

3F More Loci

1. The tangent to the ellipse with equation $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ at the point $P(a \cos t, b \sin t)$ crosses the x -axis at A and the y -axis at B .

Find an equation for the locus of the mid-point of AB as P moves around the ellipse.

2. The normal at $P(ap^2, 2ap)$ and the normal at $Q(aq^2, 2aq)$ to the parabola with equation $y^2 = 4ax$ meet at R .
- a) Find the coordinates of R .

The chord PQ passes through the focus $(a, 0)$ of the parabola.

- b) Show that $pq = -1$

- c) Show that the locus of R is a parabola with equation $y^2 = a(x - 3a)$