Question	Scheme	Marks
6(a)	$a = 5$	B1
		(1)
(b)	$\frac{dy}{dx} = -\frac{20}{x^2}$ or $\frac{dy}{dx} = -\frac{2\sqrt{5}}{t^2} \div 2\sqrt{5} = -\frac{1}{t^2}$ or $x\frac{dy}{dx} + y = 0$ oe	B1
	Gradient of normal is $\frac{-1}{"-1/t^2"} = t^2$	M1
	Normal is $y - \frac{2\sqrt{5}}{t} = t^2\left(x - 2t\sqrt{5}\right)$	M1
	$\Rightarrow ty - 2\sqrt{5} = t^3x - 2t^4\sqrt{5} \Rightarrow ty - t^3x - 2\sqrt{5}\left(1 - t^4\right) = 0$ *	A1*
		(4)
(c)	$cy - c^3x - 2\sqrt{5}\left(1 - c^4\right) = 0$ passes through $\left(-\frac{\sqrt{5}}{c}, -4c\sqrt{5}\right)$ $\Rightarrow -4c^2\sqrt{5} + c^2\sqrt{5} - 2\sqrt{5}\left(1 - c^4\right) = 0$	M1
	$\Rightarrow 2c^4 - 3c^2 - 2 = 0$ (oe)	A1
	$\Rightarrow c^2 = \frac{3 \pm \sqrt{9 - 4 \times 2 \times -2}}{4} = \ldots\left(2, -\frac{1}{2}\right)$	dM1
	$c^2 > 0 \Rightarrow c^2 = 2 \Rightarrow c = \pm\sqrt{2}$	A1
		(4)
		(9 marks)

Notes:

(a)

B1: Correct value stated.

(b)

B1: Correct expression for $\frac{dy}{dx}$, or any equivalent correct expression including it, such as $x\frac{dy}{dx} + y = 0$ or $\frac{dy}{dx} = -\frac{1}{t^2}$

M1: Attempts negative reciprocal gradient at the point *P*. Allow with *a* instead of 5 for this mark, so score for e.g. $m_N = \frac{4at^2}{20}$.

M1: Uses their normal (changed from tangent) gradient and *P* to find the equation of the tangent. Look for $y - \frac{2\sqrt{5}}{t} = "m_n"\left(x - t\sqrt{5}\right)$. If using $y = mx + c$ they must proceed as far as finding *c*.

A1*: Correct equation achieved from correct working with intermediate step.

(c)

M1: Substitutes the parameter for A into the normal equation and attempts to substitute the coordinates of B to obtain an equation in one variable. Allow if there are slips during substitution.

A1: Correct quadratic in c^2 need not be simplified.

dM1: Solves their (at least two term) quadratic in c^2 to find a value for at least c^2

A1: Deduces correct values. Both required. Ignore reference to any complex roots.

Alts

(c)	$cy - c^3x - 2\sqrt{5}\left(1-c^4\right) = 0$ intersects H again $\Rightarrow \frac{20}{x}c - c^3x - 2\sqrt{5}\left(1-c^4\right) = 0$ or $cy - \frac{20}{y}c^3 - 2\sqrt{5}\left(1-c^4\right) = 0$ $\Rightarrow c^3x^2 + 2\sqrt{5}\left(1-c^4\right)x - 20c = 0$ or $cy^2 - 2\sqrt{5}\left(1-c^4\right)y - 20c^3 = 0$	**M1** **A1**
	$\Rightarrow \left(c^3x + 2\sqrt{5}\right)\left(x - 2c\sqrt{5}\right) = 0$ or $\left(cy - 2\sqrt{5}\right)\left(y + 2\sqrt{5}c^3\right) = 0$ $\left(x = 2c\sqrt{5} \text{ is } A \text{ so }\right)$ for B $x = -\frac{2\sqrt{5}}{c^3} = -\frac{\sqrt{5}}{c} \Rightarrow c = ...$ $\left(\text{or } y = \frac{2\sqrt{5}}{c} \text{ is } A \text{ so }\right)$ for B $y = -2\sqrt{5}c^3 = -4c\sqrt{5} \Rightarrow c = ...$	**M1**
	$\Rightarrow c^2 = 2 \Rightarrow c = \pm\sqrt{2}$	**A1**
		(4)

Notes:

(c)

M1: Substitutes parameters for A and equation for H into normal to obtain a quadratic in x.

A1: Correct quadratic in x or y

M1: Solves the quadratic in x or y, identifies correct solution and equates to the relevant coordinate of B and solves for c

A1: Deduces correct values. Both required.

(c)	$m_{AB} = \frac{\frac{2\sqrt{5}}{c} - \left(-4c\sqrt{5}\right)}{2\sqrt{5}c - \left(-\frac{\sqrt{5}}{c}\right)}$	**M1**
	$m_{AB} = \frac{2+4c^2}{2c^2+1} = 2$	**A1**
	From (b), normal at A has gradient $(t^2 =)c^2 \Rightarrow c^2 = 2$	**M1**
	$\Rightarrow c^2 = 2 \Rightarrow c = \pm\sqrt{2}$	**A1**
		(4)

Notes:

(c)
M1: Attempts the gradient of *AB*.
A1: Correct gradient need not be simplified.
M1: Finds/deduces the gradient of the normal at *A* and sets equal to their gradient of *AB*.
A1: Deduces correct values. Both required.