Marked example 1

Paper 1 style · No calculator

1 7 marks AHL 1.13 ●●○ Typical

Let $z = -\sqrt{3} + \mathrm{i}$ and $w = 2\mathrm{e}^{-\mathrm{i}\pi/4}$.

(a) Find the modulus and the argument of z. **[3]**

(b) Find zw, giving your answer in the form $r\mathrm{e}^{\mathrm{i}\theta}$, where $r > 0$ and $-\pi < \theta \leq \pi$. **[2]**

(c) Find $\dfrac{z}{w}$ in the same form. **[2]**

MARKSCHEME (a)

$|z| = \sqrt{3+1} = 2$ **A1**

reference angle $\arctan\frac{1}{\sqrt{3}} = \frac{\pi}{6}$, second quadrant **(M1)**

$\arg z = \frac{5\pi}{6}$ **A1**

Total 3 marks

MARKSCHEME (b)

$2 \times 2 = 4$, $\frac{5\pi}{6} - \frac{\pi}{4} = \frac{7\pi}{12}$ **(M1)**

$zw = 4\mathrm{e}^{\mathrm{i}7\pi/12}$ **A1**

Total 2 marks

MARKSCHEME (c)

$\frac{2}{2} = 1$, $\frac{5\pi}{6} + \frac{\pi}{4} = \frac{13\pi}{12}$ **(M1)**

$\frac{z}{w} = \mathrm{e}^{-\mathrm{i}11\pi/12}$ **A1**

Total 2 marks

Note $\frac{13\pi}{12} - 2\pi = -\frac{11\pi}{12}$, inside $(-\pi, \pi]$.

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