

## STEP III, 2003 Q4

- 4 A curve is defined parametrically by

$$x = t^2, \quad y = t(1 + t^2).$$

The tangent at the point with parameter  $t$ , where  $t \neq 0$ , meets the curve again at the point with parameter  $T$ , where  $T \neq t$ . Show that

$$T = \frac{1 - t^2}{2t} \quad \text{and} \quad 3t^2 \neq 1.$$

Given a point  $P_0$  on the curve, with parameter  $t_0$ , a sequence of points  $P_0, P_1, P_2, \dots$  on the curve is constructed such that the tangent at  $P_i$  meets the curve again at  $P_{i+1}$ . If  $t_0 = \tan \frac{7\pi}{18}$ , show that  $P_3 = P_0$  but  $P_1 \neq P_0$ . Find a second value of  $t_0$ , with  $t_0 > 0$ , for which  $P_3 = P_0$  but  $P_1 \neq P_0$ .



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