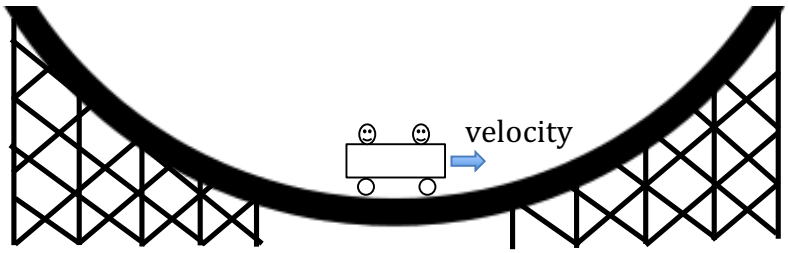
6.1.4 At the fairground

In this core task you will look at how to work out the resultant force. This is one of the key problems that students have when solving circular motion questions. Once you have the resultant force all you then need to do is equate it to the centripetal force and the rest should be easy!

What makes these examples trickier is that the circle is vertical, think carefully and remember your basic principles.

The rollercoaster ride

The following diagram shows part of a rollercoaster ride in which the passenger wagon does a loop-the-loop in a vertical circle.



(1) At what point in the circle would the maximum support force be required?

(2) Write down an expression for the resultant force acting on the rollercoaster wagon in the diagram.

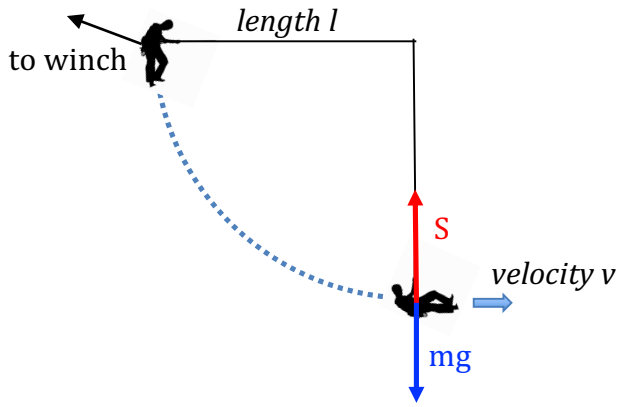
We know that any object moving in a circle must have a resultant force which acts towards the centre of the circle (the centripetal force).

(3) Write an expression equating the centripetal force to the resultant force.

(4) Where would the passengers feel heaviest? Why?

The swing

In the following ride the person on a large swing is winched up to a horizontal position. They are then allowed to swing freely.

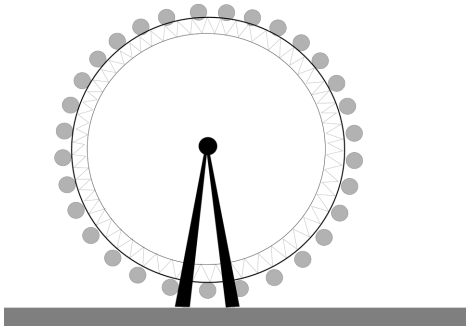


(5) Using the conservation of energy, equate the gravitational potential energy at the top of the swing to the kinetic energy at the bottom. From this, write an expression for the velocity at the bottom of the swing.

(6) By considering the centripetal force at the bottom, write down an expression for the support force required at the bottom of the swing.

(7) The person on the swing feels heavier at the bottom. If they have been released with the cable horizontal, how much heavier do they feel at the bottom?

The Big Wheel



The Singapore Flyer and the London Eye are rides which take capsules containing passengers in a circle. The forces acting on the capsules must add together in a way that there is a resultant force which acts towards the centre of the circle (the centripetal force).

In this example you must carefully identify the forces and which direction they act. At A-level you will only need to consider the forces at four points on the circle.

The top and bottom of the circle are the most important points so that you can work out maximum and minimum forces. These are the ones you will therefore deal with the most.

(8) Complete the table below to get an expression for the resultant force.

position on ride	names of forces acting on passenger	diagram showing force vectors	expression for the resultant force
top			
right			
bottom			
left			