5:

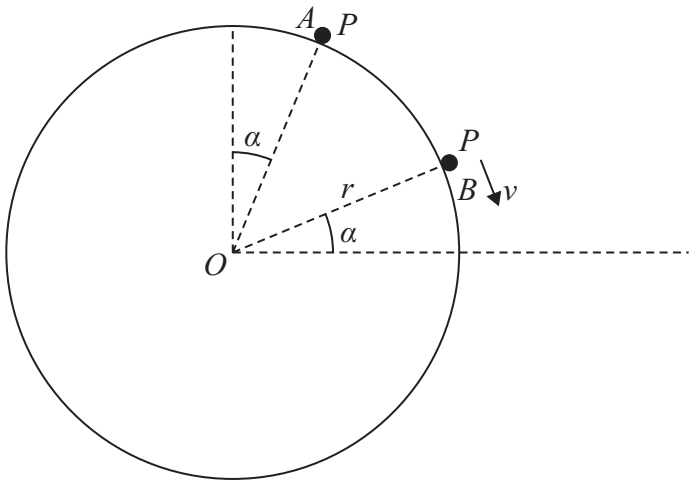


Figure 4

A fixed solid sphere has centre O and radius r.

A particle P of mass m is held at the point A on the smooth outer surface of the sphere, where OA makes an angle α, where $\alpha < 45°$, with the upward vertical.

The particle is released from rest and leaves the surface of the sphere at the point B, where OB makes an angle α with the horizontal, with speed v, as shown in Figure 4.

Air resistance is assumed to be negligible.

(a) Show that $v^2 = 2gr(\cos\alpha - \sin\alpha)$

(3)

(b) Show that $\tan\alpha = \frac{2}{3}$

(4)

At the instant when P crosses the horizontal through O, P is moving at an angle θ to the horizontal.

(c) Show that $\cos\theta = \frac{2}{\sqrt{39}}$

(7)

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Question 5 continued

(Total for Question 5 is 14 marks)