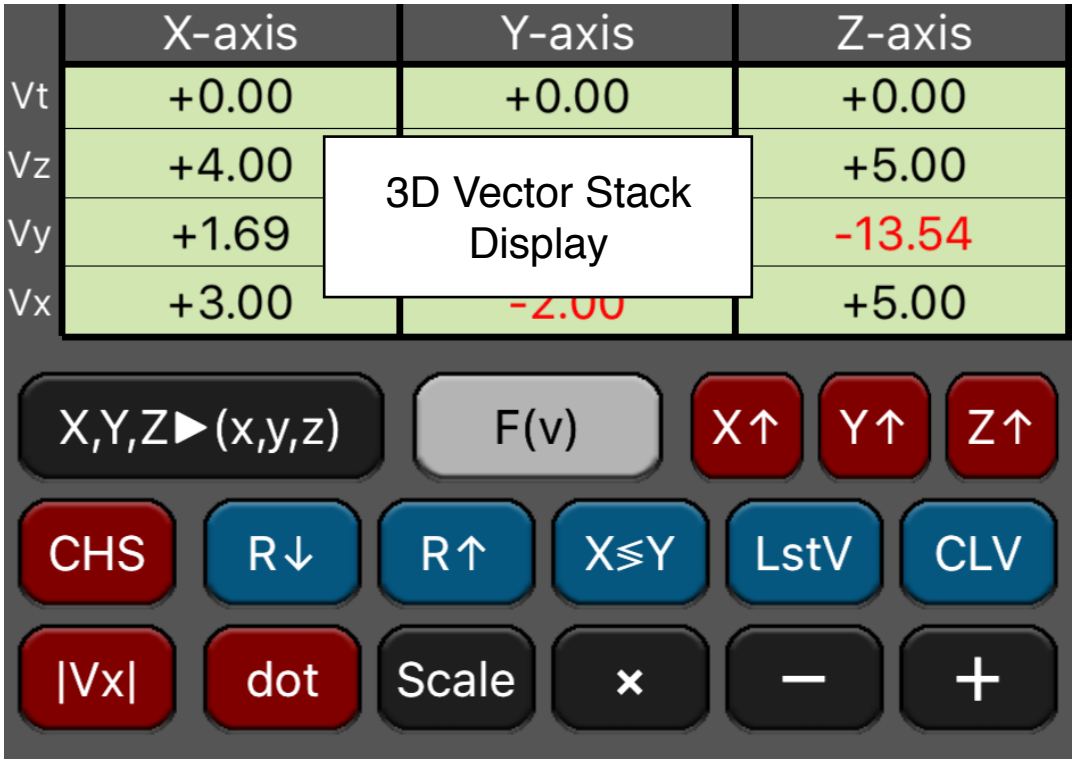
3D Vector Math Menu

This menu implements a 3D Vector stack to perform operations and functions over it. To show it, touch the "**OPT**" key, and in the "**1) Scientific:**" section touch the "**3D Vector Math**" button.



This 3d Vector-Stack is similar to the normal calculator's stack, but specially designed for operations with vectors. The number are entered in the Vector Stack from the calculator using the **[→in]** button, the calculator's stack-X value is used as the vector X coordinate, the value in stack-Y is used for the vector Y coordinate and the value in the stack-Z is used for the vector Z coordinate.

The Vector Stack, operations and functions are completely independent from the calculator and behaves in RPN logic as well.

3D Vector Math Buttons	
3D Vector Stack Display	Touch the 3D Vector Stack Display to choose the coordinates: Cartesian, Spherical or Cylindrical.
[X,Y,Z▶(x,y,z)]	Inputs the Vx vector components from the calculator's stack X, Y and Z. After, drops the calculator's stack three times.
[F(v)▶]	Shows up a set of functions buttons to apply to the Vx vector.
[X↑]	Outputs the X-axis coordinate of Vx to the calculator's stack.
[Y↑]	Outputs the Y-axis coordinate of Vx to the calculator's stack.
[Z↑]	Outputs the Z-axis coordinate of Vx to the calculator's stack.
[CHS]	Change the sign of x, y and z coordinates of the Vx vector.
[R↓]	Rolls Down the vector-stack.
[R↑]	Rolls Up the vector-stack.
[X≶Y]	Swaps the Vx and Vy vectors.
[LstV]	Recalls the last Vx vector that was just before a Function or operation was performed.
[CLX]	Clears the Vx vector to (0,0,0).
[IVxI]	Calculates the Modulus of the Vx vector and enters the result in the calculator's stack-X.

