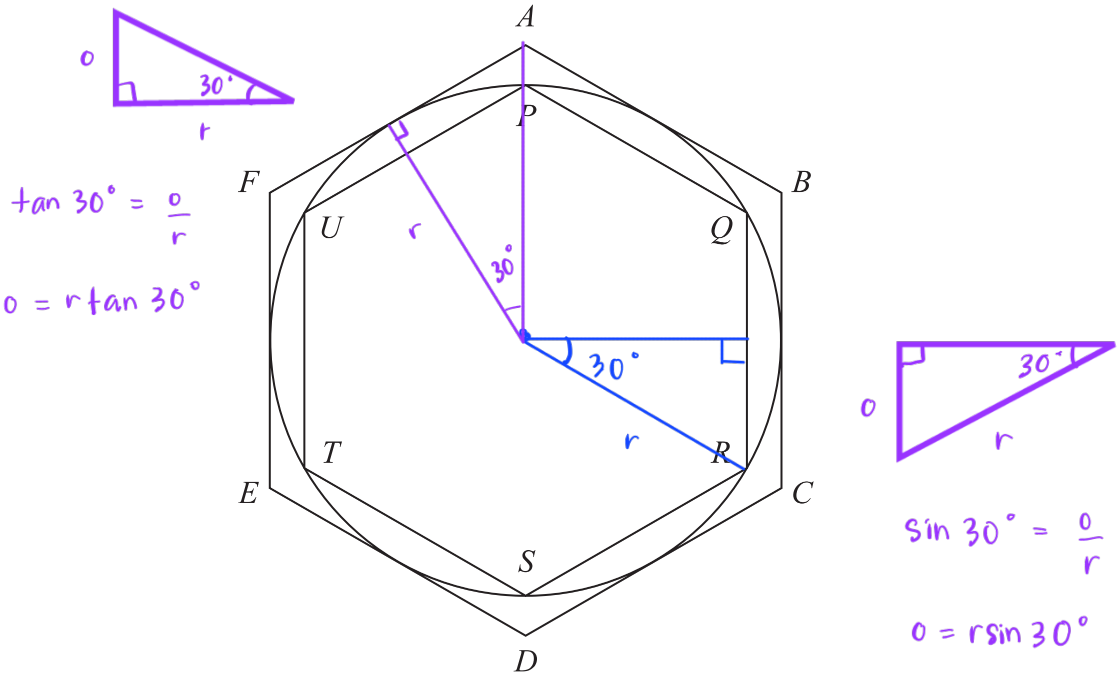
1 The diagram shows a circle, radius r cm and two regular hexagons.



Each side of the larger hexagon $ABCDEF$ is a tangent to the circle.
Each side of the smaller hexagon $PQRSTU$ is a chord of the circle.

By considering perimeters, show that

$$3 < \pi < 2\sqrt{3}$$

$r \sin 30° = \frac{1}{2} QR$

$r\left(\frac{1}{2}\right) = \frac{1}{2} QR$

$r = QR$

Perimeter small hexagon $= 6r$ (1)

$r \tan 30° = \frac{1}{2} AF$

$r\left(\frac{\sqrt{3}}{3}\right) = \frac{1}{2} AF$

$AF = \frac{2r\sqrt{3}}{3}$

Perimeter large hexagon $= \frac{2r\sqrt{3}}{3} \times 6$

$= 4\sqrt{3}\, r$ (1)

Perimeter small hexagon < Perimeter circle < Perimeter large hexagon

$6r < 2\pi r < 4\sqrt{3}\, r$ (1)

$\div r$

$6 < 2\pi < 4\sqrt{3}$

$\div 2$

$3 < \pi < 2\sqrt{3}$ (1)

$3 < \pi < 2\sqrt{3}$ (shown)

(Total for Question 1 is 4 marks)