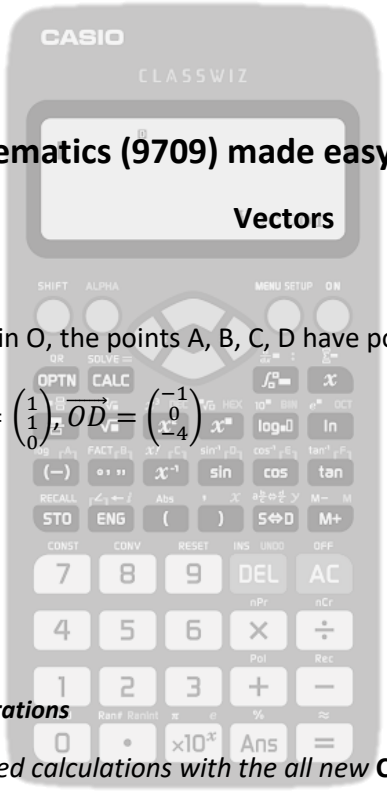
A levels Mathematics (9709) made easy with ClassWiz (Fx-991EX)



The Basics

Q1. With respect to the Origin O, the points A, B, C, D have position vectors given by

$\overrightarrow{OA} = \begin{pmatrix} 4 \\ 0 \\ 1 \end{pmatrix}$, $\overrightarrow{OB} = \begin{pmatrix} 5 \\ -2 \\ -2 \end{pmatrix}$, $\overrightarrow{OC} = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$, $\overrightarrow{OD} = \begin{pmatrix} -1 \\ 0 \\ -4 \end{pmatrix}$

Calculate

1) AB
2) CD

Solution:

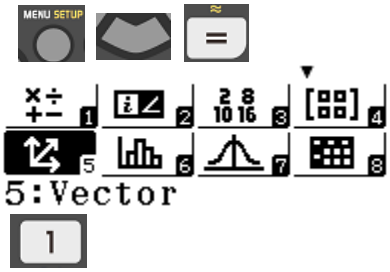
Understanding ClassWiz's operations

You can easily do vector-based calculations with the all new **Casio ClassWiz FX-991EX.**

Follow the steps below

a) Put your ClassWiz on the ***Vector*** mode.

"Right after you select Vector mode, the display asks you to define ***Vectors****.*
(Look at the figures on right of the page for help)
Here we are going to save the vectors ***OA****,* ***OB****,* ***OC****, and* ***OD*** *as* ***VctA, VctB, VctC,*** *and* ***VctD****"*



b) Select 1. Select Dimension (whether it has 2, or 3 coordinates) and add the coordinates. In this case, they are as follows (Results showed in fig1, and fig2).

3 4 = 0 = 1 =

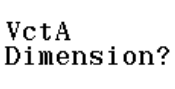


Fig1

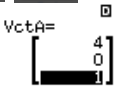
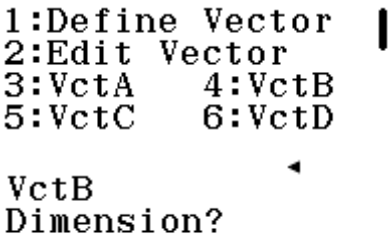


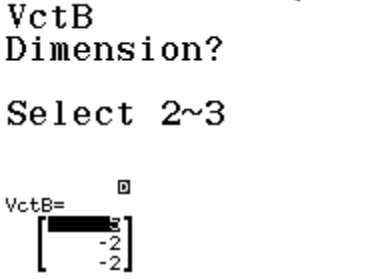
Fig2

1

c) Press OPTN, you'll see this menu (on right), and select 1 (Define Vector) following with 2 to define the vector $\overrightarrow{OB}$ (select dimensions, and add coordinates).



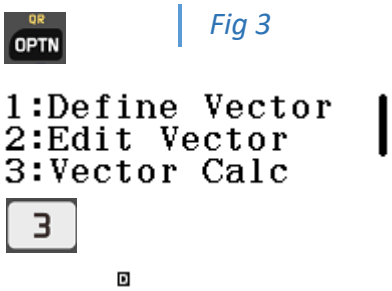
d) Repeat the step **c.**



i) In theory we know that for a vector $\overrightarrow{AB}$, the arithmetic expression would be $\overrightarrow{OB} - \overrightarrow{OA}$.

