Solutions for Sheet 1

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Task 1.1

(a) $z = (\frac{\sqrt{2}}{2} + i\frac{\sqrt{2}}{2})^3 = (\frac{\sqrt{2}}{2})^3 + 3(\frac{\sqrt{2}}{2})^2(i\frac{\sqrt{2}}{2}) + 3(\frac{\sqrt{2}}{2})(i\frac{\sqrt{2}}{2})^2 + (i\frac{\sqrt{2}}{2})^3 = \frac{1}{2}(-1+i)\sqrt{2} = \frac{1}{\sqrt{2}}(-1+i) = -\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}i$

$|z| = \sqrt{(-\frac{1}{\sqrt{2}})^2 + (\frac{1}{\sqrt{2}})^2} = 1$

$cos\varphi = \frac{Re[z]}{|z|} = \frac{-\frac{1}{\sqrt{2}}}{1} = -\frac{1}{\sqrt{2}}$

$\varphi = cos^{-1}(-\frac{1}{\sqrt{2}}) = \frac{3\pi}{4}$

$\Rightarrow z = |z| \cdot e^{i\varphi} = e^{\frac{3\pi i}{4}}$

(b)

(c) $Re[5e^{\frac{\pi}{4}i}] + \sqrt{2e^{\pi i}} =$

(d)

Task 1.2

If we look at both spectrograms, we see that there are no differences between the two waves. This is due to the fact that a cosine wave is only a phase-shifted sine wave.