

Further Mathematics: **9231 Mathematics - Further November 2025 Question Paper** 11

The sum $(2\alpha+1)^n + (2\beta+1)^n + (2\gamma+1)^n + (2\delta+1)^n$ is denoted by S_n .

(b) Find the value of S_2 . [2]

This image shows a blank sheet of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(c) Given that $S_3 = -22$, find the value of S_4 . [2]

This image shows a blank sheet of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[5]

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2 The cubic equation $x^3 + bx^2 + cx + d = 0$, where $d \neq 0$, has roots α, β, γ such that $\gamma = \frac{1}{\beta}$.

(a) Show that $\beta + \frac{1}{\beta} = d - b$.

[3]

(b) Show also that $\beta + \frac{1}{\beta} = \frac{1-c}{d}$.

[2]

(c) It is given that $b = 3$, $c = -3$ and $d > 0$.

(i) Find the value of d .

[2]

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings present.

(ii) Find the value of $\alpha^2 + \beta^2 + \gamma^2$.

[2]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. At the bottom center, there is a small black circle containing the number 6.

(b) Find the value of $(\alpha^3 - 1)^2 + (\beta^3 - 1)^2 + (\gamma^3 - 1)^2$. [2]

[illegible]

(c) Find the value of $(\alpha^3 - 1)^3 + (\beta^3 - 1)^3 + (\gamma^3 - 1)^3$. [2]

This image shows a full page of white paper with ten horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and extend across the entire width of the page. There is no text or other markings on the paper.

Name:

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(a) Find the value of $\alpha^2 + \beta^2 + \gamma^2 + \delta^2$.

[2]

(b) Find the value of $\alpha^4 + \beta^4 + \gamma^4 + \delta^4$.

[2]

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(c)

$$\sum_{r=1}^{10} \left((\alpha^2 + r)^2 + (\beta^2 + r)^2 + (\gamma^2 + r)^2 + (\delta^2 + r)^2 \right).$$

[5]