4 The “Round Up” is a hollow cylindrical ride with radius 8.0 m, as shown in Fig. 4.1. When it spins about its axis at sufficient angular speed, riders are pinned to the inner wall. The cylinder then tilts while spinning, creating the illusion of defying gravity as riders remain pinned to the wall.

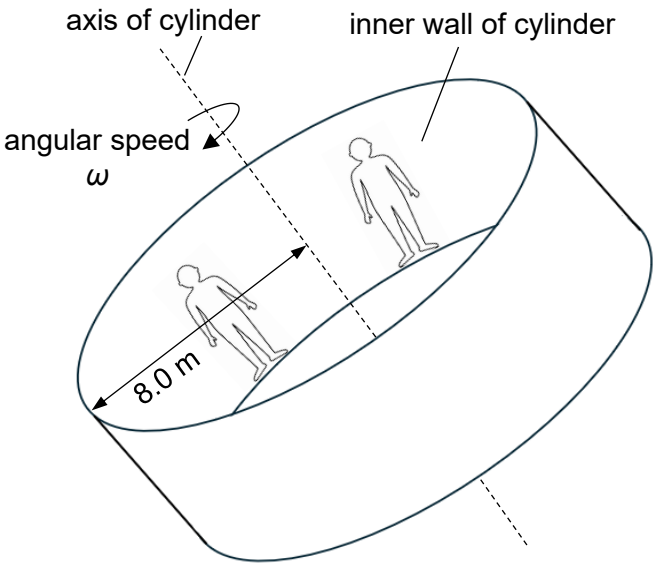

Fig 4.1

Fig. 4.2 shows the side view of the cylinder when it is tilted at an angle of 50° to the horizontal.

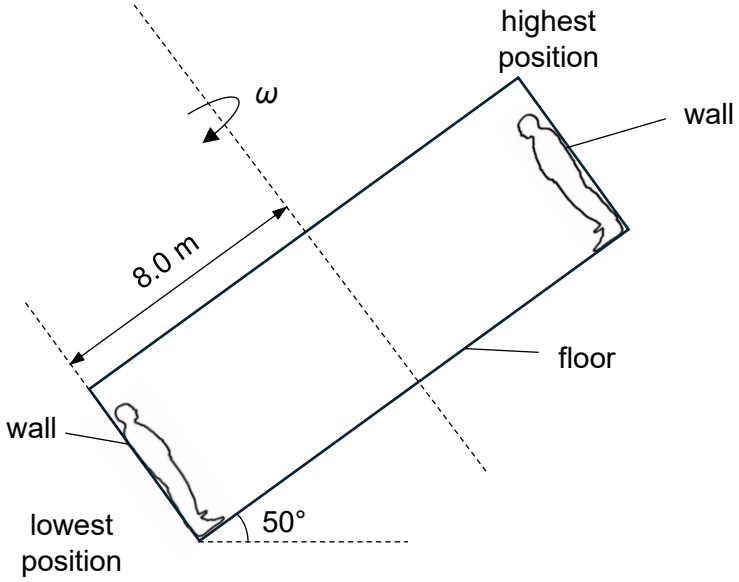

Fig 4.2

The cylinder is rotating at a constant angular speed ω that is sufficient for a rider of mass 65 kg to be just in contact with the wall at the highest position.

At the highest and lowest positions shown, the rider experiences no friction from the wall and floor of the cylinder.

(a) By considering the forces acting on the rider at the highest position, show that ω is 0.97 rad s^{-1}. Explain your working.

[2]

(b) Calculate the magnitude of normal contact force exerted by the wall of the cylinder on the rider at the lowest position.

magnitude of normal contact force = …… N [2]

(c) Calculate the gain in gravitational potential energy when the rider is moved from the lowest position to the highest position.

gain in potential energy = …… J [2]

(d) Hence, calculate the average power required to bring the rider from the lowest position to the highest position.

average power = …… W [2]