UNIT 8: Calculus

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SPECIFICATION REFERENCES

5.1 Derive formula for and calculate volumes of revolution

PRIOR KNOWLEDGE

AS Mathematics – Pure content

8.3 Definite integrals (See SoW Year 1 Unit 3b)

KEYWORDS

Rotation, solid of revolution, volume of revolution, bounded area, arc, cubic units, parameter, Cartesian equation.

8a. Volumes of revolution (5.1)	**Teaching Time** 5 Hours

OBJECTIVES

By the end of the sub-unit, students should:

- be able to derive formulae for and calculate volumes of revolution about both the *x* and *y*-axes.

TEACHING POINTS

Both volume for rotation about the *x*-axis $V = \pi \int y^2 \, \mathrm{d}x$ and the *y*-axis $V = \pi \int x^2 \, \mathrm{d}y$ are required.

Stress the importance of quoting the general formula for volume before substituting values.

Look at using more complex functions for y or x so when squaring will challenge and develop their integration skills.

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING

Finding the volume of a cone.

Finding the volume of a sphere.

Finding the volume of a section rotated about the axes. Subtracting one volume from the other. Torus?

Finding the volume of shapes rotated around a line that is parallel to one of the axes.

COMMON MISCONCEPTIONS/ EXAMINER REPORT QUOTES

'It was expected that students should at least quote the general formula for volume and then substitute their derivative. It is good practice to quote formulae before substitution. When an error is made on substitution the examiner needs to be sure that the correct formula is being used before the method mark can be awarded'.

Students must know the formula for volume. 'The majority of candidates were able to apply volume formula $\pi \int y^2 \, \mathrm{d}x$. A number of candidates, however, used incorrect formulae such as $2\pi \int y^2 \, \mathrm{d}x$ or $\int y^2 \, \mathrm{d}x$ or even $\int y \, \mathrm{d}x$'.

Students must be sure of the correct formula for volume when the variables are given parametrically. 'Some rewrote the volume formula as $\pi \int y^2 \, \mathrm{d}\theta$, with dx being replaced by $d\theta$. Those who did not apply $\pi \int y^2 \frac{dx}{d\theta} \mathrm{d}\theta$ gained little access to this question, and it was also disappointing to see some students who attempted to apply an incorrect $\pi \int \left(y \frac{dx}{d\theta}\right)^2 \mathrm{d}\theta$'.