**9.** The rectangular hyperbola $H$ has equation $xy = c^2$ where $c$ is a positive constant.

The point $P\left(ct, \frac{c}{t}\right)$, where $t > 0$, lies on $H$

(a) Use calculus to show that an equation of the normal to $H$ at $P$ is

$$t^3x - ty = c(t^4 - 1)$$

**(4)**

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

The normal to $H$ at the point with coordinates (8, 2) meets $C$ at the point $Q$ where $y > 0$

(b) Determine the exact coordinates of $Q$

**(4)**

Given that

- the point $R$ is the focus of $C$
- the line $l$ is the directrix of $C$
- the line through $Q$ and $R$ meets $l$ at the point $S$

(c) determine the exact length of $QS$

**(5)**

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**Question 9 continued**

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**(Total for Question 9 is 13 marks)**

**TOTAL FOR PAPER IS 75 MARKS**

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