12   One of the rides at a theme park is a room where the floor and ceiling both move up and down for 10π seconds.
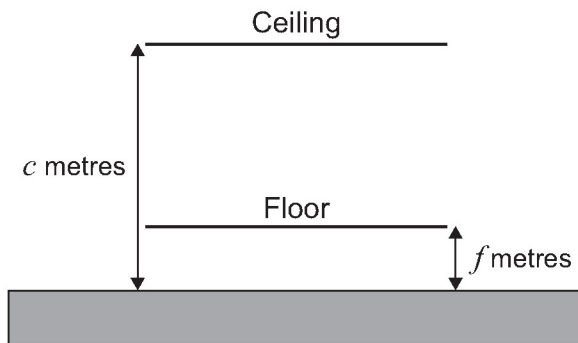
At time t seconds after the ride begins, the distance f metres of the floor above the ground is

$$f = 1 - \cos t$$

At time t seconds after the ride begins, the distance c metres of the ceiling above the ground is

$$c = 8 - 4\sin t$$

The ride is shown in the diagram below.

12 (a)   Show that the initial distance between the floor and ceiling is 8 metres.

[1 mark]

12 (b)   Show that the distance d metres between the floor and ceiling at time t is given by

$$d = 7 + R\cos(t + \alpha)$$

where R and α are positive constants to be found.

[5 marks]

12 (c)   Hence, find the minimum distance between the ceiling and the floor.

Give your answer to the nearest centimetre.

[2 marks]