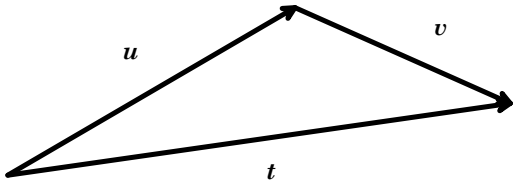
Activity 8 Component vector basics

Aim: Explore component representation of vectors.

We have seen in previous activities that vector quantities can be added by constructing diagrams where they are placed head to tail. The resultant is then a vector from the start to the finish of the diagram.

For example, in the diagram below, $\boldsymbol{t} = \boldsymbol{u} + \boldsymbol{v}$

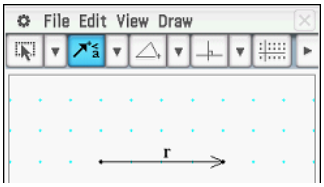


Given the magnitude and direction of vectors $\boldsymbol{u}$ *and* $\boldsymbol{v}$*, we can use scale diagrams or trigonometry to determine the magnitude and direction of vector* $\boldsymbol{t}$*.*

We will now investigate an alternative to the magnitude and direction system, called component vectors.

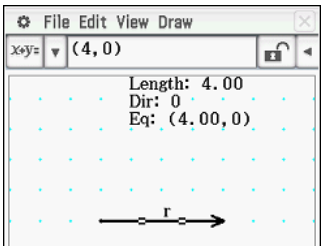
Draw a vector on a new Geometry page

- Open Geometry
- Select [File | New]
- Insert a vector **r** directed towards right of screen



Display measurements on the screen

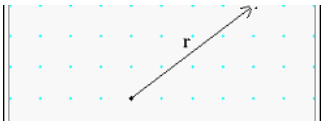
- Tap to select **r**
- In the Measure pull down menu, select length
- Tap to insert the measurement
- Repeat the previous step for the direction
- Repeat to insert the equation
  (in this case the vector's component form)



The measurements are linked dynamically to the vector. Note that the direction is measured anti-clockwise relative to the positive x-axis.

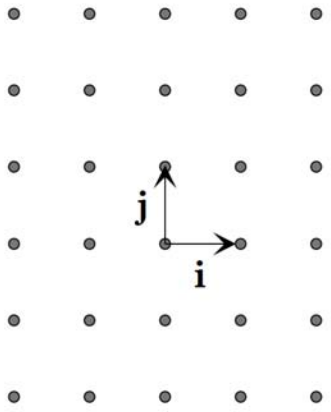
Alter the vector

- Tap to select the head of **r**
- Drag this point so that the vector is four units to the right and three units up



1. Write down all the measurements for this vector from the calculator.

The component vector system describes vectors in terms of the number of horizontal and vertical units. We denote ***i*** *a unit vector in the positive x direction and* ***j*** *a unit vector in the positive y direction.*



So any vector ***r*** *in two dimensions can be written as* $\mathbf{r} = x\mathbf{i} + y\mathbf{j}$.

Note the use of bold type to represent vector quantities. This is difficult using pen and paper, so we often use tildes ($\underset{\sim}{\mathrm{r}} = x\underset{\sim}{\mathrm{i}} + y\underset{\sim}{\mathrm{j}}$*) to distinguish between scalar and vector quantities.*

The vector $\mathbf{r}$ *in Q1 can be written as* $\mathbf{r} = 4\mathbf{i} + 3\mathbf{j}$*, or as a matrix* $\mathbf{r} = \begin{bmatrix} 4,3 \end{bmatrix}$ or $\mathbf{r} = \begin{bmatrix} 4 \\ 3 \end{bmatrix}$

or as an ordered pair in triangular brackets $\mathbf{r} = \langle 4,3 \rangle$.

