Problems for chapter 2.

Summary:

$$A_x = A\cos\theta \quad , \quad A_y = A\sin\theta$$

$$A = \sqrt{A_x^2 + A_y^2}$$

$$\tan\theta = \frac{A_y}{A_x}$$

$$(\mathbf{A}\pm\mathbf{B})_x = A_x \pm B_x \quad , \quad (\mathbf{A}\pm\mathbf{B})_y = A_y \pm B_y$$

1.* Draw with a suitable scale, the following vectors:

$A_x = 3.0$, $A_y = 4.0$ m
$F_x = -2.0$, $F_y = -3.0$ N
$C_x = -2.5$, $C_y = 4.6$ km
$\Gamma_x = 3.9$, $\Gamma_y = -4.2$ N m

2.* For each of the above vectors find the length, both by direct measurement and by calculation.

3.* For each of the above vectors find the angle they make with the x-axis, both by direct measurement (or estimation if you can't find a protractor) and by calculation.

4. Draw with a suitable scale, the following vectors:

$A_x = 5.0$, $A_y = 12.0$ m
$F_x = -2.5$, $F_y = 3.0$ N
$C_x = -3.5$, $C_y = -6.6$ km
$\Gamma_x = 4.0$, $\Gamma_y = -5.0$ N m

5. For each of the above vectors find the length, both by direct measurement and by calculation.

6. For each of the above vectors find the angle they make with the x-axis, both by direct measurement (or estimation if you can't find a protractor) and by calculation.

7.* Find the length of the sum and the length of the difference of the two vectors

$D_x = 24.3$, $D_y = -12.2$ km
and $G_x = -33.1$, $Gy = 13.1$ km.

8. Find the length of the sum and the length of the difference of the two vectors

$D_x = 14.3$, $D_y = -2.2$ km
and $G_x = 3.1$, $Gy = -3.1$ km.

9.* If a traveller goes 4.00 km due north, then 5.50 km north-east, and finally returns 6.25 km due south, how far are they from their starting point? (You will need to define x- and y-axes.) Draw a diagram of this journey, can you instruct the traveller how to return to base at the end of the trip?

10. If a traveller goes 14.00 km due north, then 15.50 km north-east, and finally returns 25.00 km due south, how far are they from their starting point? (You will need to define x- and y-axes.) Draw a diagram of this journey, can you instruct the traveller how to return to base at the end of the trip?

11.* Go back to question 7. and calculate the angles **D**+**G** and **G-B** make with the x-axis.

12. Go back to question 8. and calculate the angles **D**+**G** and **G-B** make with the x-axis.

13.* A formula to find the angle between two vectors, **A** and **B**, is

$$\cos\phi = \frac{A_x B_x + A_y B_y}{\sqrt{A_x^2 + A_y^2}\sqrt{B_x^2 + B_y^2}}$$

where ϕ is the angle between the two vectors. Use this formula to find the angle between $A_x = 1.5$ u , $A_y = 5.6$ u and $B_x = 4.2$ u , $B_y = 2.1$ u.
Now try finding the angle between **D** and **G** in question 7., this may take a little bit of sketching or thinking.

14. Find the angle between **D** and **G** in question 8.

15.*Vectors can also be written in the form **A** = (A_x,A_y) units. Find the sum of (2.3,4.5) m, (-1.1,5.4) m and (-2.0, 7.3) m. Find the sum of the first two of these vectors and subtract the third from this sum, what is the length of the result and what angle does the resulting vector make with the x-axis?

16. Find the sum of (3.2,5.4) m, (-1.1,3.4) m and (2.0, -4.3) m. Then find the sum of the first two of these vectors and subtract the third from this sum, what is the length of the result and what angle does the resulting vector make with the x-axis?

17.* A person walking south along the coast at a speed of 6.0 km per hour sees a ship heading north with a speed of 10 km per hour. The ship is to the east, 5.0 km from the straight, north-south coastline and is 2.5 km south of the person. What is the bearing (angle from the north turning through a clockwise direction) of the ship relative to the person? What is the speed of the ship relative to the person?

18. A person walking north along the coast at a speed of 5.0 km per hour sees a ship heading north with a speed of 12 km per hour. The ship is to the east, 6.0 km from the straight north-south coastline and is 9.5 km south of the person. What is the bearing (angle from the north

turning through a clockwise direction) of the ship relative to the person? What is the speed of the ship relative to the person?