**Examples**

Semenya is balanced on a taut rope. Her weight is 500 N and the rope makes an angle of 10° with the horizontal on both sides of her foot. Determine the tension in the rope.

**Solution:**

Semenya is at rest. Therefore the forces are in equilibrium, and the net force is zero. The three forces shown in the diagram therefore form a closed vector diagram. (Always draw a rough diagram so that you can see the vectors in relation to each other.) For the right-angled triangle ABC, AC = 250 N (half the weight). T₁ and T₂ are equal in magnitude. Therefore:

\[
\sin 10° = \frac{250}{T₁} \quad \text{OR} \quad T₁ = T₂ \quad \text{and} \quad T₁ + T₂ = 500 \text{ because } F_{\text{net}} = 0
\]

\[
T₁ \sin 10° + T₂ \sin 10° = 500
\]

\[
2T₁ \sin 10° = 500
\]

\[
T₁ = \frac{250}{\sin 10°}
\]

\[
T₁ = T₂ = 1439.69 \text{ N}
\]

**Exercise 4**

1. Use a scale diagram to determine the resultant of the following vectors. Test your answer by using either the head to tail or tail to tail method each time. Choose a suitable scale yourself.

1.1 10 N bearing 90° and 6 N bearing 30°
1.2 300 N bearing 135° and 450 N bearing 200°

2  Use the method in which the components of vectors are used, to find the magnitude and direction of the resultant:
2.1 120 N bearing 90°; 160 N bearing 180°; 410 N bearing 0° and 60 N bearing 270°
2.2  120 N bearing 70° and 160 N bearing 40°

2.3  410 N bearing 230° and 60 N bearing 300°
2.4 110 N bearing 190° and 60 N bearing 130°

3. Juan pushes a lawnmower with a weight of 120 N, so that the 350 N force that he exerts makes an angle of 65° with the horizontal. The friction experienced by the lawnmower is 90 N backwards. Calculate the magnitude of the normal force as well as the resultant of this set of forces using components.
4. The following system is in equilibrium. Determine the magnitude and direction of \( T_1 \) and \( T_2 \) respectively. Use a scale diagram and choose your own scale. First draw a free force diagram.

5. The following system is in equilibrium. Calculate the magnitude and direction of \( F_1 \) and \( F_2 \) by dividing the forces into their components. Use Pythagoras' theorem to calculate the horizontal component of \( F_2 \). First draw a free force diagram.

**Hint:** Only \( F_2 \) and the weight have vertical components.
Carli, with a mass of 20 kg, slides down a slide at a constant speed. The slide has a slope of 40° to the horizontal.

6.1 Draw a force diagram and a free force diagram of Carli on the slide.

6.2 Calculate the weight of Carli.

6.3 Determine the component of the weight perpendicular to the slide.

6.4 Determine the component of the weight parallel to the slide.

6.5 Write down, without doing a calculation, the magnitude and direction of the normal force exerted on Carli.

6.6 Write down, without doing a calculation, the magnitude and direction of the frictional force exerted on Carli.

6.7 Calculate the coefficient of static friction for this system.