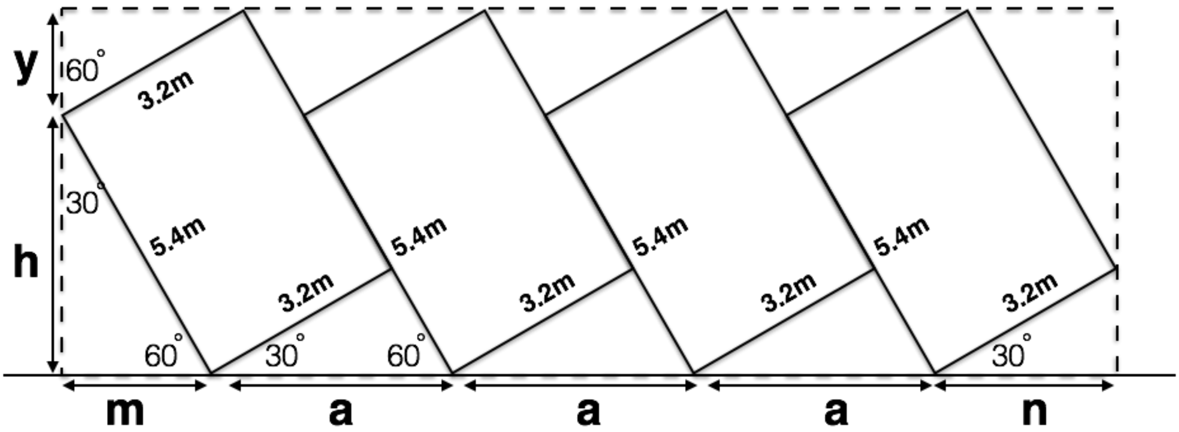
TEACHER NOTES PARKING ANGLES

These tasks use right angled trigonometry and basic angle rules.

Task 1

We have labelled some lengths and angles on the diagram below.



Each of the missing lengths can be found as follows:

$$\boldsymbol{m} = 5.4\ \cos 60 = 2.7$$

$$\boldsymbol{a} = \frac{3.2}{\sin 60} = 3.695 \ldots$$

$$\boldsymbol{n} = 3.2 \cos 30 = 2.771 \ldots$$

$$\boldsymbol{h} = 5.4 \sin 60 = 4.676 \ldots$$

$$\boldsymbol{y} = 3.2 \cos 60 = \ 1.6$$

The length of the rectangular section of the road is:

$$m + 3a + n = 16.56m$$

The width of the rectangular section of the road is:

$$h + y = 6.28m$$

Task 2

The length of the road needed is greater than for 60 degrees, but the width needed is less.

Task 3

A **hint** to give students is that the longest length in a rectangle is its diagonal. Therefore, when the **diagonal runs vertical/horizontal** that will be when the width/length of road is greatest.

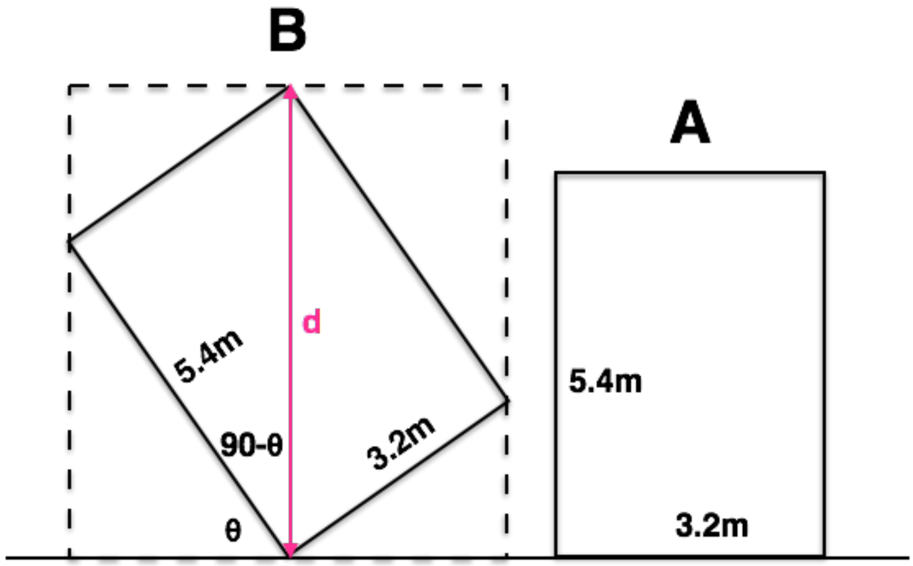
To convince themselves of this perhaps students could take a rectangular object/piece of card to represent the parking bay, and two straight edges (eg rulers) and see how the width/length of the space it takes up changes as it rotates.

In the case of **finding the angle that gives the greatest width of road**, students should start with their rectangular object at 90 degrees to the horizontal (position A below). Their rulers go horizontally on top and below the rectangle.

They will then notice as they rotate it (anti-clockwise) that they need to move the two straight edges further apart.

The greatest width is not when the rectangular object is at 90 degrees to the horizontal (position A), but when the diagonal (pink in the diagram below) is at 90 degrees to the horizontal (position B).

Students then need to use trigonometry to find the angle θ in position B. See calculations on the next page.



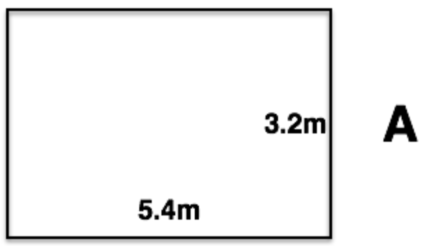
Finding θ for greatest width:

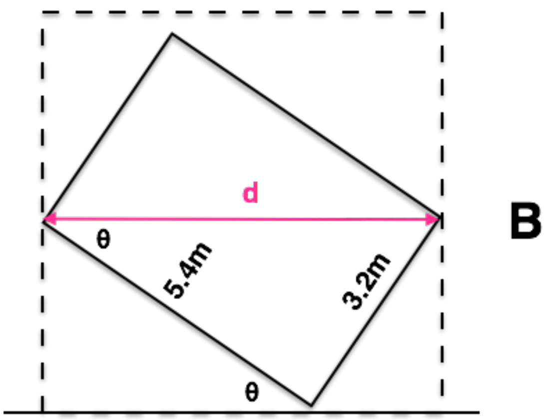
$$\tan(90-\theta)=\frac{3.2}{5.4}$$

$$90-\ \theta=\tan^{-1}\frac{3.2}{5.4}$$

$$\theta=59.35\ldots$$

To find the **angle that gives greatest length**, we can do a similar thing. Students could start with their rectangular object in position A (diagram below) with a vertical ruler at either end, and then rotate the object clockwise to position B. They should notice they have to move their rulers further apart and that in position B (when the diagonal is parallel to the horizontal) the length is greatest.





Finding θ for greatest length:

$$\tan\theta=\frac{3.2}{5.4}$$

$$\theta=30.65\ldots$$

The angle that gives the greatest length and the angle that gives the greatest width sum to 90 degrees, as they are the two acute angles in the right-angled triangle made by the dimensions of the parking bay.