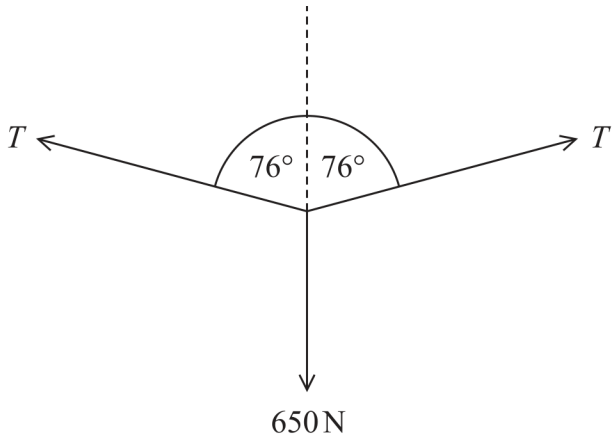
13 The Tyrolean traverse is a technique for crossing a deep valley. The photograph shows a climber crossing a river using this technique. The climber moves along a rope suspended from the bank on either side of the river.

(Source: © Folio Images/Alamy Stock Photo)

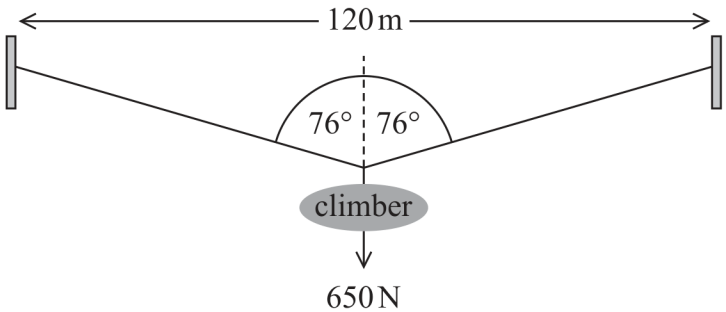
(a) The free-body force diagram for the climber is shown below. The weight of the climber is 650 N.



Show that the tension T in the rope is about 1.3×10^3 N.

(3)

(b) The rope has an unstretched length of 120 m as shown below.



(i) Determine the strain in the rope while it is supporting the weight of the climber.

You may ignore the weight of the rope.

(3)

Strain = ...

(ii) The rope has a cross-sectional area of $3.14 \times 10^{-4}\,m^2$.

Determine the Young modulus of the rope material.

(3)

Young modulus = ...

(Total for Question 13 = 9 marks)