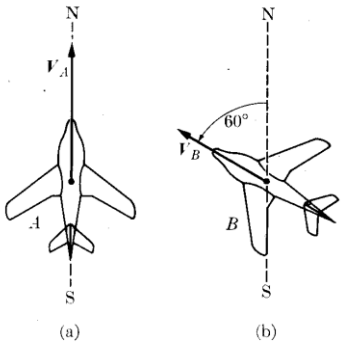
Abdelhafid Boussouf University Centre of Mila,

Institute of Sciences and Technology **Department of Technical sciences**

Series N°2: Kinematics of material point (part 2)

Exercise 1



An airplane A flies toward N at 300 mh^{-1} relative to the ground. At the same time, another plane B flies in the direction N 60° W at 200 mh^{-1} relative to the ground. Find the velocity of A relative to B and of B relative to A.

Exercise 2

A car passes in front of a building of height h. When the car is exactly next to the building, a ball falls from the top of the building. We would like to study the movement of the ball relative to the car (how the driver register the movement of the).

1- Determine the absolute and relative frames.

2- Find the acceleration, velocity, and the trajectory of the ball with respect to the driver for the two cases:

   a. The car moves with constant velocity.

   b. The car moves with a constant acceleration without initial velocity (the car start moves with acceleration).

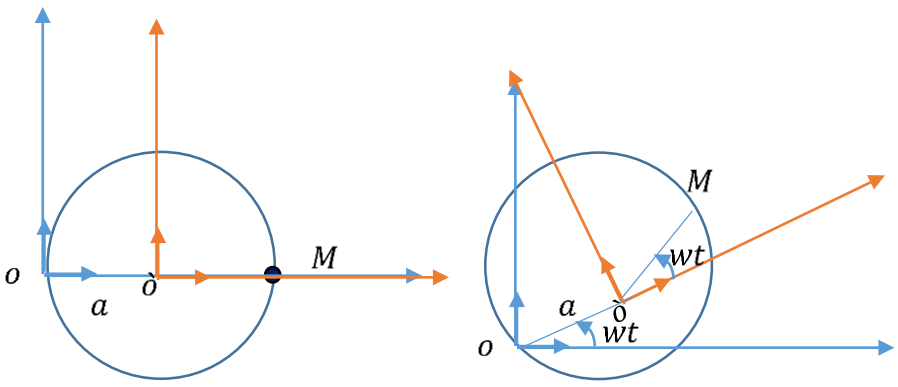
Exercise 3

A circle of radius 'a' can rotate around the point (o) on its circumference (figure below). When the circle begins to rotate, a point M begins to move along its circumference with the same angular velocity as the circle rotates about the point o.

1- Write the absolute position $\vec{r}$ in the relative frame $(o, \vec{i}, \vec{j}, \vec{k})$.

2- Write the absolute velocity $\vec{v}_a$ in the relative frame $(o, \vec{i}, \vec{j}, \vec{k})$.

3- Write the absolute acceleration $\vec{a}_a$ in the relative frame $(o, \vec{i}, \vec{j}, \vec{k})$.



Exercise 4

A rod begins to move along the x-axis with a linear velocity $\vec{v}_{o\dot{o}}$ and rotates about its end with a constant angular velocity $\vec{w}$. At the same time, a point M moves along the rod so that, $\|\vec{r}\| = \alpha(t)$ (see the figure). Find:

1- The formula of $\vec{r}_{0\dot{0}}$ on $(0, \vec{\imath}, \vec{j}, \vec{k})$.

2- The formula of $\vec{r}$ on $(0, \vec{\imath}, \vec{j}, \vec{k})$.

3- The formula of $\vec{v}_r$ *and* $\vec{v}_t$ on $(0, \vec{\imath}, \vec{j}, \vec{k})$, then deduce the absolute velocity $\vec{v}_a$.

4- The formula of $\vec{a}_r$, $\vec{a}_t$*and* $\vec{a}_C$ on $(0, \vec{\imath}, \vec{j}, \vec{k})$, then deduce the absolute acceleration $\vec{a}_a$.