

The Movements

EXERCISE 1: The position vector of a moving point M animated by a rectilinear movement relative to a reference frame (O, \vec{i}) is given by:

$$\overrightarrow{OM} = (-t^2 + 5t + 1) \vec{i}$$

- 1) Determine the nature of the movement of the moving point M. Deduce the value of its acceleration and give the expression of its velocity as a function of time.
- 2) Give the value of the initial speed and the initial position of the moving point.
- 3) At what instant does the movement of the mobile point M change its direction?
- 4) Show that this movement is divided into two phases, draw the graphs of x, v and a.

EXERCISE 2: Two points M1 and M2 move on the same axis $x'x$. At the instant $t = 0$, M1 has an abscissa of 4m toward the left of the origin and moves in the positive direction of the axis at a speed of 3 m/s. Point M2 moves on the opposite direction; the value of its speed is 3 m/s and at the instant $t = 2$ s its abscissa is 5m toward the right of the origin.

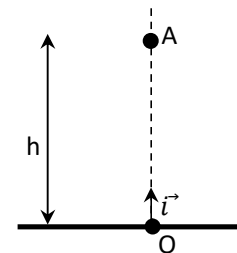
- 1) Establish the time equations of M1 and M2.
- 2) Will they meet? If yes, where and when?

EXERCISE 3: A mobile M makes a movement in the plane $(O, x y)$ provided with a reference frame $R(O, \vec{i}, \vec{j})$. Starting from the origin of time base, the mobile passes through the point: $O(x_0 = 0 \text{ m}, y_0 = 4 \text{ m})$, with a speed: $v \vec{v}_0 = 2 \vec{i} - \vec{j}$. We give the acceleration vector $\vec{a} = -5 \vec{j}$.

- 1) Give the equation of the trajectory.
- 2) Determine the coordinates of the intersection point of the trajectory with the abscissa axis.
- 3) Find the coordinates of the peak point (highest point) of the trajectory.

EXERCISE 4: A ball is launched vertically upward, at a date t_0 taken as the origin of the time base, from a point "A" located at an altitude of $OA = h$ from the ground and at a speed of $v_0 = 30 \text{ m.s}^{-1}$. The air resistance is negligible. We give $||g^{\vec{r}}|| = 10 \text{ m.s}^{-2}$.

- 1) Find the time equation of the movement of the ball in the frame (O, \vec{i}) .
- 2) Prove that the movement has two phases.
- 3) Compute the value of the altitude of the starting position, knowing that the ball reaches the ground at time $t = 12$ s.



- 4) Calculate the value of the maximum altitude reached by the ball and deduce its speed value when it hits the ground.

EXERCISE 5: In the terrestrial reference frame, a horizontal disk rotates at 500 revolutions / minute around a vertical axis.

- 1) Determine the distance traveled by a point M located at $R = 5$ cm from the axis.
- 2) Calculate the value of the constant speed of this point by two different methods.
- 3) The value of the speed is constant; does the point M have an acceleration?

The disk then slows down and the speed of M is given by the relation: $V = 2.62 - 0.10 t$ (t is in seconds).

- 4) Calculate and represent the velocity and acceleration vectors of the point M, at time $t_1 = 10$ s.
- 5) How long does it take for the disk to stop?

EXERCISE 6: Two cyclists M1 and M2 move on a circular trajectory with center O and radius $R = 100$ m. The speed of M1 is 18 km/h and that of M2 is 27 km/h. At $t = 0$, M1 passes from Ω : the origin of the spaces, while M2 has the elongation angle: $\theta = \frac{\pi}{3}$.

M1 moves in the counterclockwise direction and M2 in the opposite direction.

- 1) Determine the expressions of the elongation angle of the mobiles over time.
- 2) On what dates will they meet?