SOLVE AS MUCH AS YOU CAN IN THIS WEEK.
This assignment should be solved completely next week.

Exercise 4:

The position vector of a moving particle (M) in the space reference system $(O;\ \vec{\imath};\ \vec{\jmath})$ is given by:

$$\vec{r} = t\vec{\imath} + t^2\vec{\jmath} \quad [SI]$$

1. Determine the equation of the trajectory. Deduce the shape of the trajectory.
2. Locate the positions of the moving particle (M) at t =0s, 1s, and 2s.
3. Draw the position vector at t = 2s.
4. Determine the characteristic elements of the position vector at t =2s.
5. Does the particle pass in the point of coordinates (2; 3)? Justify.

Exercise 5:

The coordinates of a moving particle (P) in the space reference system $(O;\ \vec{\imath};\ \vec{\jmath})$ are given by:

$$x = 3\cos t \ \ and \ \ y = 3\sin t \quad [SI]$$

1. Write the position vector of (P) at any time.
2. Determine the equation of the trajectory. Deduce the shape of the trajectory.
3. Locate the positions of the moving object (P) at $t = 0\ s,\ \frac{\pi}{2}\ s$, and $\pi\ s$.

Exercise 6:

In the space reference system $(O;\ \vec{\imath};\ \vec{\jmath})$, the position vector of a moving particle (M) is given, any instant, by the expression:

$$\vec{r} = 2t\vec{\imath} + t^2\vec{\jmath} \quad [SI]$$

1. Give the parametric equations of motion of M.
2. Determine the equation of the trajectory described by M.
3. Draw the trajectory of M.
4. Determine the displacement vector $\Delta\vec{r}$ of M between the two instants $t_1 = 0s$, and $t_2 = 2s$.
5. Draw the displacement vector $\Delta\vec{r}$.

Exercise 7:

The position vector of a moving particle in the space reference system $(O;\ \vec{\imath};\ \vec{\jmath})$ is given by:

$$\vec{r} = \overrightarrow{OM} = 3t\vec{\imath} + (t^2 + 1)\vec{\jmath} \quad [SI]$$

1. Determine the equation of the trajectory.
2. Determine the displacement vector and its magnitude between $t_1 = 1s$ and $t_2 = 2s$.
3. Determine the average velocity and its magnitude between $t_1 = 1s$ and $t_2 = 2s$.
4. The average velocity and the displacement vector have the same direction. Why?
5. The average speed of M between $t_1 = 1s$ and $t_2 = 2s$ is not equal to the magnitude of the average velocity of M between $t_1 = 1s$ and $t_2 = 2s$. Why?

Exercise 11:

The position vecotr of a moving particle M in the space of reference system $(O; \vec{i}; \vec{j})$ is given by:

$$\vec{r} = (4t + 2)\vec{i} + (2t^2 + 4t + 1)\vec{j} \ [SI]$$

1. Determine the velocity vector at any instant.
2. Write the compoenets v_x and v_y of the velocity vector.
3. Determine the acceleration vector at any isntant.
4. Write the compoents a_x and a_y of the acceleration vector.

Exercise 12:

The coordinates of a moving particle in a two dimensional motion is given by:

$$\begin{cases} x = 2t \\ y = 4t^2 + 1 \end{cases} \ [SI]$$

1. Does the particle pass through the origin during its motion? Justify.
2. Determine the velocity vector at any instant.
3. Write the characteristic elements of the velocity vector at $t = 1s$.
4. Draw the velocity vector at $t = 1s$.
5. Determine the acceleration vector at any instant.
6. Write the characteristic elements of the acceleration vector at $t = 1s$.
7. Sketch the acceleration vector at $t = 1s$. Deduce the nature of motion of the moving particle.

Exercise 13:

In a plane motion, the position vector of a moving particle is given by:

$$\vec{r} = t\vec{i} + t^2\vec{j} \ [SI]$$

The radius of curvature of the trajectory at $t = 1s$ is $R = 5.59m$

1. Determine the velocity vector at any instant.
2. Calculate the instantaneous speed at $t = 1s$.
3. Determine the expression of the tangential acceleration at any instant. Deduce its algebraic value at $t = 1s$.
4. Calculate the magnitude of the normal acceleration at $t = 1s$.
5. At $t = 1s$, complete the following expression: $\vec{a} = \_\vec{u}_t + \_\vec{u}_n$.

Exercise 14:

In a two dimensional motion, the position vector of a moving particle is given by:

$$\vec{r} = 3t\vec{i} + (-6t^2 + 2t)\vec{j} \ [SI]$$

1. Determine the velocity vector at any instant.
2. Determine the expression of the speed at any instant.
3. Determine the instant at which the velocity vector becomes parallel to the x-axis.
4. Determine the acceleration vector at any instant. Deduce the magnitude of the acceleration vector at any instant.