**EXERCISES**
**KINEMATICS**

Before you do the exercises bellow, you must know the indicators of the materials. These are the indicators of the material that you have to master:

- \Analyze the quantity of displacement, velocity and acceleration in motion in two dimensions by using vector analysis
- Analyze the velocity and acceleration in circular motion
- Analyze displacement and velocity in parabolic motion by using vector analysis
- Analyze linear acceleration and centripetal acceleration in circular motion

**EXERCISES**:

1. Position of a particle at any time is given by $\mathbf{r} = (\sqrt{3}\cos 2t)\mathbf{i} + (4\sin 2t)\mathbf{j}$. Find the velocity of the particle at $t = \pi/4$ s!
2. The velocity of a particle is given by $v = (4t)\mathbf{i} + (5 + 6t^2)\mathbf{j}$. Determine the equation for the position of the particle, if the particle is initially at origin!
3. Vector of position of a body is given by $\mathbf{r} = 3t^2\mathbf{i} + t^3\,\mathbf{j}$. Where r is in meter and t in second. What is its vector of average velocity between t = 1 s and t = 3 s?
4. A ball is thrown vertically upward. Draw the graphics of the velocity and the speed as a function of time!
5. A body moves with the velocity of $v = (3t^2 + 5t - 2)$ m/s. Draw the graphic of its acceleration as a function of the time! Prove that the change of the velocity of the body from t = 0 to t = 2 is equal to the region area bellow the curve of the graphic a-t!
6. Position of a projectile that is launched at a certain elevation is expressed by $\mathbf{r} = (16t)\mathbf{i} + (12t - 5t^2)\mathbf{j}$. Determine:
    a. The initial velocity of the projectile
    b. The angle of elevation of the projectile
    c. The time that is needed by the projectile to reach the highest point
    d. The highest point that can be reached by the projectile
    e. The horizontal range of the projectile

7. A bomb is dropped from an airplane that is moving horizontally at the speed of 200 m/s at 490 m altitude. If g = 9.8 $m/s^2$, find the horizontal distance where the bomb will explode!
8. A wheel rotates and it undergoes 1800 revolution in 2 minutes. Determine:
    a. Its angular velocity if expressed in rad/s
    b. The angular displacement of the wheel during first three seconds
9. Angular velocity of a wheel at any time is given by $\omega = 6t^2$ rad/s. Find :
    a. Equation of its angular position
    b. Its angular acceleration at t = 3 s
    c. Its centripetal acceleration at t = 1 s ( the radius of the wheel is 1 m)
10. A cyclotron, a device to accelerate particle, can make an ion to move in a circle with the radius of 2 m. Initial velocity of the ion is 10 m/s. If the cyclotron can accelerate the ion with the angular acceleration of 15 $rad/s^2$, find:
    a. Its angular velocity at t= 5 s
    b. The distance that has been covered by the ion after moving for 5s