# Exercise 1

Paper 1 style · No calculator

## 1 7 marks AHL 1.13 ●●○ Typical

Let $z = -1 - \sqrt{3}\,\mathrm{i}$ and $w = 3\mathrm{e}^{\mathrm{i}\pi/3}$.

**(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]**

The markscheme is on the next page: try the question first. Written and verified by a practising IB mathematics teacher, produced with AI assistance; solved twice and recomputed by software. Not affiliated with or endorsed by the International Baccalaureate Organization.
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**MARKSCHEME (a)**

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

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

$\arg z = -\frac{2\pi}{3}$ **A1**

Total 3 marks

**MARKSCHEME (b)**

$2 \times 3 = 6,\ -\frac{2\pi}{3} + \frac{\pi}{3} = -\frac{\pi}{3}$ **(M1)**

$zw = 6\mathrm{e}^{-\mathrm{i}\pi/3}$ **A1**

Total 2 marks

**MARKSCHEME (c)**

$\frac{2}{3},\ -\frac{2\pi}{3} - \frac{\pi}{3} = -\pi$ **(M1)**

$\frac{z}{w} = \frac{2}{3}\mathrm{e}^{\mathrm{i}\pi}$ **A1**

Total 2 marks

**Note** $-\pi$ is outside $(-\pi, \pi]$: the argument is $\pi$.