Now after you have saved all the vectors, it's time for the Calculation.
Press [OPTN], and select '*Vector Calc*' by pressing 3. (*See fig 3)*

Fig 3



Again press [OPTN], and for the arithmetic operations above write
([4] [−] [OPTN] [3] [=])
the expression as **VctB – VctA**.

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Woohoo! You just learned the very basics for vector calculation. Vector
Now try finding the vector $\overrightarrow{CD}$ yourself.

(**Ans.** ClassWiz's operations for vector $\overrightarrow{CD}$ are: [OPTN] [6] [−] [OPTN] [5] [=])

Now let's see How the functions of Casio's all new ClassWiz (Fx-991EX) series help solve A Levels Mathematics (P3) Vectors' questions.

- **As an example, and to showcase the mind-blowing functions, we have chosen the following question from CIE past papers.**

Oct/Nov 2003

10 The lines l and m have vector equations

$$\mathbf{r} = \mathbf{i} - 2\mathbf{k} + s(2\mathbf{i} + \mathbf{j} + 3\mathbf{k}) \quad \text{and} \quad \mathbf{r} = 6\mathbf{i} - 5\mathbf{j} + 4\mathbf{k} + t(\mathbf{i} - 2\mathbf{j} + \mathbf{k})$$

respectively.

(i) Show that l and m intersect, and find the position vector of their point of intersection. [5]

(ii) Find the equation of the plane containing l and m, giving your answer in the form $ax + by + cz = d$. [6]

As you can see, this question carries 11 marks (in total). What if you can solve the question quickly with 100% accuracy? Seems unlikely, No? Well, No.
With all new **Casio ClassWiz (Fx-991EX)** now you can actually solve the question speedily and maintaining 100% accuracy (okay… at least 99.99% just like safeguard).

Let's start!

(i) **Show that *l* and *m* intersect, and find the position vector of their point of intersection. [5]**

Now for such a question, you form 3 equations for x, y, and z in terms of **s**, and **t** (in this case), and solve them simultaneously to get the points of intersection (if present).

a) For such a case the 3 simultaneous equations would be:

X = 1 + 2s	X = 6 + t
Y = s	Y = -5 - 2t
Z = -2 + 3s	Z = 4 + t

Here we have 2 unknowns to find i.e., **s**, and **t** so we'll choose any 2 equations and solve them.
Make three equations (X = X, Y = Y, Z = Z). The resulting equations would be as follows

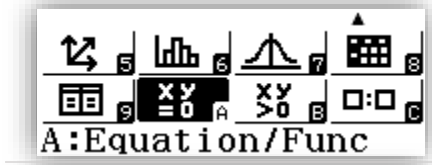
2s - t = 5 -(i)

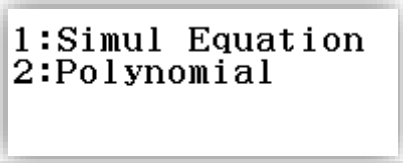
s + 2t = -5 -(ii)

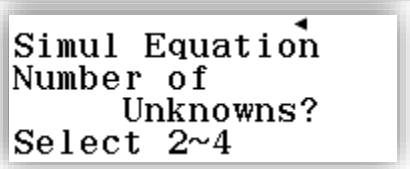
3s – t = 6 -(iii)

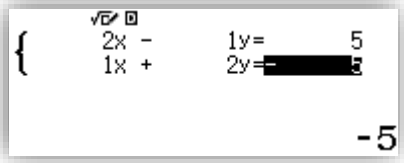
Now with your **ClassWiz (Fx-991EX)** go the **Equation/Func** mode; Select **Simul Equation;** Enter the number of unknowns (in this case 2), and press **=** to get the result.