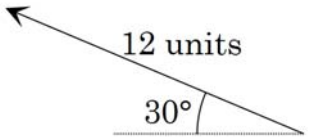
2. With vector $\mathbf{r} = x\mathbf{i} + y\mathbf{j}$, describe a process for determining the magnitude $|\mathbf{r}|$ and the direction of $\mathbf{r}$.

3. Move the head of your vector around so that the vector is 3 units to the left and 2 units down. Draw a diagram of this vector and write down all the measurements from the calculator. Pay particular attention to the sign of the components.

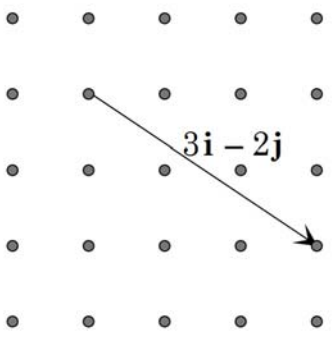
4. Describe a process for converting a vector given in magnitude and direction form into component form.

5. Convert the following vectors and check your answers using the Geometry application.

   a) Convert to component form



   b) Convert to magnitude and direction form.



Vector operations

Enter and store the following vectors in the Main screen.

p = [3 , 4] **q** = [2 , –1] **r** =[–6 , 0] **s** = [8 , ∠(240)] (Note the output)

Detailed calculator instructions can be found in the Learning notes section.

6. Perform the following calculations in the Main screen and record the output. Draw a diagram to help explain the calculation.

a) **p** + **q**

b) **q** – **r**

c) 2**s** + **r**

d) norm(**p**)

e) angle(**p**,**r**)

Change to "Decimal" setting

f) angle(**q**,[1,0])

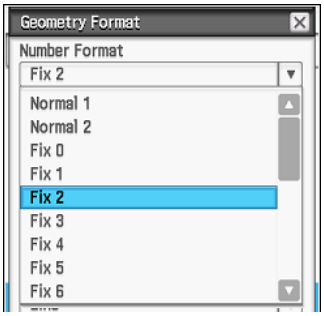
g) toPol(**q**)

Try using "Decimal" then "Standard" setting

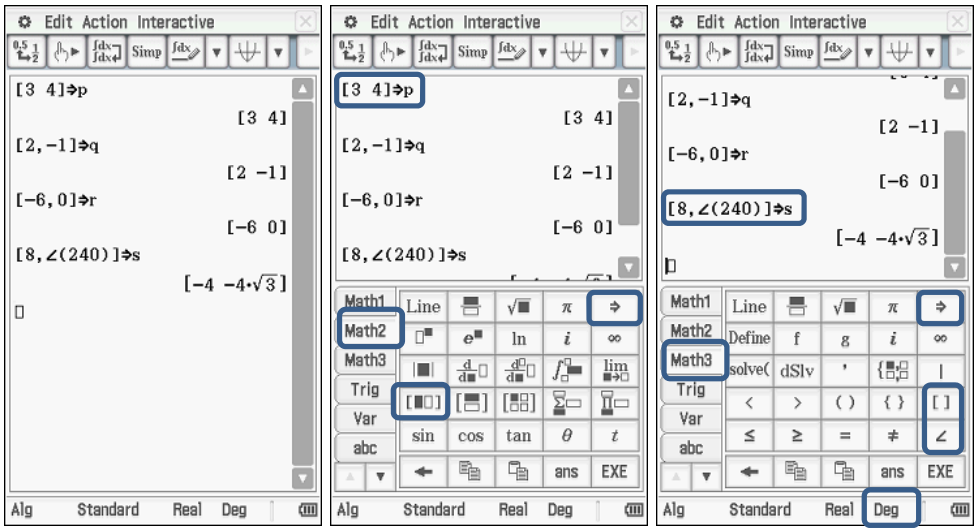
h) UnitV(**p**)

Learning notes

The number of decimal places displayed in the Geometry screen can be set in Number Format pull down menu in the [⚙ | Geometry Format] window.



Storing Vectors:



Vector Operations can be found in [Interactive | Vector] or [Action | Vector]: