**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 $P\left(a\cos(t),b\sin(t)\right)$ 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.

1. The normal at $P\left(ap^{2}, 2ap\right)$ and the normal at $Q\left(aq^{2}, 2aq\right)$ to the parabola with equation $y^{2}=4ax$ meet at $R$.
2. Find the coordinates of $R$.

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

1. Show that $pq=-1$
2. Show that the locus of $R$ is a parabola with equation $y^{2}=a\left(x-3a\right)$