University of M'sila

Faculty of: Technology **Common Base**

Second Series of exercises

Exercise 01:

I- *A mobile travel a distance in 3 phases. The* ***1st*** *is* done at the speed of $\mathbf{25Km/h}$ for $t_1 = 4$ minutes, the ***2nd*** phase is done at the speed of ***50km/h*** *for* $t_1 = 8$ *minutes, and finally* the ***3rd*** *phase is done at the speed of 20***km/h** *for* $t_3 = 2$ *minutes.*

- Find the average speed of this course.

II- *A runner crosses,* ***1.5 times***, a *circular track with radius* ***R*** = ***20 m*** *for a duration* ***t*** = ***50 s***. *What are* the average *speed and the average velocity vector?*

III- *A particle moves in rectilinear motion whose equation of is:* $x = 3(t^3 - 9t^2 + 15t)\ m.$

1°/ Describe *the phases of motion.*

2°/ *What is the distance traveled during the '* **6 secondes** *'*

3°/ What *is the displacement for this same period*

Exercise 02: (Additional)

Two motorists separated by ***90*** m, *one starts from point* ***A*** *(taken as origin of times and abscissa)* at the *constant* speed of **5 m/s**, *while* the *other at the speed of* ***2 m/s*** *in the same direction.*

1°/ *How long does it take for him to catch up with the other motorist?*

2°/ *At what distance he catches him?*

3°/ *What is, at that instant, the displacement of each of them?*

Exercise 03:

In the orthonormal basis $(\vec{\imath}, \vec{\jmath}, \vec{k})$, *we give the rod-crank (or slider-crank) system where crank* OA *of length* l *which is animated by a uniform circular motion with angular velocity* ω, *drives a connecting rod* AB *of the same length* l, *the latter in turn drives a slide* B.

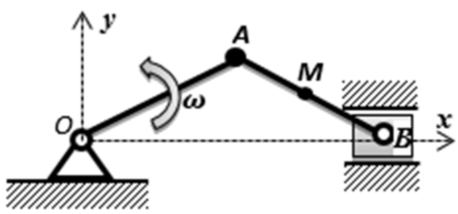

fig.1

1°/ *What are the trajectories of the points $\boldsymbol{A}$, $\boldsymbol{B}$ and $\boldsymbol{M}$ middle of* ***AB.***

2°/ *Give expressions of the velocity of points $\boldsymbol{A}$, $\boldsymbol{B}$ and $\boldsymbol{M}$ as well as their magnitudes.*

3°/ *Give the expressions of the acceleration of points $\boldsymbol{A}$, $\boldsymbol{B}$ and $\boldsymbol{M}$ as well as their magnitudes.*

4°/ *Show that the motions of the points $\boldsymbol{A}$ and $\boldsymbol{M}$ are central motions.*

Exercise 04:

In a polar basis the motion of a particle obeys to the following equations:

$\boldsymbol{\rho(t) = \alpha e^{\beta t}}$ *and* $\boldsymbol{\theta(t) = \beta t}$ $(\boldsymbol{\alpha}, \boldsymbol{\beta})$ *are constants.*

1°/ *Determine the trajectory equation. Represent it for* $\boldsymbol{\beta > 0}$ *and* $\boldsymbol{\beta < 0}$.

2°/ *Determine the velocity and acceleration as well as their magnitudes.*

3°/ *Determine the radius of curvature $\boldsymbol{\mathcal{R}}$.*

Exercise 05:

A particle moves in straight line by a constant velocity $\vec{\boldsymbol{v}} = \boldsymbol{v_0}\vec{\boldsymbol{i}}$, enters a medium where it will be subjected to deceleration $\vec{\boldsymbol{a}} = -\boldsymbol{k}\boldsymbol{v}^2\vec{\boldsymbol{i}}$ ($\boldsymbol{k}$ is a positive constant). By taking the moment of penetration into the medium as the origin of times and spaces

1°/Establish *the law to which speed obeys* $\vec{\boldsymbol{v}}(\boldsymbol{t})$ **.**

2°/ *Give the equation of motion* $\boldsymbol{x}(\boldsymbol{t})$ **.**

3°/ *Show that after a course ' $\boldsymbol{x}$ ' the speed is :* $\boldsymbol{v} = \boldsymbol{exp}\,(-\boldsymbol{kx})$

Exercise 06: (H.W)

A particle moves in the plane ($\boldsymbol{xoy}$). Starts from the rest at point $\boldsymbol{A}$ ($\boldsymbol{0}, \boldsymbol{0}$), with a velocity that obeys the following law:

$$\vec{\boldsymbol{v}} = \boldsymbol{\alpha}.\vec{\boldsymbol{i}} + \boldsymbol{\beta x}.\vec{\boldsymbol{j}}$$

1° / *Find the equation of the trajectory. What is its type. Draw it?*

2° / *Give the expression of acceleration and deduce the type of motion.*

3° / *Determine the radius of curvature $\boldsymbol{\mathcal{R}}$.*

Exercise 07: (Additional)

The components of the velocity of a particle, starting from the origin, are:

$$\dot{x} = 6\,t \quad \text{and} \quad \dot{y} = 8\,t$$

1° / *Determine the equation of motion* $S(t)$

2° / *Determine the velocity of the particle.*

3° / *Determine the tangential and normal accelerations.*

3° / *Deduce the radius of curvature*

Exercise 08: (Additional)

The motion of a point on the periphery of a wheel of radius $R = 2\,m$*, is governed by the equation* $S(t) = 0.1\,t^3$.

1°-/ *Determine the normal and tangential acceleration of this point*

2°-/ *What will be its speed after one lap of the course?*