2]

(ii) Determine the height of the ramp.

height = ... m [2]

(a) After the sphere leaves the ramp, it continues to travel upwards until it hits the ceiling at an angle of 5.0° to the horizontal as shown in Fig. 1.2.

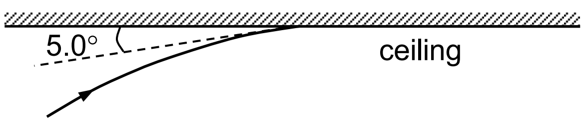

Fig. 1.2 (not to scale)

(i) Calculate the vertical component of velocity of the sphere just before hitting the ceiling.

vertical component of velocity = ... m s^{-1} [2]

(ii) Calculate the vertical displacement of the sphere from the instant it leaves the ramp to the instant it hits the ceiling.

vertical displacement = ... m [2]

(iii) Explain how momentum is conserved in the collision with the ceiling.

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[2]

2 A theme-park ride consists of two cages. They are moving in a circular path at constant speed v about a horizontal axis. Fig. 2.1 shows the ride at one instant when cage A is vertically above cage B.

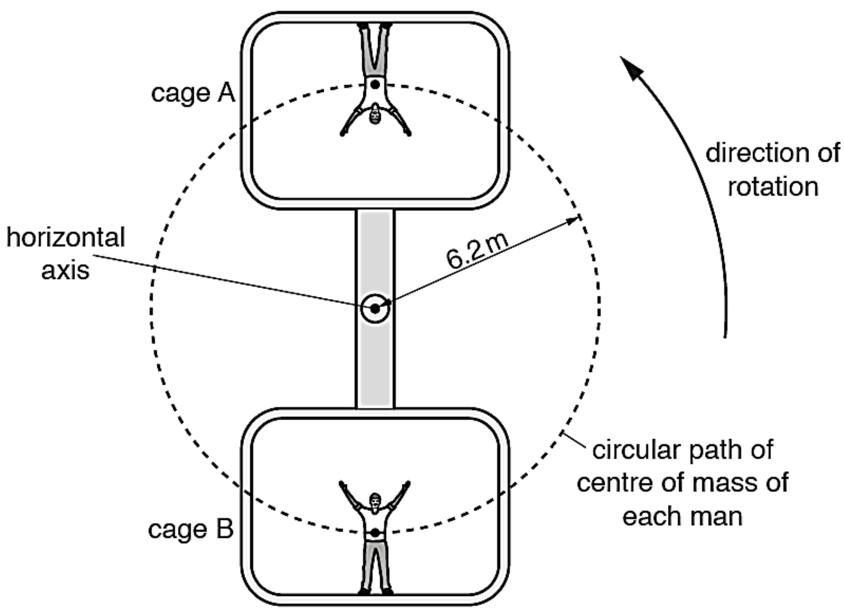

Fig. 2.1 (not to scale)

(a) A man is riding in each cage. The mass of each man is 75 kg. The centre of mass of each man is 6.2 m from the horizontal axis. The period of one rotation is 4.1 s.

(i) Determine the speed v of the centre of mass of each man.

v = ... m s^{-1} [2]

(ii) Calculate the magnitude of the acceleration of the centre of mass of each man.

acceleration = ... m s^{-2} [2]

(b) Fig. 2.2 shows the forces acting on the man in cage B at the instant the cages are in the positions shown. It shows the man in cage A at that same instant.

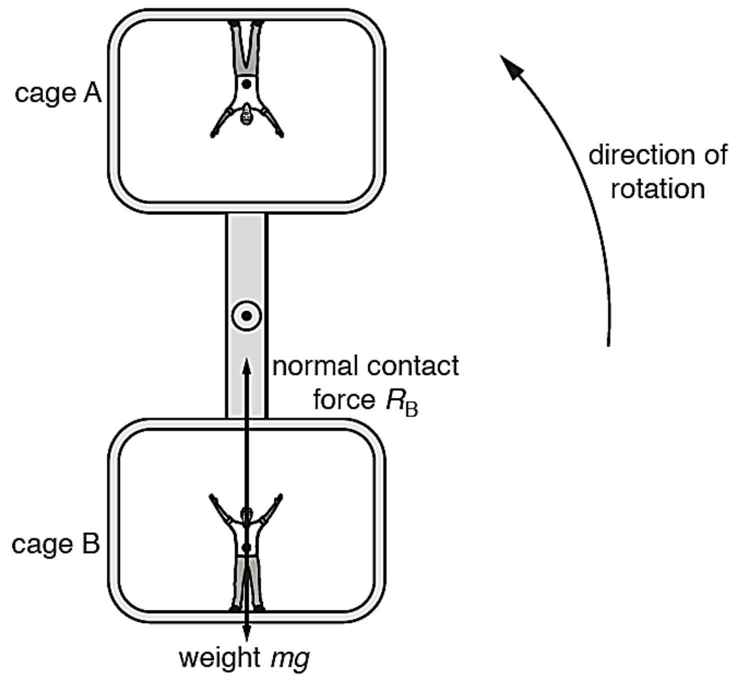

Fig. 2.2 (not to scale)

(i) On Fig. 2.2, mark labelled arrows to represent the magnitude and direction of the forces acting on the man in cage A.
[2]

(ii) Calculate the magnitude of the normal contact force R_A on the man in cage A at this instant.

R_A = ... N [2]

(c) **(i)** Explain why a minimum value for the speed is needed for the man in cage A

to maintain contact with the floor of his cage.

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... [2]

(ii) Calculate this minimum speed.

minimum speed = ... m s^{-1} [2]