4   A vertical peg is attached to the edge of a horizontal disc of radius r, as shown in Fig. 4.1.
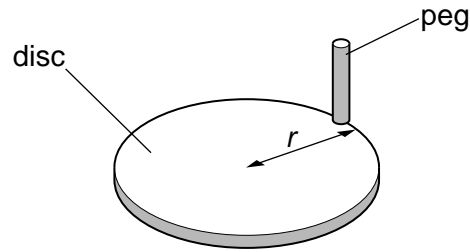
Fig. 4.1

The disc rotates at constant angular speed ω. A horizontal beam of parallel light produces a shadow of the peg on a screen, as shown in Fig. 4.2.

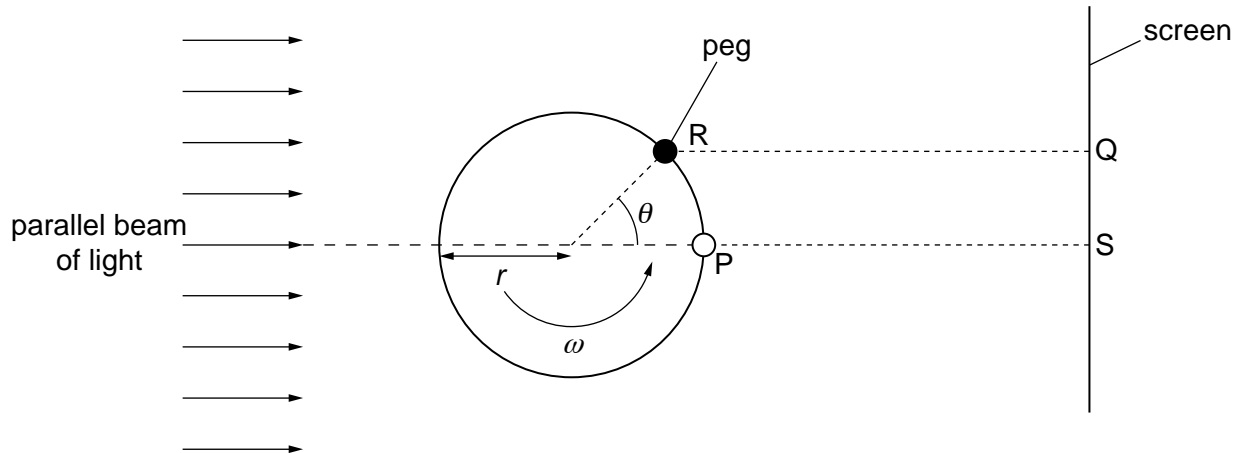**Fig. 4.2** (plan view)

At time zero, the peg is at P, producing a shadow on the screen at S.
At time t, the disc has rotated through angle θ. The peg is now at R, producing a shadow at Q.

(a) Determine,

    (i)   in terms of ω and t, the angle θ,

    .... [1]

    (ii) in terms of ω, t and r, the distance SQ.

    .... [1]

(b) Use your answer to **(a)(ii)** to show that the shadow on the screen performs simple harmonic motion.

....

....

.... [2]

(c) The disc has radius r of 12 cm and is rotating with angular speed ω of 4.7 rad s^{-1}.

Determine, for the shadow on the screen,

(i) the frequency of oscillation,

frequency = ... Hz [2]

(ii) its maximum speed.

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