3D Vector Math Buttons	
[dot]	Calculates the dot product of Vy and Vx vectors. The result in the calculator's stack-X.
[Scale]	Stores the Vx vector in 'LstV' and Multiplies the Vx vector by the calculator's stack-X value.
[x]	Cross Product Vy by Vx. Stores Vx in 'LstV', drop the vector stack and put the result of Vy ⊗ Vx in Vx.
[-]	Subtracts Vx from Vy. Stores Vx in 'LstV', drop the vector stack and put the result of Vy - Vx in Vx.
[+]	Adds Vy and Vx. Stores Vx in 'LstV', drop the vector stack and put the result of Vy + Vx in Vx.
[∢Y,X]	Calculates the angle between Vy and Vx vectors. Enters the result in stack-X.
Touching the **[F(v)]** button, shows additional Functions:	
[∢ Vy, Vx]	Change the sign of all three coordinates of the Vx vector.
[Unit Vx]	Stores Vx in 'LstV' and calculates the directional cosines of Vx vector.
[Vx Angles]	Enters in the calculator's stack the angles of the Vx with the X,Y and Z-axis coordinates.
[Vy ∡ Vx]	Stores Vx in 'LstV' and calculates the projection of Vy vector over the Vx vector.

3D Vector Math Buttons	
[X-axis ⟳]	Rotates Vx vector around the X-axis in the angle of stack-X value.
[Y-axis ⟳]	Rotates Vx vector around the Y-axis in the angle of stack-X value.
[Z-axis ⟳]	Rotates Vx vector around the Z-axis in the angle of stack-X value.

Example 1:
Determine the angles that vector (3, -2, 5) forms with the coordinates axis X, Y and Z.

Solution:

5 **[ENTER]** 2 **[CHS]** **[ENTER]** 3 **[X,Y,Z▶(x,y,z)]**	Enter the vector (3,-2,5) into the vector Stack.
[F(v)] **[Vx Angles]**	Calculates the angles in the current angle units. **Result :** (DEG angle mode) calculator's stack **X** = **60.88** with X-axis. calculator's stack **Y** = **108.93** with Y-axis. calculator's stack **Z** = **35.80** with Z-axis.

Example 2:
A vector AB is directed from point A(-1, -2, 1) to point B(-2, 3, 4), find the Angle between A and B and the unit vector of the vector AB.

Solution:

Keystrokes	Description
4 **[ENTER]** 3 **[ENTER]** 2 **[CHS]** **[X,Y,Z▶(x,y,z)]**	Enter the vector B(-2, 3, 4) into the vector Stack.
1 **[ENTER]** 2 **[CHS]** **[ENTER]** 1 **[CHS]** **[X,Y,Z▶(x,y,z)]**	Enter the vector (-1, -2, 1) into the vector Stack.
[∢ Vy, Vx]	Calculates the angle between A and B vectors. **Result: 90.00** (DEG angle mode)
[-]	Calculates vector AB.
[F(v)] "**Vx Unit Vector**"	Calculates the Unit vector of AB. **Result :** coordinate **X** = **-0.1690** coordinate **Y** = **0.8452** coordinate **Z** = **0.5071**

Example 3:
Calculate the cross product of a vector in spherical coordinates (5, 60º, 45º) with a vector in cylindrical coordinates (8, 22º, 3). Show the result in cartesian, spherical and cylindrical coordinates :

Solution: (assumes FIX 2 number format)

Keystrokes	Description
3D Vector Stack Display '**Spherical**'	Touch the display to set display format to Spherical coordinates.

Keystrokes	Description
45 **[ENTER]** 60 **[ENTER]** 5 **[X,Y,Z▶(x,y,z)]**	Enters the vector (5, 60º, 45º) in spherical coordinates into the vector stack.
3D Vector Stack Display '**Cylindrical**'	Touch the display to set display format to Cylindrical coordinates.
3 **[ENTER]** 22 **[ENTER]** 8 **[X,Y,Z▶(x,y,z)]**	Enters the vector (8, 22º, 3) in cylindrical coordinates into the vector stack.
[x]	Calculates the Cross Product. **Cylindrical** coordinates **Result:** coordinate **R** = **9.51** coordinate **Φ** = **79.74º** coordinate **Z** = **-13.54**
3D Vector Stack Display '**Spherical**'	**Spherical** coordinates **Result:** coordinate **R** = **16.54** coordinate **θ** = **144.91º** coordinate **Φ** = **79.74º**
3D Vector Stack Display '**Cartesian**'	**Cartesian** coordinates **Result :** coordinate **X** = **1.69** coordinate **Y** = **9.36** coordinate **Z** = **-13.54**