2 **(a)** Explain why, for an object moving in a horizontal circular motion at a constant speed, its resultant force must be perpendicular to its velocity.

……

……

…… [2]

(b) 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.

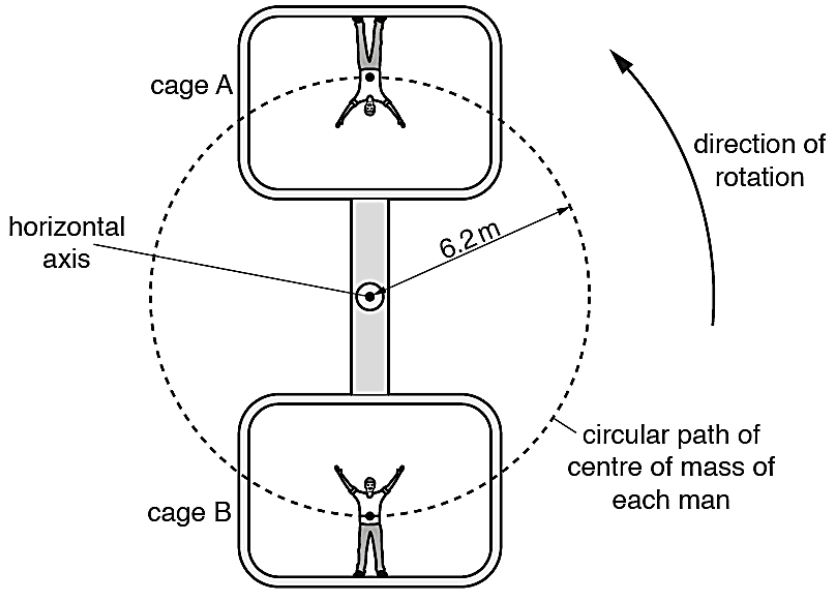

Fig. 2.1 (not to scale)

A 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]

(iii) Calculate the magnitude of the normal contact force R_B on the man in cage B at this instant.

R_B = ... N [2]

(c) 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.

…….....

…….....

……..... [2]

(d) Determine the minimum speed required for the man in cage A to maintain contact with the floor of his cage.

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

[Total: 12]