Question Number	Scheme	Notes	Marks
5	$-8-8\mathrm{i}\sqrt{3}$		
(a)	$r=\left(\sqrt{(8)^2+\left(8\sqrt{3}\right)^2}\right)=16$	16	B1
	$\theta=-\pi+\tan^{-1}\left(\frac{8\sqrt{3}}{8}\right)$ or e.g. $\theta=-\frac{\pi}{2}-\tan^{-1}\left(\frac{8}{8\sqrt{3}}\right)$	Correct strategy for the argument (may see correct value only from calculator) or can be implied by a correct argument not in range e.g. $\frac{4\pi}{3}$	M1
	$16\left(\cos\left(-\frac{2\pi}{3}\right)+\mathrm{i}\sin\left(-\frac{2\pi}{3}\right)\right)$	Correct form and correct values. Condone careless use of brackets as long as the intention is clear.	A1
			(3)
(b)	**Note that in (b) the candidate may legitimately work with e.g.** $16\left(\cos\left(\frac{2\pi}{3}\right)-\mathrm{i}\sin\left(\frac{2\pi}{3}\right)\right)$		
	$z^4=16\left(\cos\left(2k\pi-\frac{2\pi}{3}\right)+\mathrm{i}\sin\left(2k\pi-\frac{2\pi}{3}\right)\right)$ Correct use of $2k\pi$ seen or implied. This may be implied by the above expression seen or used with any non-zero integer value (positive or negative) for k		M1
	$z=16^{\frac{1}{4}}\left(\cos\left(\frac{2k\pi}{4}-\frac{2\pi}{12}\right)+\mathrm{i}\sin\left(\frac{2k\pi}{4}-\frac{2\pi}{12}\right)\right)$ Divide their angle by 4 after $\pm2k\pi$ and find 4th root of their 16 **Dependent on the previous mark.**		**d**M1
	$z=2\left(\cos\left(-\frac{\pi}{6}\right)+\mathrm{i}\sin\left(-\frac{\pi}{6}\right)\right),\ 2\left(\cos\left(\frac{\pi}{6}\right)-\mathrm{i}\sin\left(\frac{\pi}{6}\right)\right),\ 2\mathrm{e}^{-\frac{\pi}{6}\mathrm{i}},\ -\mathrm{i}+\sqrt{3}$		
	$z=2\left(\cos\left(\frac{\pi}{3}\right)+\mathrm{i}\sin\left(\frac{\pi}{3}\right)\right),\ 2\left(\cos\left(\frac{5\pi}{3}\right)-\mathrm{i}\sin\left(\frac{5\pi}{3}\right)\right),\ 2\mathrm{e}^{\frac{\pi}{3}\mathrm{i}},\ 1+\mathrm{i}\sqrt{3}$		
	$z=2\left(\cos\left(\frac{5\pi}{6}\right)+\mathrm{i}\sin\left(\frac{5\pi}{6}\right)\right),\ 2\left(\cos\left(\frac{7\pi}{6}\right)-\mathrm{i}\sin\left(\frac{7\pi}{6}\right)\right),\ 2\mathrm{e}^{\frac{5\pi}{6}\mathrm{i}},\ \mathrm{i}-\sqrt{3}$		
	$z=2\left(\cos\left(-\frac{2\pi}{3}\right)+\mathrm{i}\sin\left(-\frac{2\pi}{3}\right)\right),\ 2\left(\cos\left(\frac{2\pi}{3}\right)-\mathrm{i}\sin\left(\frac{2\pi}{3}\right)\right),\ 2\mathrm{e}^{-\frac{2\pi}{3}\mathrm{i}},\ -1-\mathrm{i}\sqrt{3}$		
	1 correct root in any form		A1
	All 4 roots correct in any form (allow equivalent arguments)		A1
	All 4 roots in correct surd form or exact equivalent in required form.		A1
	The A marks must follow correct work and should not be awarded if any correct roots are obtained fortuitously. So must follow a correct answer in part (a) although the argument may not be in the required range.		
			(5)
			Total 8

Special Case in (b):

Candidates who do not consider $\pm2k\pi$ **at any stage** and apply De Moivre correctly to get

$$z^4=16\left(\cos\left(-\frac{2\pi}{3}\right)+\mathrm{i}\sin\left(-\frac{2\pi}{3}\right)\right)\Rightarrow z=2\left(\cos\left(-\frac{\pi}{6}\right)+\mathrm{i}\sin\left(-\frac{\pi}{6}\right)\right)\left(=-\mathrm{i}+\sqrt{3}\right)$$

Can score a B1 special case and this should be awarded as the first A mark on ePEN