Year 11 Extension 1	**Parameters Assignment**	**Date Due:**

1. Derive the Cartesian equation for $x = 4p$, $y = 2p^2 - 2$.

2. By first finding the focal length, a, write down the parametric equations for:
   (a) $x^2 = 20y$ (b) $y = 4x^2$

3. (a) Derive the equation of the chord of the parabola joining $P(10p, 5p^2)$ and $Q(10q, 5q^2)$ on the parabola $x^2 = 20y$.

   (b) Show that the condition for PQ to be a focal chord is that $pq = -1$.

4. The points $P(2ap, ap^2)$ and $Q(2aq, aq^2)$ are the points on the parabola $x^2 = 4ay$.

   (a) Derive the equation of the tangent at P.

   (b) Determine the coordinates of M, the point of the tangents at P and Q.

   (c) Find the coordinates of R, the mid-point of the chord PQ.

   (d) Show the parabola bisects MR.

5. PQ is a focal chord of the parabola $x^2 = 4ay$. The tangent at $P(2ap, ap^2)$ meets the latus rectum at L. If S is the focal of the parabola, prove that $SL^2 = SP.SQ$.

6. P is the point with parameter p on the parabola $x^2 = 8y$.

   (a) Prove that the equation of the normal at P is $x + py = 2p^3 + 4p$.

   (b) Show that the locus of R, the point of intersection of normals at P and Q, the endpoints of focal chord PQ, is given by $x^2 = 2(y - 6)$.

7. $P(2ap, ap^2)$ is a point on the parabola $x^2 = 4ay$.

   (a) Write down the equation of the tangent at P.

   (b) Derive the equation of the perpendicular drawn from S, the focus, to the tangent at P. Note that this will not be the normal.

   (c) Find the equation of the locus of N, the foot of the perpendicular from S, to the tangent.

8. Find the equation of the chord of contact drawn to $x^2 = 8y$ from external point $(-2, -4)$.

9. $P(2at, at^2)$ is a point on the parabola $x^2 = 4ay$ and m is the tangent at P.

   (a) Write down the equation of m.

   (b) If m cuts the x-axis at T and the y-axis at R, find the coordinates of T and R.

   (c) Find the ratio in which P divides TR.

   (d) Show that m makes equal angles with the y-axis and with PS, where S is the focus.

10. Find the equation of the locus of the mid-points of all chords of the parabola passing through a point P, with parameter p, and the vertex of the parabola $x^2 = 2y$.