Marked example 3

Paper 2 style · Graphic display calculator

3 8 marks AHL 1.14 ●●○ Typical

Consider the equation $z^3 = 2 + 11\mathrm{i}$.

(a) Show that $2 + \mathrm{i}$ is a root of the equation. **[2]**

(b) Find the other two roots, giving your answers in the form $a + b\mathrm{i}$. **[4]**

(c) The three roots form a triangle in the complex plane. Find its area. **[2]**

MARKSCHEME (a)

$(2+\mathrm{i})^3 = 8 + 12\mathrm{i} + 6\mathrm{i}^2 + \mathrm{i}^3$ **M1**

$= 8 + 12\mathrm{i} - 6 - \mathrm{i} = 2 + 11\mathrm{i}$ **A1**

Total 2 marks

Note Every term must be seen: the answer is given.

MARKSCHEME (b)

multiply by $\mathrm{e}^{\pm \mathrm{i}2\pi/3}$ **M1**

$(2+\mathrm{i})\left(-\frac{1}{2} + \frac{\sqrt{3}}{2}\mathrm{i}\right)$ **(A1)**

$-1.87 + 1.23\mathrm{i},\ -0.134 - 2.23\mathrm{i}$ **A1A1**

Total 4 marks

MARKSCHEME (c)

equilateral, circumradius $|2+\mathrm{i}| = \sqrt{5}$: $3 \times \frac{1}{2}(\sqrt{5})^2 \sin\frac{2\pi}{3}$ **(M1)**

$= 6.50$ **A1**

Total 2 marks

Note Exact value $\frac{15\sqrt{3}}{4}$.

Written and verified by a practising IB mathematics teacher, produced with AI assistance; solved twice and recomputed by software.
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