors.

Exercise 3

Let be a vector $\vec{U} = (t\vec{i} + 3\vec{j})/(\sqrt{t^2 + 9})$

1. Show that $\vec{U}$ is a unit vector?
2. Calculate its derivative with respect to time?

Exercise 4

A particle is launched with an initial horizontal speed v_0 according to the time-dependent

$$\text{equations: } \begin{cases} x = v_0 t \\ y = \frac{1}{2} g t^2 \end{cases} \quad \text{Determine:}$$

1. The components of speed and its module.
2. The components of acceleration and its module.

Supplementary exercise:

A) Let $\vec{A}(1, 2, 1)$, $\vec{B}(1, 0, c)$ be two vectors where $c \in \mathbb{R}$.

1. Calculate the scalar product $\vec{A} \cdot \vec{B}$ and the modulus of the two vectors as a function of c .
2. Determine the values of c for which the angle $\vec{A}, \vec{B}$ (is equal to $\pi/3$).

B) Consider the points A (3, 5, 4), B (3, 1, 3), C (8, 5, 5) and D (1, 2, 3) in space.

Calculate the mixed product $(\vec{DA}, \vec{DB}, \vec{DC})$, deduce the volume of the parallelepiped formed by the three vectors.