| Question Number | Scheme | Marks |
|---|---|---|
| **8(a)** | $200t^3 = 25$ or $\left(\frac{25}{x}\right)^2 = 40x$ or $y^2 = 40\left(\frac{25}{y}\right)$ | M1 |
| | $t = \frac{1}{2}$ or $x = \frac{5}{2}$ or $y = 10$ | A1 |
| | $\left(\frac{5}{2}, 10\right)$ | A1 (3) |
| **(b)** | $y^2 = 40x \Rightarrow x = \frac{y^2}{40} \Rightarrow \frac{dx}{dy} = \frac{2y}{40}$ or $2y\frac{dy}{dx} = 40 \Rightarrow \frac{dy}{dx} = \frac{40}{2y}$ or $\frac{dy}{dx} = \frac{\sqrt{10}}{\sqrt{x}}$<br>or by parametric differentiation: $\frac{dy}{dx} = \frac{1}{t}$ | B1 |
| | at $(10,20)$: $\frac{dy}{dx} = 1$ or $\frac{dx}{dy} = 1$ | M1 |
| | Grad normal $= -1$ | A1 |
| | $y - 20 = -(x - 10)$ | M1 |
| | $x + y - 30 = 0$ | A1 (5) |
| **(c)** | $xy = 25 \quad x + y - 30 = 0$ | |
| | $x + \frac{25}{x} - 30 = 0$ or $\frac{25}{y} + y - 30 = 0$ or $\frac{5}{t} + 5t - 30 = 0$ | M1 |
| | $x^2 - 30x + 25 = 0$ or $y^2 - 30y + 25 = 0$ or $5t^2 - 30t + 5 = 0$ | dM1 |
| | $x = 15 \pm \sqrt{200}$ or $y = 15 \pm \sqrt{200}$ or $t = 3 \pm 2\sqrt{2}$ (or exact equivalents) | A1 |
| | eg $x = 15 + \sqrt{200} \Rightarrow y = 15 - \sqrt{200}$ | ddM1 |
| | $(15 + 10\sqrt{2}, 15 - 10\sqrt{2}) \quad (15 - 10\sqrt{2}, 15 + 10\sqrt{2})$ | A1A1 (6) |
| | | **[14]** |

**(a)**

**M1** Attempt an equation in a single variable.

**A1** Correct value for $x$, $y$ or $t$

**A1** Correct values for $x$ and $y$. Need not be in coordinate brackets. No other points seen.

**(b)**

**B1** Any correct expression involving the derivative, $\frac{dy}{dx}$ or $\frac{dx}{dy}$, for $P$

**M1** Attempt to obtain value of their derivative at (10, 20). May be from an incorrect curve.

**A1** Correct gradient of normal.

**M1** Equation of normal by any complete method. Must involve a sign change of their derivative and have numerical gradient. Cam be scored from an incorrect starting equation/point.

**A1** Correct equation in form demanded (though terms may be in different order).

**(c)**

**M1** Use the equation of $H$ and their equation of the normal from (b) to obtain an equation in a single variable

**dM1** Obtains a 3TQ and attempts to solve by any valid means.

**A1** Correct values for $x$ or $y$ or $t$. Must be exact but need not be fully simplified (but discriminant must be evaluated).

**ddM1** Use at least one of their values for $x$ or $y$ to obtain a value for the other coordinate or $t$ to find at least one set of coordinates. (Can be scored with inexact values.)

**A1** Either pair of coordinates correct. Allow if unsimplified.

**A1** Second pair of coordinates correct and no extra solutions and both pairs in simplest form (as shown in scheme). Need not be coordinates as long as correctly paired.

Award A1A0 if $x = 15 \pm 10\sqrt{2}, y = 15 \pm 10\sqrt{2}$ is given