

C4 Vectors with Autograph

Status box and Results box are useful

View > Status box

View > Results box

2D Vectors



Creates a new 2D page





Equal Aspect is useful

The basics

- Definition (component vs magnitude & direction form)
 - Places a point on the screen
 - or
 - Allows you to enter coordinates
(Remember to return to Cursor mode:)
Right-click on the point and select **Vector...**
Vectors can be added in component or magnitude and direction form
- Equal vectors
Vectors can be moved by dragging the start-point
- Position vectors
Dragging the start-point to the origin is equivalent to a position vector
- Multiplying by a scalar
Select the start-point and the vector
Right-click and select **Multiply Vector**
- Negative vectors
Select the start-point and the vector
Right-click and select **Negative Vector**
- Adding
Create two vectors (better with different start-points)
Select one point and two vectors
Right-click and select **Add Vectors**
The vectors can be moved to show a closed triangle
- Subtracting
As with adding vectors
A negative vector can be used to show a closed triangle
- Unit vectors
Select the start-point and the vector
Right-click and select **Unit Vector**
The unit vector is shown in the results bar


Co-ordinate Geometry

- Vector joining 2 points
Place two points on the screen
Select both points (select the 1st then hold down shift-select the 2nd)
Right-click and select **Create Vector**
The “Join Vector” is shown in the status bar at the bottom
- Vector equation of a line
Select  and enter a vector equation of a line
or
Select a point and a vector, right-click and select **Line from Vector**
- The concept of the vector equation of a line
Create a line defined by a vector equation
e.g. $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -4 \\ -1 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ 2 \end{pmatrix}$
Create points at (0, 0), (-4, -1) and (-4 + 3a, -1 + 2a)
NB a is representing λ
Create vectors joining each pair of points
Vary a using the constant controller 
All three Join Vectors can be investigated as a changes
- Cartesian vs. vector form of a line
Vector and Cartesian forms can be entered on the same axes
- Intersection of 2 lines
Select 2 lines, right-click and select **Solve intersections**

Angles and Scalar Product

- Scalar product
Select 2 vectors, right-click and select **Scalar product**
- Angle between two vectors
Select 2 vectors, right-click and select **Angle between vectors**
- Perpendicular vectors
Select a point and a vector, right-click and select **Perpendicular vector**


3D Vectors

 Creates a new 3D page



Vectors and points can be added in the same way as on 2D pages

Entering co-ordinates is often easier than adding points

Vectors and lines in 3D

- Points in 3D
Add a point, right-click and select **Draw Coordinate box**
Axes > Edit Axes > Option > Always Outside switched off can be useful
- Angle between 2 vectors
Select 2 vectors, right-click and select **Scalar product**
Using 2 vectors with the same start-point and placing a plane on the screen can help to visualise this
- Equation of a line
Select  and enter a vector equation of a line
or
Select a point and a vector, right-click and select **Line from Vector**
- Intersection
Select 2 lines, right-click and select **Intersections**
- Angle between 2 lines
Select 2 lines, right-click and select **Angle between lines**

Planes

- Vector form (3 points)
Select  and enter a vector equation of a plane
or
Select 3 points, right-click and select **Plane**
or
Select 2 vectors with the same start-point and the start-point, right-click and select **Plane**
- Cartesian form
Select  or press Enter and enter a Cartesian equation of a plane
- Perpendicular to a plane
Select a plane and a point on it, right-click and select **Normal line**
or **Normal Unit Vector**
or
Select a vector and a point, right-click and select **Plane from vector**
- Intersection of a line and a plane
Select a line and a plane, right-click and select **Intersection**
- Distance of a point from a plane
Select a point and a plane, right-click and select **Closest distance**