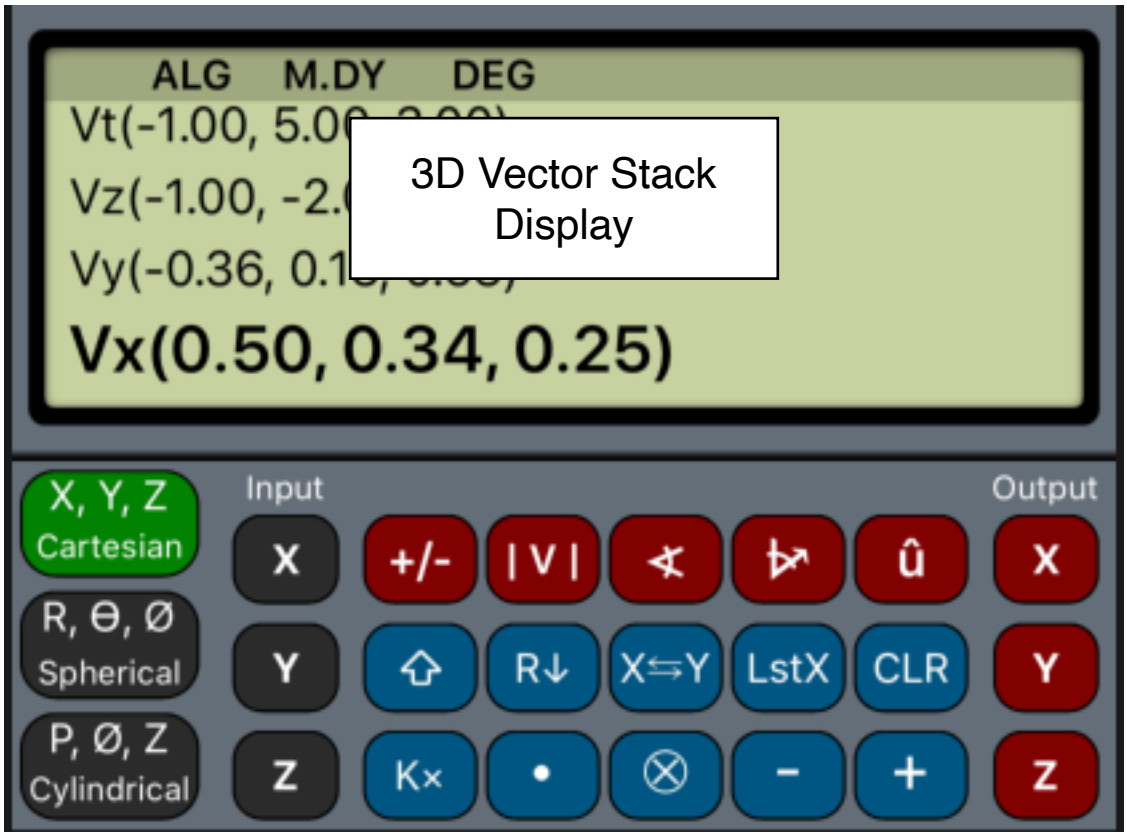
Vectors 3D Menu

This menu implements a 3D Vector stack to perform operations and functions over it. To show it, touch the "**SCI ▶**" button in the main menu and select the "**Vectors 3D**" option.



The "3D Vector Stack" is similar to the normal calculator's stack, but specially designed for operations with vectors. The coordinates are entered in the "Vector Stack" from the calculator using the **[X]**, **[Y]** and **[Z]** "input" buttons.

The Vector Stack, operations and functions are completely independent from the calculator stack.

Vector 3D Buttons	
[X, Y, Z] **[R, Θ, Ø]** **[P, Θ, Z]**	Set Cartesian coordinates Set Spherical coordinates Set Cylindrical coordinates
Input **[X]** **[Y]** **[Z]** **[R]** **[P]** **[Θ]** **[Ø]**	Input the calculator's displayed number to: - Vector cartesian coordinate 'X'. - Vector cartesian coordinate 'Y'. - Vector cartesian coordinate 'Z'. - Vector magnitude 'R' coordinate. - Vector polar magnitude 'P' coordinate. - Vector polar angle 'Θ' coordinate. - Vector azimuth angle 'Φ' coordinate.
Output **[X]** **[Y]** **[Z]** **[R]** **[P]** **[Θ]** **[Ø]**	Outputs to calculator's stack-X the: - Vector cartesian coordinate 'X'. - Vector cartesian coordinate 'Y'. - Vector cartesian coordinate 'Z'. - Vector magnitude 'R' coordinate. - Vector polar magnitude 'P' coordinate. - Vector polar angle 'Θ' coordinate. - Vector azimuth angle 'Φ' coordinate.
[+ / -]	Multiplies the vector **Vx** by -1.
[| V |]	Calculates the Magnitude of the **Vx** vector.
[∢]	Calculates the angle between the **Vx** and **Vy** vectors.
[⊳]	Calculates the projection of vector **Vy** onto vector **Vx**.
[û]	Calculates the unitary vector of **Vx** (same direction with magnitude 1.0).

