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6. The parabola C has Cartesian equation $y^2 = 8x$

The point $P(2p^2, 4p)$ and the point $Q(2q^2, 4q)$, where $p, q \neq 0$, $p \neq q$, are points on C.

(a) Show that an equation of the normal to C at P is

$$y + px = 2p^3 + 4p$$

(5)

(b) Write down an equation of the normal to C at Q

(1)

The normal to C at P and the normal to C at Q meet at the point N

(c) Show that N has coordinates

$$\left(2(p^2 + pq + q^2 + 2), -2pq(p + q)\right)$$

(5)

The line ON, where O is the origin, is perpendicular to the line PQ

(d) Find the value of $(p + q)^2 - 3pq$

(5)

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Q6