

Question	Scheme	Marks	AOs
<b>3(a)</b>	Correct overall strategy employed, eg. $A = 2 \times \left( \frac{1}{2} \int_{2\pi}^{3\pi} \sin^2\left(\frac{\theta}{6}\right) d\theta - \frac{1}{2} \int_{4\pi}^{5\pi} \sin^2\left(\frac{\theta}{6}\right) d\theta + \frac{1}{2} \int_0^{\pi} \sin^2\left(\frac{\theta}{6}\right) d\theta \right)$	M1	3.1a
	Evidence of use of $\frac{1}{2} \int \sin^2\left(\frac{\theta}{6}\right) d\theta$	B1	1.1a
	$\int \sin^2\left(\frac{\theta}{6}\right) d\theta = \int \frac{1}{2} \left( 1 - \cos\left(\frac{\theta}{3}\right) \right) d\theta$	M1	3.1a
	$= \frac{1}{2} \left( \theta - 3 \sin\left(\frac{\theta}{3}\right) \right)$	A1	1.1b
	$A = \left( 2 \times \frac{1}{2} \right) \times \frac{1}{2} \left[ \left( (3\pi - 0) - \left( 2\pi - \frac{3\sqrt{3}}{2} \right) \right) - \left( \left( 5\pi + \frac{3\sqrt{3}}{2} \right) - \left( 4\pi + \frac{3\sqrt{3}}{2} \right) \right) + \left( \left( \pi - \frac{3\sqrt{3}}{2} \right) - (0) \right) \right]$	M1	2.1
	$= \frac{\pi}{2}$	A1	1.1b
		<b>(6)</b>	
<b>(b)</b>	Area of painting on wall = (area curve) $\times$ (12/(width of curve)) <sup>2</sup> with their area and width.	M1	3.1a
	Width of curve $\left( = \sin\left(\frac{3\pi}{6}\right) + \sin\left(\frac{2\pi}{6}\right) \right) = 1 + \frac{\sqrt{3}}{2} = 1.866\dots$	B1	1.1b
	So as two coats needed, total area of paint required = $2 \times \frac{\pi}{2} \times 41.354 = 129.92\dots \text{ m}^2$	M1	2.2a
	So 5 tins of paint will be needed.	A1	3.2a
		<b>(4)</b>	

**(10 marks)**

**Notes:**

**(a)**

**M1:** A correct attempt to find the correct area, splitting into suitable required sections and attempting the integration, combining correctly. There are many variations that could be used so check carefully the strategy is correct.

**B1:** Applies the area formula to the curve with any limits. The  $\frac{1}{2}$  may be implied if a correct overall formula is used.

**M1:** Applies the double angle formula to set up the integral

**A1:** Correct integration of  $\sin^2(\theta/6)$

**M1:** Applies limits correctly to all of their integrals and combines and simplifies.

**A1:** Correct area from a fully correct method.

**(b)**

**M1:** Full attempt to find the appropriate scaling factor (must be squaring) to scale the area found in (a) to the area required for the wall painting.

**B1:** Correct width of logo in the curve found.

**M1:** Area of paint required for two coats found.

**A1:** Correct number of tins identified. Must be an integer answer.