3. The angle θ, $0 < \theta < \dfrac{\pi}{2}$, satisfies

$$\tan\theta \tan 2\theta = \sum_{r=0}^{\infty} 2\cos^r 2\theta$$

(a) Show that $\tan\theta = 3^p$, where p is a rational number to be found.

(8)

(b) Hence show that $\dfrac{\pi}{6} < \theta < \dfrac{\pi}{4}$

(2)