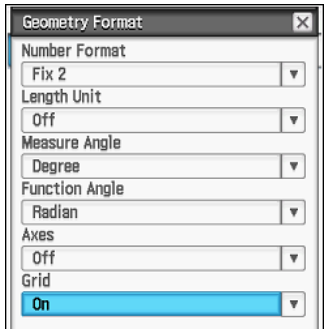
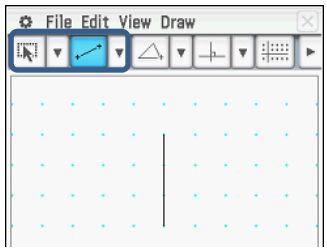
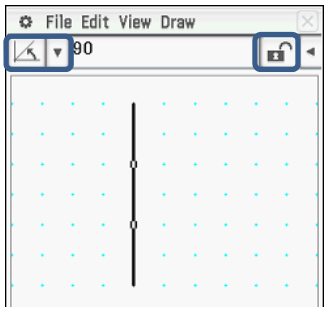
Activity 6 Magnitude and direction basics

Aim: Use scale diagrams to solve displacement problems.

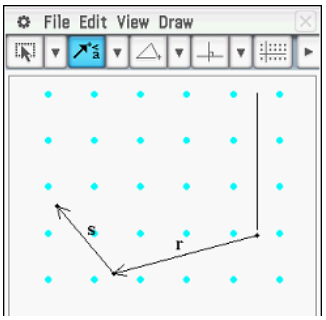
1. A windsurfing competition requires competitors to complete a triangular course around two buoys. From the start/finish line, competitors head to the first buoy located 3.2 km away on a bearing of 255˚. From there, the second buoy is 1.9 km away on a bearing of 320˚. Determine the distance and bearing of the third leg from the buoy to the start/finish line.

   Construct a scale diagram in Geometry

Setup • Open the Geometry application • Select [File | New] • Select [⚙ | Geometry Format] and set Measure Angle to Degrees Axes to Off and Grid to On	
Construct a north line • Select y the line segment tool • Tap near the middle of the screen • Tap due north to draw a line segment • Tap ▭. Tap to select points A and B • Select [Edit | Properties | Hide]	
Set direction to north • Tap to select the north-south line segment. Tap ▶ to go round the corner • Select direction Y from the Measurement drop down and ensure the angle is 90˚ (from the positive *x* axis) • Tap R to constrain	

Draw vectors to represent legs 1 and 2 of the course

- Tap ◀ to go back round the corner
- Select H the draw vector tool
- Tap on the base of the line segment
- Tap on a point towards the south-west
- Tap on the end of the vector
- Tap on a point towards the north-west
- Select [View | Zoom to Fit]



Set magnitude and direction

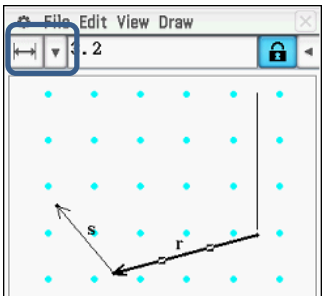
- Tap ▶ to go round the corner.

Set length of **r**

- Select vector **r**.
- Set the distance m to 3.2
- Tap R to constrain

Set bearing of **r**

- Select vector **r** and the north-south line
- Set the supplementary angle between them ↻ to 105° (360−255)
- Tap R to constrain

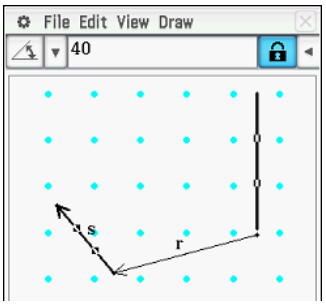


Set length of **s**

- Tap in open space
- Tap on vector **s**
- Set the distance m to 1.9 and constrain

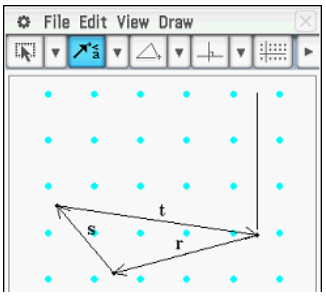
Set bearing of **s**

- Select vector **s** and the north-south line
- Set the angle between Q to 40° (360−320) and constrain



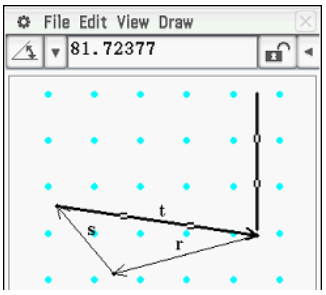
Construct return vector

- Tap ◀ to go back round the corner
- Tap H
- Construct a vector from the head of vector **s** back to the start/finish line



Measure return vector

- Tap ▶ to go round the corner
- Tap to select vector **t**
- Select distance m to determine the length of the third leg
- Select vector **t** and the north-south line to determine the angle between them

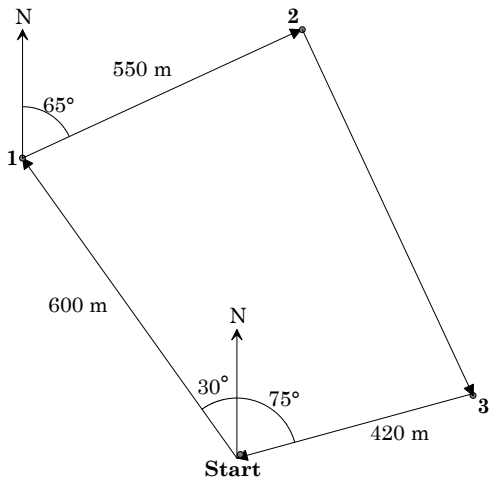


a) Draw a diagram below and label with all relevant distances and angles.

b) State the solution from the Geometry application.

c) Solve the problem manually using the sine and cosine rules.

2. An orienteering course involves participants travelling to a series of checkpoints then returning to the start. The course is shown below.



a) Construct a scale diagram in the Geometry application to help you determine the distance and bearing from checkpoint **2** to checkpoint **3**.

b) Describe a process for solving this problem manually.

Learning notes

Scalar quantities do not have a direction. Vector quantities have both a magnitude (size) and a direction.

Some examples:

Scalar
Distance
Speed
Mass

Vector
Displacement
Velocity
Force
Acceleration

The focus in this activity is on displacement vectors.

The use of a north-south line segment is optional. Vector angles can be constrained using the direction tool Y from the Measurement drop down; however, these are measured from the positive x axis, i.e. a polar co-ordinate system as in the unit circle. You are encouraged to experiment and decide on your preferred method.

The Geometry application provides a scale diagram approach to solving trigonometry problems. Whilst initially this may take time to get used to, with practice it can be more efficient than the manual method involving sine and cosine rules. In particular it allows simple solutions to complex problems involving four or more 'legs' that would have traditionally been considered very time-consuming to attempt manually.

This activity could have been completed using line segments rather than vectors. The advantage of the vector representation will become apparent in subsequent activities.