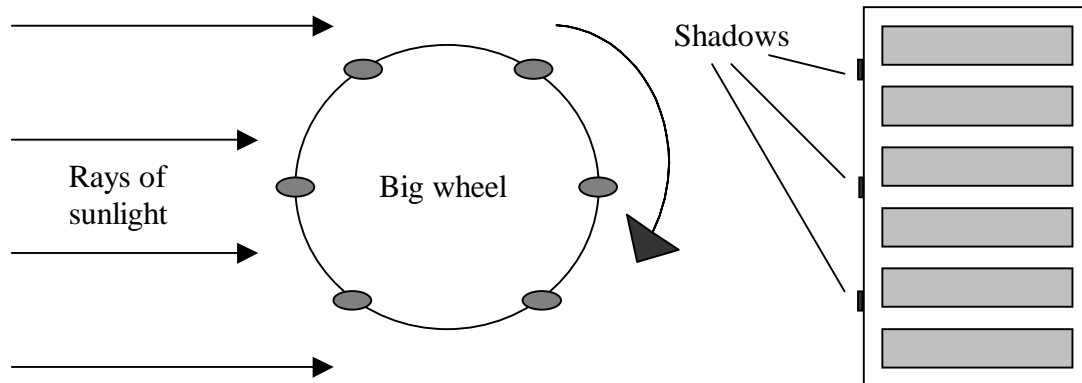


16. A large fairground wheel casts a shadow on to a nearby building. At a time when the sun's rays strike the building horizontally, a boy measures the speed of the shadow of one of the cars on the wheel as it passes different floors of the building.



At a floor which is level with the centre of the wheel, the speed is 0.17ms^{-1} .
 At a floor 10m higher, the speed is 0.16ms^{-1} .

Calculate:

(a) the time it takes to complete one rotation

The shadow performs a SHM. At the centre of the wheel the shadow has its maximum speed $\omega R = 0.17\text{ m.s}^{-1}$
 with R being the amplitude of the SHM.
 10 m higher $u^2 = \omega^2(R^2 - y^2) \Rightarrow 0.16^2 = \omega^2 \times R^2 - \omega^2 \times 0.16^2 \Rightarrow 0.16^2 = 0.17^2 - \omega^2 \times 0.16^2 \Rightarrow \omega = 0.05744563 = 0.0057\text{ rad.s}^{-1}$
 Thus $T = 2\pi/\omega = 2\pi / 0.057 = 1102.31 = 1100\text{ s}$

[6]

(b) the diameter of the wheel.

$\omega \times R = 0.17 \Rightarrow R = 0.17 / 0.0057 = 29.82 = 29\text{ m}$

[2]

Total 8 marks