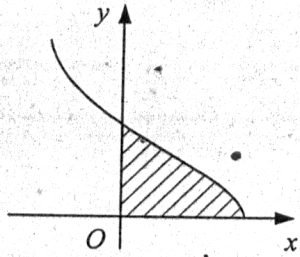

The diagram shows the curve with parametric equations

$$x = \cos 2t, \quad y = \tan t, \quad 0 \le t < \frac{\pi}{2}.$$

The shaded region is bounded by the curve and the coordinate axes.

a Show that the area of the shaded region is given by

$$\int_0^{\frac{\pi}{4}} 4\sin^2 t \, dt.$$

b Hence find the area of the shaded region, giving your answer in terms of π.

c Write down expressions in terms of $\cos 2A$ for

i $\sin^2 A$,

ii $\cos^2 A$,

and hence find a cartesian equation for the curve in the form $y^2 = f(x)$.