

Question 18**(11 marks)**

A ferris wheel has a radius of 80 metres and rotates in an anticlockwise direction at a rate of one revolution every 72 seconds. The ferris wheel has 16 cars that are equally spaced around the wheel as shown in the diagram.

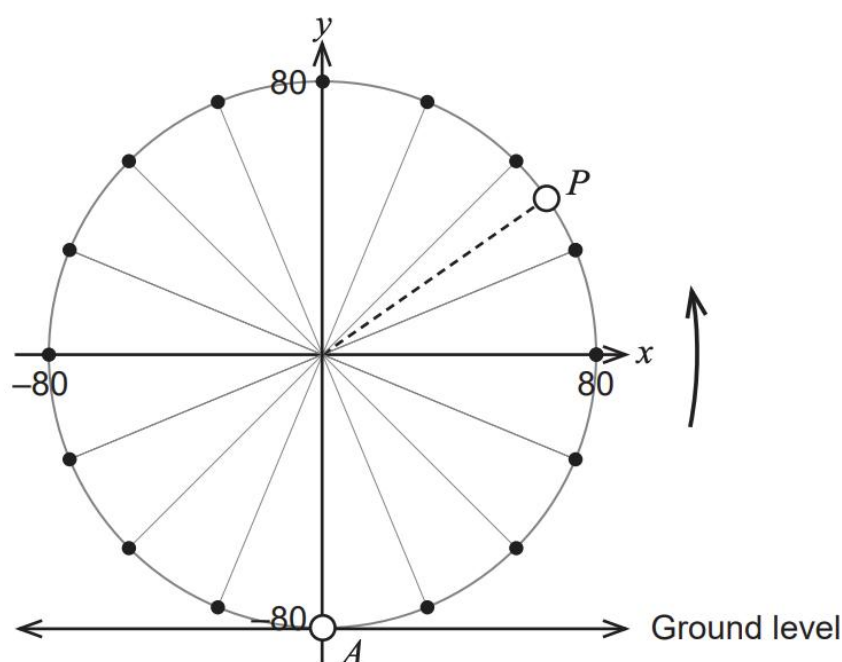
A coordinate system is set up so that the centre of the ferris wheel is at the origin and the ground level has equation $y = -80$. Passengers begin their ride when a car is at position A $(0, -80)$.

Consider a passenger in a car at position P .

Let t = the number of seconds the ride has been in progress from position A .

θ = the angle in radians that the car has rotated from position A .

y = the height of a car above the centre of the ferris wheel (metres).



- (a) Show that $\frac{d\theta}{dt} = \frac{\pi}{36}$ radians per second.

(1 mark)

(b) Given that $y(\theta) = 80\sin(\theta + \alpha)$, explain why $\alpha = -\frac{\pi}{2}$.

(1 mark)

(c) Determine how quickly a passenger is moving upward when they are 100 metres above the ground, correct to the nearest 0.01 metres per second. (4 marks)

(d) Show that function $y(t)$ satisfies the condition for simple harmonic motion. (2 marks)

A different passenger happens to be in a car that is two cars ahead of a particular car on the ferris wheel.

- (e) At what speed, correct to the nearest 0.01 metres per second, is the trailing passenger moving upward when the other passenger is moving downward at exactly the same speed? (3 marks)