4 The quartic equation $x^4 + x^3 + x^2 + x + 1 = 0$ has roots α, β, γ, δ.

(a) Show that a quartic equation with roots $2\alpha + 1, 2\beta + 1, 2\gamma + 1, 2\delta + 1$ is

$$y^4 - 2y^3 + 4y^2 + 2y + 11 = 0.$$ [4]

The sum $(2\alpha + 1)^n + (2\beta + 1)^n + (2\gamma + 1)^n + (2\delta + 1)^n$ is denoted by S_n.

(b) Find the value of S_2. [2]

(c) Given that $S_3 = -22$, find the value of S_4. [2]