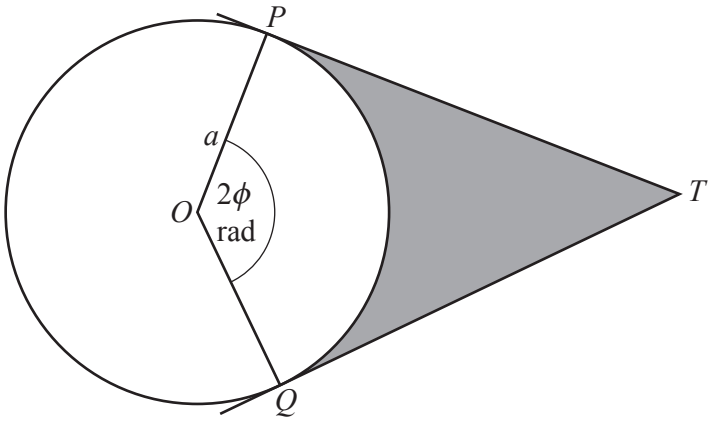
9 In this question all lengths are in centimetres.



The diagram shows a circle, centre O, radius a. The lines PT and QT are tangents to the circle at P and Q respectively. Angle POQ is 2ϕ radians.

(a) In the case when the area of the sector OPQ is equal to the area of the shaded region, show that $\tan\phi = 2\phi$. [4]

(b) In the case when the perimeter of the sector OPQ is equal to half the perimeter of the shaded region, find an expression for $\tan\phi$ in terms of ϕ. [3]