

STEP III, 2007, Q1

- 1 In this question, do not consider the special cases in which the denominators of any of your expressions are zero.

Express $\tan(\theta_1 + \theta_2 + \theta_3 + \theta_4)$ in terms of t_i , where $t_1 = \tan \theta_1$, etc.

Given that $\tan \theta_1$, $\tan \theta_2$, $\tan \theta_3$ and $\tan \theta_4$ are the four roots of the equation

$$at^4 + bt^3 + ct^2 + dt + e = 0$$

(where $a \neq 0$), find an expression in terms of a , b , c , d and e for $\tan(\theta_1 + \theta_2 + \theta_3 + \theta_4)$.

The four real numbers θ_1 , θ_2 , θ_3 and θ_4 lie in the range $0 \leq \theta_i < 2\pi$ and satisfy the equation

$$p \cos 2\theta + \cos(\theta - \alpha) + p = 0,$$

where p and α are independent of θ . Show that $\theta_1 + \theta_2 + \theta_3 + \theta_4 = n\pi$ for some integer n .



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