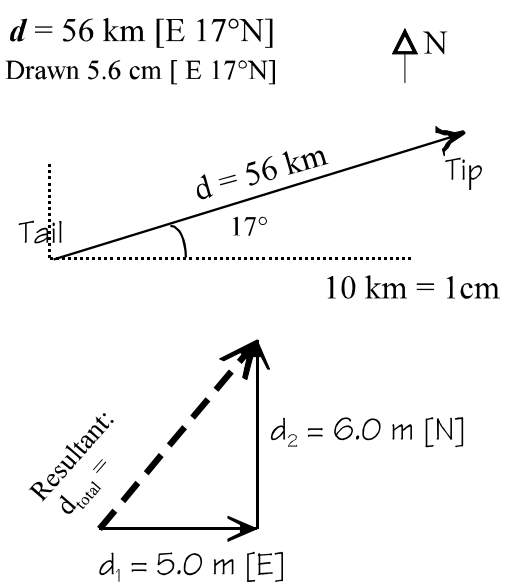
Displacement, Distance and the Addition of Vectors

In grade 10 science we must add vectors graphically – with a scale diagram. Algebraic addition cannot be used, although you may use it to check your answers – next year (gr.11 physics) we will add vectors algebraically with trigonometry.

Vectors having different directions can be added using a graphical method called the **tip to tail** method:

- Draw one vector (to scale) – we'll call this the first vector. Be sure to include a label with magnitude if possible.
- At the **tip** of the first vector, determine the direction of the second vector.
- Draw the second vector, using the same scale as the first, with the **tail** of the second at the **tip** of the first vector.
- Draw a line from the **tail** of the first (starting point) to the **tip** of the second (ending point). This new vector represents the sum or **resultant** of the two vectors.
- Measure the **magnitude** and **direction** of the resultant.

- Vectors can be added in any order. Do the vector addition in question #3 two different ways to verify this.



Practice Questions:

7. A bear went searching for honey and walks due east for 6.0 km and then 4.0 km due west. Calculate the total distance and resultant displacement.

8. Find the displacement of an airplane that flies 5.0 km due east and then turns and flies 7.0 km due north.

9. In a bike race, Sebastian pedalled 35 km [E] followed by 40 km [S]. Calculate the total distance travelled, his resultant displacement, and final position.

10. Sourdough Sadie left her cabin to look for gold. She walked 8.0 km [S], then 12 km [E], and finally 3.0 km [N]. Calculate Sadie's displacement.

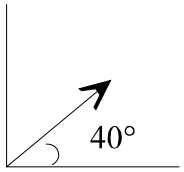
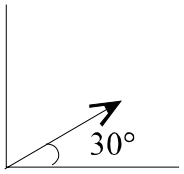
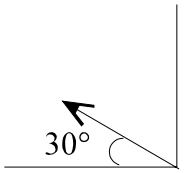
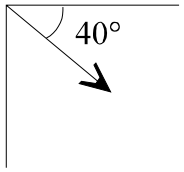
11. Sue left home and jogged 3.0 km [S], then 4.0 km [W], and finally 5 km [N 37° E]. Draw a vector diagram to determine Sue's total displacement.

12. Explain why you get the same resultant displacement if two displacements are added in the reverse order.

Note:
Collinear vectors are vectors which are along the same straight line (ie parallel or anti-parallel) as in question #1. Collinear vectors can be added without a vector diagram since 4 km [W] = – 4 km [E]. Now add the collinear vectors as you would normal integers.

Vectors and Directions

There are several different conventions for writing directions.
Complete the following directions and diagrams.

Diagram	Compass Direction	Nelson Science textbook method	Bearing (navigation)	RCS direction (math)
	[E 40° N] or [N 50° E] (why?)	[40° N of E] or [50° E of N]	bearing of 050 (clockwise from north)	40° RCS (counter-clockwise from +ve x-axis)
				
				
				
	[W 20° S] or			
		[30° W of S] or		
	[N]			
	[W]			
	[SW]			