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.

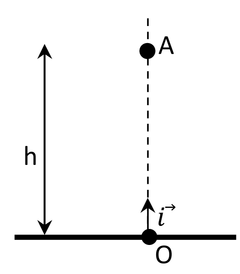
EXERCISE 2: Two points M1 and M2 move on the same axis x'x. At the instant t = 0, M1 has an abscissa of 4m toward the left of the origin and moves in the positive direction of the axis at a speed of 3 m/s. Point M2 moves on the opposite direction; the value of its speed is 3 m/s and at the instant t = 2s 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 m, y_0 = 4 m), with a speed: $\vec{v}_0 = 2\,\vec{i} - \vec{j}$. 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 m.s-1. The air resistance is negligible. We give $||\vec{g}||$ = 10 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 = 12s.
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 = 100m. 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?