6.

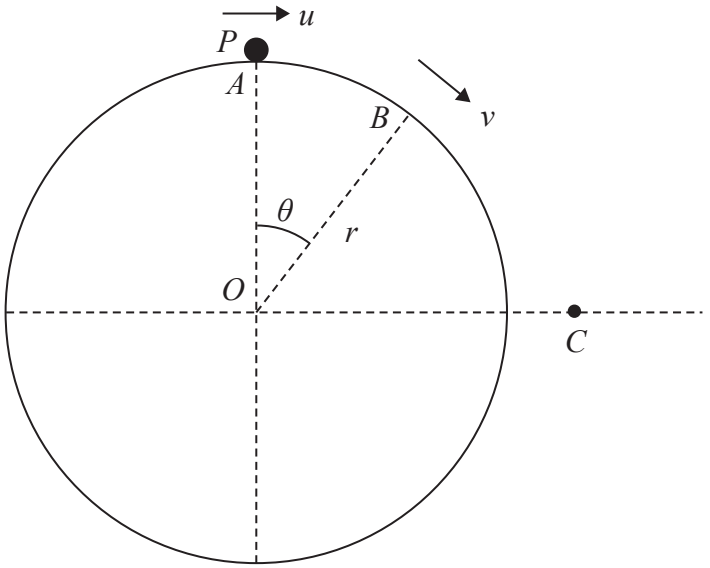


Figure 4

A fixed solid sphere has centre O and radius r.
A particle P of mass m is held at rest on the smooth surface of the sphere at A, the highest point of the sphere.
The particle P is then projected horizontally from A with speed u and moves on the surface of the sphere.
At the instant when P reaches the point B on the sphere, where angle $AOB = \theta$, P is moving with speed v, as shown in Figure 4.

At this instant, P loses contact with the surface of the sphere.

(a) Show that

$$\cos\theta = \frac{2gr + u^2}{3gr}$$

(7)

In the subsequent motion, the particle P crosses the horizontal through O at the point C, also shown in Figure 4.

At the instant P passes through C, P is moving at an angle α to the horizontal.

Given that $u^2 = \frac{2gr}{5}$

(b) find the exact value of $\tan\alpha$.

(6)

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Question 6 continued

(Total for Question 6 is 13 marks)