Exercice 1

In a landmark $(O,\vec{\imath},\vec{\jmath},\vec{k})$, we consider the 4 moving parts A,B,C and D which are defined by their position vectors. $\overrightarrow{OA} = \begin{cases} x = t \\ y = \frac{t}{\sqrt{3}} \end{cases}$, $\overrightarrow{OB} = \begin{cases} x = 3t - 1 \\ y = 9t^2 + 1 \end{cases}$, $\overrightarrow{OC} = \begin{cases} x = 10 + 10\,cost \\ y = 10sint \end{cases}$, $\overrightarrow{OD} = \begin{cases} x = t + 1 \\ y = 2 + \sqrt{4 - t^2} \end{cases}$

1- Determine the equation of the trajectory.

Exercice 2

We consider the material point of mass m=3 kg, its coordinates in a landmark $(O,\vec{\imath},\vec{\jmath},\vec{k})$ are : M(-2,t-1,1-t^2), give :

1- Its position vector.
2- The coordinates of the velocity $\vec{v}$ and its modulus.
3- The components of the acceleration vector $\vec{a}$ and its modulus.
4- The angle θ between $\vec{v}$ and $\vec{a}$, specify its value at t=2s.
5- The unit vector tangent to the trajectory $\overrightarrow{U_T}$
6- The projection of $\vec{a}$ on the axis tangent to the trajectory T, that what it represents?
7- The components of $\overrightarrow{a_T}$
8- The normal acceleration and the radius of curvature.
9- The force $\vec{F}$ acting on the material point M and its moment with respect to the origin.

Exercice 3 (Homework)

Let M be a particle of space that describes a motion defined by : M= 2t $\vec{\imath}$ +4 t(t-1)$\vec{\jmath}$.

1- Determine the equation of the trajectory of M and deduce its nature.
2- Calculate the velocity of M at the instant t.
3- Show that the movement has a constant acceleration of which we will determine the tangential and normal components.

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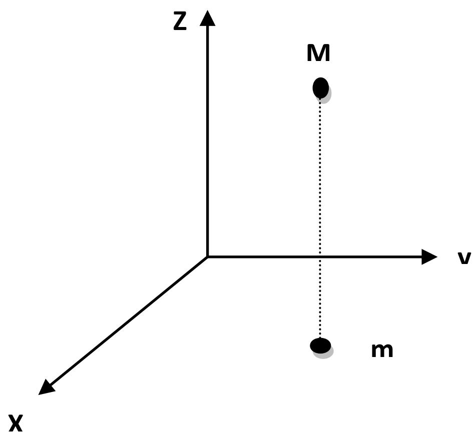
Exercice 4

We consider the material point of mass m =3 kg, moves in space according to the following law in the landmark $(O,\vec{\imath},\vec{\jmath},\vec{k})$

$$\begin{cases} x = R\,coswt \\ y = R\,sinwt \\ z = at \end{cases}$$

Where R, w and a are constants
Let m_1 be the projection of M on the plane (xoy).



1- What is the nature of the trajectory of m in the plane (xoy).).
2- What is the nature of the motion of M on the axis (OZ).
3- The coordinates of the velocity $\vec{v}$ and its modulus.
4- The coordinates of the acceleration vector $\vec{a}$ and its

modulus.

5- Calculate the tangential acceleration a_T and normal a_N .

Exercice 5

The plane is relative to an orthonormal reference xoy of origin O and the basis $(\vec{\imath}, \vec{\jmath})$, the coordinates x and y of a moving point M in the plane $(O, \vec{\imath}, \vec{\jmath})$ vary with time according to the law :

$$\overrightarrow{OM} = \begin{cases} x = 2cos\frac{t}{2} \\ y = 2sin\frac{t}{2} \end{cases}$$

Determine:

1- The nature of the trajectory.
2- The components of the velocity vector.
3- The curvilinear abscissa S of the point M at the instant t, taking as initial condition S=0 when t=0.
4- the normal and tangential components of the acceleration and deduce the radius of curvature of the trajectory.

.Exercice 6

In a reference $\mathfrak{R}$, a point M moves in a plane with a given acceleration as a function of time by the following expression: $\vec{\gamma}(M) = \alpha\vec{\tau} + \beta t^2$

Where τ and n are the unit vectors of the Frenet trihedron and α and β are positive constants and t time. It is assumed that at the instant $t = 0$, the particle is at rest.

1- Give the dimensions of α and β.
2- Determine $s(t)$ the curvilinear abscissa of the point M knowing that $s(t = 0) = 0$.
3- Demonstrate that the expression for the radius of curvature of the trajectory is given by $Rc = \alpha^2/\beta$.