# 1E Part 1 Finite Summations

1. Given that $z = cos\left(\frac{\pi}{n}\right) + isin\left(\frac{\pi}{n}\right)$, where $n$ is a positive integer, show that:

$$1 + z + z^2 + .. + z^{n-1} = 1 + icot\left(\frac{\pi}{2n}\right)$$

Notes for $e^{i\theta} + e^{2i\theta} + e^{3i\theta} + .. + e^{ni\theta}$

2. $S = e^{i\theta} + e^{2i\theta} + e^{3i\theta} + .. + e^{8i\theta}$, for $\theta \neq 2n\pi$, where $n$ is an integer

a) Show that

$$S = \frac{e^{\frac{9i\theta}{2}} sin4\theta}{sin\left(\frac{\theta}{2}\right)}$$

Let: $P = cos\theta + cos2\theta + cos3\theta + .. + cos8\theta \;\; and \;\; Q = sin\theta + sin2\theta + sin3\theta + .. + sin8\theta$

b) Use your answer to part a to show that $P = cos\frac{9\theta}{2}sin4\theta cosec\frac{\theta}{2}$, and find similar expressions for $Q$ and $\frac{P}{Q}$