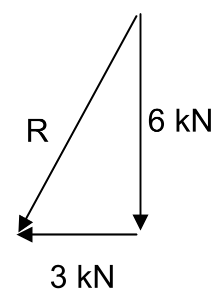
SOLUTIONS TO TUTORIAL EXAMPLES

CHAPTER 7

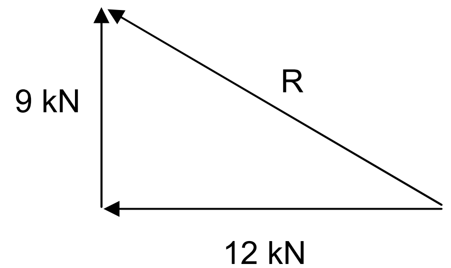
Question 1

Magnitude of resultant force R = $\sqrt{(6^2 + 3^2)}$ = 6.71 kN
Direction of resultant force (R) = $\tan^{-1}(6/3)$ = 63.4° from horizontal (downwards and to left)



Question 2

Magnitude of resultant force R = $\sqrt{(9^2 + 12^2)}$ = 15 kN
Direction of resultant force (R) = $\tan^{-1}(9/12)$ = 36.9° from horizontal (upwards and to left)



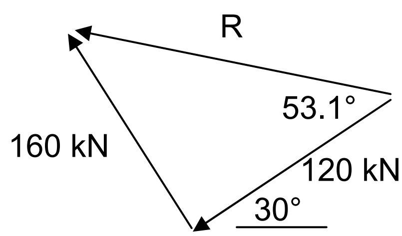
Question 3

It can be seen that the two forces shown are at right angles to each other therefore the normal trigonometrical rules associated with right angled triangles apply.

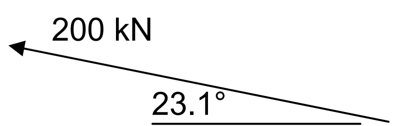
Magnitude of resultant force R = $\sqrt{(120^2 + 160^2)}$ = 200 kN
Direction of resultant force (R) relative to the line of the 120 kN force = $\tan^{-1}(160/120)$ = 53.1°.

The 120 kN force is itself at an angle of 30° from the horizontal.

Therefore the angle of the resultant force from the horizontal is (53.1 − 30) = 23.1° from horizontal (upwards and to left).

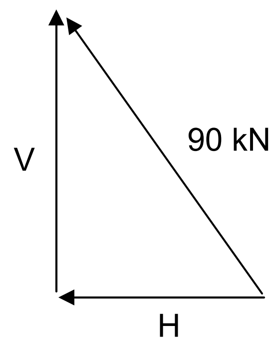


In summary, the resultant force is 200 kN in at an angle of 23.1° to the horizontal (upwards and to the left).



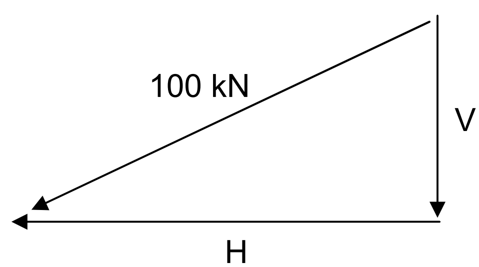
Question 4

Horizontal component (H) = 90 × cos 60° = 45 kN (to left).
Vertical component (V) = 90 × sin 60° = 77.9 kN (upwards).



Question 5

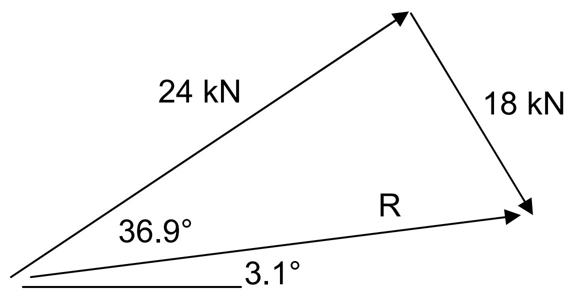
Horizontal component (H) = 100 × cos 40° = 76.6 kN (to left).
Vertical component (V) = 100 × sin 40° = 64.3 kN (downwards).



