

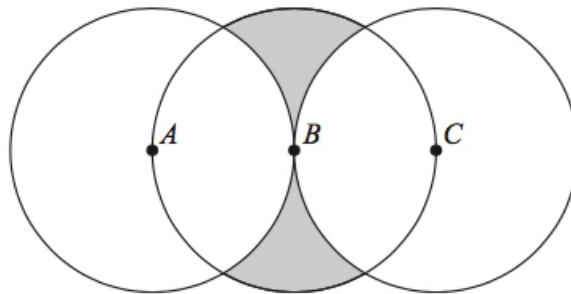
**Dr Oliver Mathematics**  
**Worked Examples**  
**Shaded Area 5**

**From:** Edexcel GCSE Mathematics 2022 Paper 1H (Non-Calculator)

1. The diagram shows three circles, each of radius 4 cm. (5)

The centres of the circles are  $A$ ,  $B$ , and  $C$  such that  $ABC$  is a straight line and

$$AB = BC = 4 \text{ cm.}$$



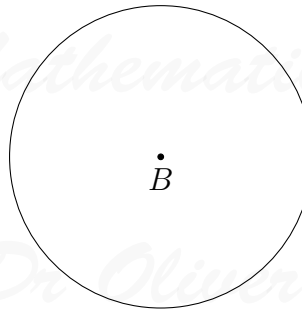
Work out the total area of the two shaded regions.

Give your answer in terms of  $\pi$ .

**Solution**

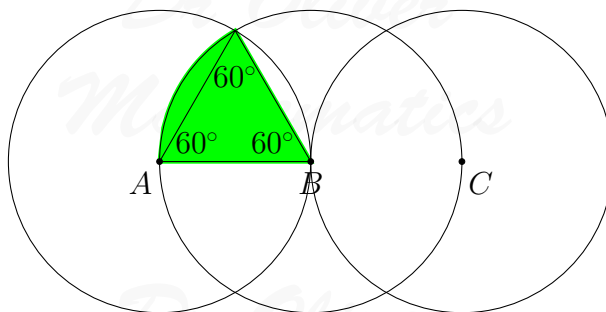
Well, we want to know

- the area of a circle, of radius 4 cm:



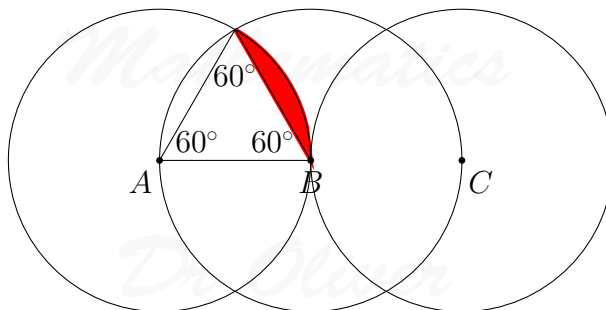
$$\begin{aligned} \text{area of the circle} &= \pi \times 4^2 \\ &= 16\pi; \end{aligned}$$

- the area of the sector:



$$\begin{aligned} \text{area of the sector} &= \frac{60}{360} \times \pi \times 4^2 \\ &= \frac{8}{3}\pi; \end{aligned}$$

- the area of the segment:



$$\begin{aligned} \text{area of the segment} &= \text{area of the sector} - \text{area of the triangle} \\ &= \left(\frac{60}{360} \times \pi \times 4^2\right) - \left(\frac{1}{2} \times 4 \times 4 \times \sin 60^\circ\right) \\ &= \frac{8}{3}\pi - \left(8 \times \frac{\sqrt{3}}{2}\right) \\ &= \frac{8}{3}\pi - 4\sqrt{3}. \end{aligned}$$

Finally,

$$\begin{aligned} & \text{total area} \\ &= \text{area of a circle} - (4 \times \text{total of the sector}) - (4 \times \text{total of the segment}) \\ &= (16\pi) - 4\left(\frac{8}{3}\pi\right) - 4\left(\frac{8}{3}\pi - 4\sqrt{3}\right) \\ &= 16\pi - \frac{32}{3}\pi - \frac{32}{3}\pi + 16\sqrt{3} \\ &= \underline{\underline{16\sqrt{3} - \frac{16}{3}\pi}}. \end{aligned}$$