(Follow this: MENU (-) 1 2 2 = − 1 = 5 = 1 = 2 = − 5 = = =)

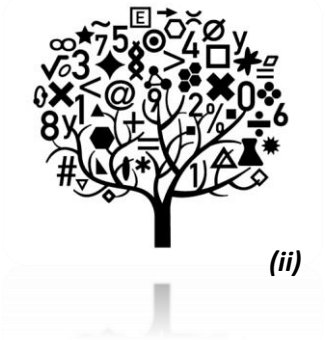








At last, we have calculated the value of **s**, and **t** (disguised as **x**, and **y**). Put these value in 3rd simultaneous equations - you have used only first two equations – to confirm the answer.
Put the value of **s**, or **t** in line ***l***, or ***m*** to ***get the position vector of their point of Intersection***.



(ii) **Find the equation of the plane containing *l,* and *m*, giving your answers in the form *ax + by + cz = d***

As we know, the plane of an equation is in the form $\vec{r}.\vec{n} = \vec{n}.\overrightarrow{OA}$ – where $\overrightarrow{OA}$ is any point on the plane.

To form this equation, we need to find the normal of the plane, and for the normal we know the ***Cross Product*** of direction vectors of 2 lines (that lies on the plane) gives us the ***normal*** to the plane.

Taking **V1** as direction vector of ***line l*** and **V2** as direction vector of ***line m,*** we get:

V1 = 2i + j + 3k
V2 = i – 2j + k

Now open **ClassWiz (Fx-991Ex)** and define **V1** as **VctA**, and **V2** as **VctB.**
(Follow these buttons: MENU 5 1 3 2 = 1 = 3 = OPTN 1 2 3 1 = (−) 2 = 1 =)

Now to find the **Cross-Product** (or **normal**), type **VctA x VctB** (refer/see to the guide/picture as follows)

OPTN 3 × OPTN 4 =

7

Finally, you have calculated the value for the **normal**. $\vec{r}.\vec{n} = \vec{n}.\overrightarrow{OA}$.
Now you need to calculate the value for the **dot-product** of **Normal**, and $\overrightarrow{OA}$.

For a general point on the plane, put **s** in ***line l*** or **t** in ***line m*** equal to 0.
Here I am putting **s = 0**, and the point I get is **i – 2k.** I'll define this point as **VctC.**

Now, Select OPTN, , and 1 for **VctAns** (The vector of normal you just calculated) [OPTN ▼ 1]

Again OPTN, , and select 2, for **Dot Product**. [OPTN ▼ 2]

Once again OPTN, and select 5 for **VctC.** [OPTN 5]

And press =

You get:

Now you can rewrite the equation as

$$\vec{r}.(7\boldsymbol{i} + \boldsymbol{j} - 5\boldsymbol{k}) = 17$$

And simplifying it in the form ***ax + by + cz = d***

i.e., **7x + y – 5z = 17**

- Further carrying on the question, **what if we were required to find the *Acute angle* between line *l*, and line *m*?**

To find the angle between 2 intersecting lines, you can use **ClassWiz's *Angle*** function.

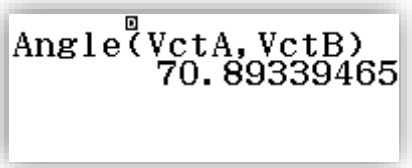
You have already saved the direction vectors of line ***l***, and line ***m*** as **V1**, and **V2** in **VctA**, and **VctB.**
We'll make use of that.

Generally, the formula we use is $\cos\theta = \frac{V1.V2}{|V1|.|V2|}$

So how can you find the angle with **ClassWiz** (**Fx-991EX)**?
Refer to the following guide:

While still in the *vector* mode, Select OPTN, , and 3 . [OPTN ▼ 3]

Then type in **VctA , VctB** and press =. [OPTN 3 SHIFT) OPTN 4) =]
At last! You have calculated the angle between the **line *l***, and **line *m***.



Miscellaneous commands

1. Press SHIFT followed by RESET 9 for **Reset.**
2. Press SHIFT followed by = for direct **answer** in **decimals** rather than **fractions**.
3. Press SHIFT followed by CONV 8 for **conversions**.
4. Press SHIFT followed by CONST 7 for **constants**.
5. Press SHIFT followed by MENU SETUP, followed by 2 to choose between **Degree**, **Radian**, or **Gradian.**