Question 6

Since the 60 kN and the 36 kN forces both act along the same line of action (albeit in opposite directions), they combine to give a 24 kN force (i.e. 60 − 36) along a line at 40° to the horizontal (upwards and to right). The problem now comprises two forces at right angles, as shown in the diagram below.

Magnitude of resultant force R = $\sqrt{(24^2 + 18^2)}$ = 30 kN
Direction of resultant force (R) relative to the line of the 24 kN force = $\tan^{-1}(18/24)$ = 36.9°.



(Note: 36.9 + 3.1 = 40)

In summary, the resultant force is 24 kN in at an angle of 3.1° to the horizontal (upwards and to the right).

Question 7

First, resolve the 14 kN force into its two components:

Horizontal component (H) = 14 × cos 45° = 9.9 kN (to right).
Vertical component (V) = 14 × sin 45° = 9.9 kN (upwards).

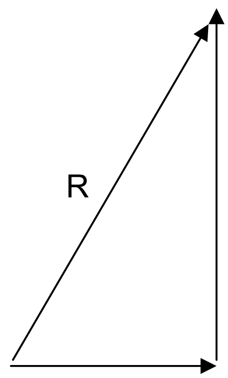
Next, add this vertical component to the 4 kN upwards force:

(9.9 + 4) = 13.9 kN

Next, subtract the 3 kN horizontal force (which acts to the left) from the horizontal component:

(9.9 − 3) = 6.9 kN.

So the problem reduces to a vertical (upwards) force of 13.9 kN acting with a horizontal force of 6.9 kN (to the right). See diagram below.



Magnitude of resultant force R = $\sqrt{(13.9^2 + 6.9^2)}$ = 15.5 kN
Direction of resultant force (R) = $\tan^{-1}(13.9/6.9)$ = 63.6° from horizontal (upwards and to right).

Question 8

A similar approach to Question 7 can be followed. First, resolve the 200 kN force into its two components:

Horizontal component (H) = 200 × cos 25° = 181.3 kN (to right).
Vertical component (V) = 200 × sin 25° = 84.5 kN (downwards).

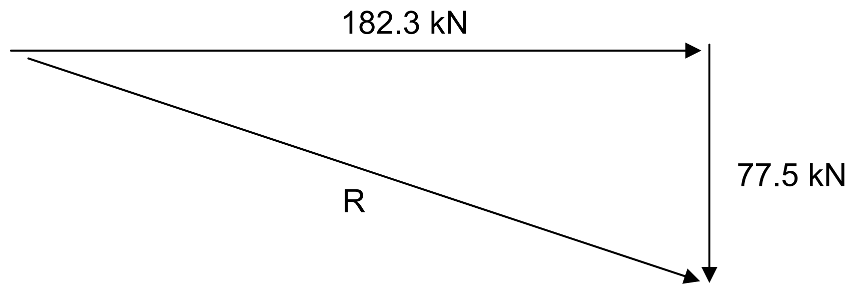
Next, subtract the (upward) 7 kN vertical force from this vertical component:

(84.5 − 7) = 77.5 kN

Next, add the 1 kN horizontal force (which acts to the right) to the horizontal component (which also acts to the right):

(1 + 181.3) = 182.3 kN.

So the problem reduces to a vertical (downwards) force of 77.5 kN acting with a horizontal force of 182.3 kN (to the right). See diagram below.



Magnitude of resultant force R = $\sqrt{(77.5^2 + 182.3^2)}$ = 198 kN
Direction of resultant force (R) = $\tan^{-1}(77.5/182.3)$ = 23.0° from horizontal (downwards and to right).