Hint for Chapter 1 Section 8 Problem 9

Use the equality

$$\frac{1-e^{i(n+1)\theta}}{1-e^{i\theta}} = \left(\frac{1-e^{i(n+1)\theta}}{1-e^{i\theta}}\right)\left(\frac{e^{-i\theta/2}}{e^{-i\theta/2}}\right),$$

multiply out the right hand side, and note that the denominator becomes $-i2\sin(\theta/2)$.