5.

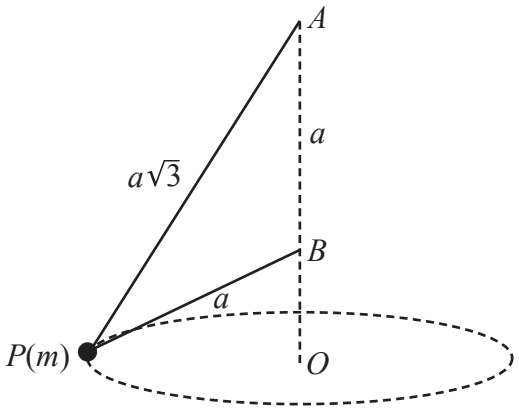


Figure 5

A particle P of mass m is attached to one end of a light inextensible string of length $a\sqrt{3}$. The other end of the string is attached to a fixed point A. The particle P is also attached to one end of a second light inextensible string of length a. The other end of this string is attached to a fixed point B, where B is vertically below A, with $AB = a$.

The particle P moves in a horizontal circle with centre O, where O is vertically below B.

The particle P moves with constant angular speed ω, with both strings taut, as shown in Figure 5.

(a) Show that the upper string makes an angle of 30° with the downward vertical and the lower string makes an angle of 60° with the downward vertical.

(2)

(b) Show that the tension in the upper string is $\frac{1}{2}m\sqrt{3}(2g - a\omega^2)$.

(8)

(c) Show that $\frac{2g}{3a} < \omega^2 < \frac{2g}{a}$

(4)

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Question 5 continued

(Total for Question 5 is 14 marks)