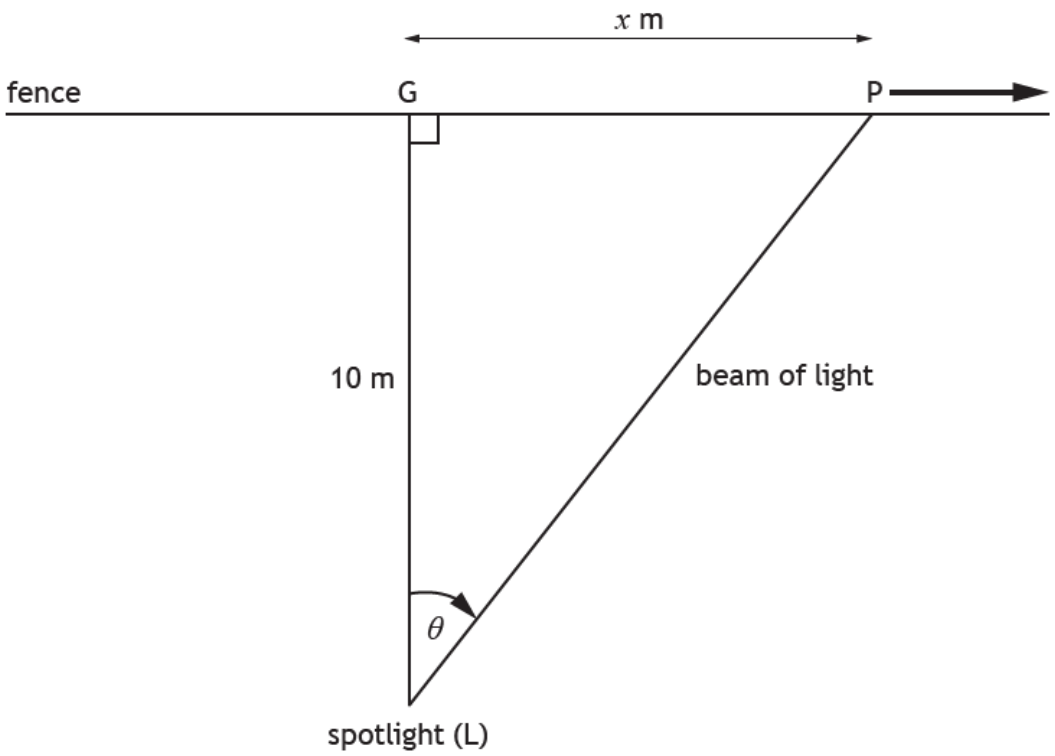
Advanced Higher Maths
SQA 2022 Paper 2
Question 13

Advanced Higher Maths
Maths.scot

A security spotlight is situated 10 metres from a straight fence. The spotlight rotates at a constant speed and makes one full revolution every 12 seconds.

The situation at time t seconds is modelled in the diagram below, where:

- L is the position of the spotlight
- G is the point on the fence nearest to the spotlight
- P is the position where the light hits the fence
- θ is the angle between LG and LP
- x is the distance in metres from G to P.



(a) Show that:

(i) $\frac{d\theta}{dt} = \frac{\pi}{6}$ radians per second 1

(ii) $\frac{dx}{dt} = \frac{5\pi}{3}\sec^2\theta$ metres per second. 4

(b) Prove that $1 + \tan^2\theta = \sec^2\theta$. 1

(c) Hence, or otherwise, find the exact value of $\frac{dx}{dt}$ when P is 5 metres from G. 3

Answers/methods:

(a) (i) Full turn divided by time.

(ii) Use related rates of change.

(b) Proof. See marking instructions.

(c) $\frac{25\pi}{12}$ ms^{-1}