Vector 3D Buttons	
[R↓]	Rolls down the vector-stack.
[⇧]	Lift the vector-stack duplicating the vector **Vx**.
[X⇆Y]	Swaps the **Vx** and **Vy** in the vector stack.
[LstX]	Recalls the last **Vx** vector that was just before an operation.
[CLR]	Clears the **Vx** vector to (0,0,0).
[K×]	Scales the **Vx** vector by the calculator's stack-X value.
[•]	Calculates the **Dot product** of **Vx** and **Vy** vectors and enters the result in the calculator's stack.
[⊗]	Calculates the **Cross product** of **Vx** and **Vy**. Drop the vector stack and put the result in **Vx**.
[-]	Calculates **Vy** minus **Vx**. Drop the vector stack and put the result in **Vx**.
[+]	Calculates **Vy** plus **Vx**. Drop the vector stack and put the result in **Vx**.

Example 1: (Scale, Magnitude and different coordinates system)
Considering the vector (3,4,5) in cartesian coordinates:

1. Scale by 3 and Express the result in spherical coordinates.
2. Calculate de magnitude of the result.
3. Scale the original vector by 0.5 and express it in cylindrical coordinates

Solution (DEG angle unit, FIX number format with 2 decimals) :

[Shift] [CLEAR DATA]	Clear display data.
[X,Y,Z]	Set the coordinate system to Cartesian.
3 **[X]** 4 **[Y]** 5 **[Z]** 3 **[K×]** **[R, Θ, Ø]**	Input the vector A: Vt(0.00, 0.00, 0.00) Vz(0.00, 0.00, 0.00) Vy(0.00, 0.00, 0.00) **Vx(21.21, ∠45.00, ∠53.13.00)** (Answer 1)
[I V I]	**IVxI = 21.21** (Answer 2)
[LstX] 0.5 **[K×]** **[P, Θ, Z]**	Recuperate original vector. Scale by 0.5 **Vx(2.50, ∠53.13, 2.5)** (Answer 3)

Example 2: (Angle and Projection)
Given vector-A = (3, -2, 5) in cartesian coordinates and vector-B = (15, ∠25°, ∠42°) in spherical coordinates, find the angle between them and the projection of vector-B onto vector-A.

Solution (DEG angle unit) :

[X,Y,Z]	Set the coordinate system to Cartesian.
3 **[X]**	Input X-coordinate.
2 **[+/-] [Y]**	Input Y-coordinate.
5 **[Z]**	Input Z-coordinate.
[R, Θ, Ø]	Set the coordinate system to Spherical.
15 **[R]**	Input R-coordinate.
25 **[+/-] [Θ]**	Input Θ-coordinate.
42 **[Ø]**	Input Ø-coordinate.

[∢]	Angle between vectors. ∢ **= 37.23**
[▷]	Projection of vector-B onto vector-A. **Vx(11.94, ∠35.80, ∠-33.69.00)**

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

Solution:

Keystrokes	Description
[X,Y,Z] 1 **[+/-] [X]** 2 **[+/-] [Y]** 1 **[Z]** 2 **[+/-] [X]** 3 **[Y]** 4 **[Z]**	Input vector A(-2, 3, 4) and B(-1,-2,1) into the vector Stack.
[X⇆Y]	Change the order of vector A and B in the stack.
[-]	Calculates the angle between A and B vectors. **Vx(-1.00, 5.00, 3.00)**
[û]	Calculates unitary vector of AB. **Vx(-0.17, 0.85, 0.51)**

Example 4: (Add and crossproduct)
Add a vector-A = (5, 60º, 45º) in spherical coordinates to a vector-B = (8, 22º, 3) in cylindrical coordinates. Then calculate the cross product with a cartesian vector-C = (0.5,0.34,0.25). Show the results in cartesian coordinates :

Solution: (assumes FIX 2 number format)

Keystrokes	Description
[R, Θ, Ø] 5 **[R]** 60 **[Θ]** 45 **[Ø]**	Set Spherical coordinates. Input vector-A **Vx(5.00, ∠60.00, ∠45.00)**
[R, Θ, Z] 8 **[P]** 22 **[Θ]** 3 **[Z]**	Set Cylindrical coordinates. Input vector-B **Vx(8.00, ∠22.00, 3.00)**
[+]	Add Vx and Vy. **Vx(12.10, ∠30.03, 5.50)**
[X,Y,Z]	Set Cartesian coordinates. **Vx(10.48, 6.06, 5.50)**
0.5 **[X]** 0.34 **[Y]** 0.25 **[Z]**	Input vector-C. **Vx(0.50, 0.34, 0.25)**
[⊗]	Calculate the cross product (A + B) ⊗ C **Vx(-0.36, 0.13, 0.53)**