In plane polar coordinates Laplace's equation takes the form

$$\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r} + \frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2} = 0$$

The solution required is finite in the region $r \geq 2$, is periodic in $\theta$ with period $2\pi$, and is an odd function of $\theta$ :

$$u(r, \theta) = -u(r, -\theta),$$

(a) Use separation of variables to show that the general solution may be written in the form

$$u(r, \theta) = \sum_{n=1}^{\infty} B_n r^{-n} \sin(n\theta).$$