FIRST PART: DEMENSIONAL ANALYSIS

EXERCISE 01:

Study the homogeneity of the following equations:

- ✓ $C = P + \rho . g . z$ ***In which P represents pressure, p stands for density, z denotes height, and C remains a constant.***
- ✓ $2(x_0 - vt) = gt^2 \sin(\theta)$
- ✓ $v = -\frac{f}{R} gt + \sqrt{2Lg \sin(\theta)}$

Where x_0 ***is the initial position, v is velocity, L is distance, f and Rn are reaction forces,*** θ ***is an angle, and t and T are times.***

EXERCISE 02 :

Consider the physical quantities s, v, a and t with dimensions [s]= L , [v]= LT^{-1}***, [a]=*** $L\,T^{-2}$ ***, and [t]= T. Check whether each of the following equations is dimensionally consistent:***

$s = vt + 0.5\, a\, t^2$ $\qquad$ $s = vt^2 + 0.5\, a.t$ $\qquad$ $v = \sin(at^2/s)$

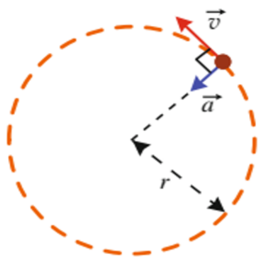
EXERCISE 03:

Determine the dimension of the variable 'X' that achieve dimensional consistency for the equation, given that 'h' represents height, "v" is the velocity and 'm' represents mass.

$$\frac{1}{2} m\, v^2 = m\, X\, h$$

EXERCISE 04:

A particle moves with a constant velocity v ***in a circular orbit of a radius*** r ***as shown in the facing figure. The magnitude of its acceleration is proportional to some power of*** r (r^n) ***and some power of*** v (v^m)***. Determine both powers*** n ***and*** m ***of*** r ***and*** v ***respectively.***



SECOND PART: VECTORS

EXERCISE 01:

Consider the following points: A (1, 1, 1), B (2, -1, 0), and C (0, 2, 2).

1- ***Represent these points in a Cartesian coordinates system (O, xyz)***
2- ***Determine the components of the vectors*** $\overrightarrow{AB}$ ***and*** $\overrightarrow{BC}$
3- ***Calculate the angle M between the two vectors*** $\overrightarrow{AB}$ ***and*** $\overrightarrow{BC}$***.***

EXERCISE 02:

4- *Using the graphical and analytical methods, find the sum and subtraction of the following vectors*

$$\overrightarrow{V_1} = 3\vec{\imath} + 3\vec{\jmath} \qquad \overrightarrow{V_2} = 2\vec{\imath} + 2\vec{\jmath}$$

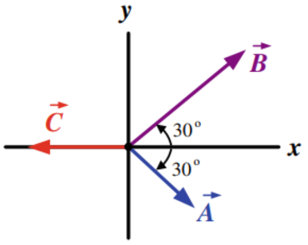
5- *Find the angle formed by $\overrightarrow{V_1}$ and $\overrightarrow{V_2}$*

6- *Calculate the dot (scalar) product and the cross (vector) product of $\overrightarrow{V_1}$ and $\overrightarrow{V_2}$*

EXERCISE 03:

1- *Vector $\vec{A}$ has x and y components of 4 cm and -5 cm, respectively. Vector $\vec{B}$ has x and y components of -2 cm and 1 cm, respectively. If $\vec{A} - \vec{B} + 3\,\vec{C} = \vec{0}$, then what are the components of the vector $\vec{C}$.*

2- *Three vectors are oriented as shown in Figure below, where A = 10, B = 20, and C = 15 units. Find: (a) the x and y components of the resultant vector $\vec{D} = \vec{A} + \vec{B} + \vec{C}$, (b) the magnitude and direction of the resultant vector $\vec{D}$.*



EXERCISE 04:

In a direct orthonormal coordinate system $\Re(\vec{\imath}, \vec{\jmath}, \vec{k})$ we consider the following vectors:

$$\overrightarrow{V_1} = 3\vec{\imath} + 3\vec{\jmath} \qquad \overrightarrow{V_2} = \vec{\imath} + 3\vec{\jmath} + \vec{k} \qquad \overrightarrow{V_3} = \vec{\imath} - \vec{\jmath} + 2\vec{k} \qquad \overrightarrow{V_4} = 2\vec{\imath} - \vec{k}$$

- ✓ *Represent the vectors $\overrightarrow{V_1}$ and $\overrightarrow{V_2}$.*
- ✓ *Calculate the magnitude of $\overrightarrow{V_1}$ and $\overrightarrow{V_2}$, the dot product $\overrightarrow{V_1}.\overrightarrow{V_2}$ and the cross product $\overrightarrow{V_1} \wedge \overrightarrow{V_2}$.*
- ✓ *Calculate the angle θ formed by the vectors $\overrightarrow{V_1}$ and $\overrightarrow{V_2}$.*
- ✓ *Prove that the vector $\overrightarrow{V_3}$ is perpendicular to the plane (P) formed by vectors $\overrightarrow{V_1}$ and $\overrightarrow{V_2}$.*
- ✓ *Prove that the vector $\overrightarrow{V_4}$ belongs to the plane (P).*
- ✓ *Determine the unit vector $\vec{U}$ carried by the vector $\overrightarrow{V_1}$ and $\overrightarrow{V_2}$.*