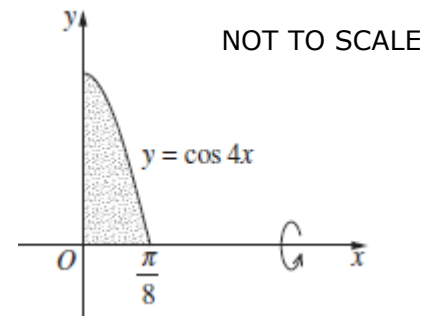


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- 2014 12b** The region bounded by  $y = \cos 4x$  and the  $x$ -axis, between  $x = 0$  and  $x = \frac{\pi}{8}$ , is rotated about the  $x$ -axis to form a solid. Find the volume of the solid.



3

$$\begin{aligned}
 \text{Volume} &= \pi \int y^2 dx \\
 &= \pi \int_0^{\frac{\pi}{8}} \cos^2 4x dx \\
 &= \frac{\pi}{2} \int_0^{\frac{\pi}{8}} (1 + \cos 8x) dx \\
 &= \frac{\pi}{2} \left[ x + \frac{1}{8} \sin 8x \right]_0^{\frac{\pi}{8}}
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{\pi}{2} \left[ \frac{\pi}{8} + \frac{1}{8} \sin \pi - 0 \right] \\
 &= \frac{\pi}{2} \left[ \frac{\pi}{8} \right] \\
 &= \frac{\pi^2}{16} \\
 \therefore \text{ volume of } &\frac{\pi^2}{16} \text{ units}^3.
 \end{aligned}$$

State Mean:

2.25

\* These solutions have been provided by [projectmaths](#) and are not supplied or endorsed by BOSTES.

### Board of Studies: Notes from the Marking Centre

Candidates were required to use the formula for volume, use double angle formula involving

$\cos^2 4x = \frac{1}{2}(1 + \cos 2 \cdot 4x) = \frac{1}{2}(1 + \cos 8x)$  and complete two substitutions.

Common problems were:

- using the double angle formula incorrectly; for example, knowing the identity for  $\cos^2 x$  but not making the correct substitution to find the identity for  $\cos^2 4x$
- knowing the primitive of  $\cos^2 x$  and attempting to jump straight to the primitive of  $\cos^2 4x$  but making errors in determining their expression
- making errors with their substitutions of  $\sin \pi$ , with  $\sin \pi = 1$  being the most common mistake
- omitting  $\pi$  from the expression for the volume
- assuming that  $(\cos 4x)^2 = \cos 16x$  or  $\cos^2 16x$ .

**Source:** [http://www.boardofstudies.nsw.edu.au/hsc\\_exams/2014/pdf\\_doc/2014-maths-ext-1.pdf](http://www.boardofstudies.nsw.edu.au/hsc_exams/2014/pdf_doc/2014-maths-ext-1.pdf)