Question Number	Scheme	Marks
2 (a)	$3^{3x} = \left(3^x\right)^3 = y^3$	B1 **(1)**
(b)	$\dfrac{1}{3^{x-2}} = \dfrac{1}{3^x \times 3^{-2}} = \dfrac{9}{y}$	M1 A1 **(2)**
(c)	$\dfrac{81}{9^{2-3x}} = \dfrac{9^2}{9^{2-3x}} = 9^{2-(2-3x)} = 9^{3x} = 3^{6x} = y^6$	M1 A1 **(2)**
		(5 marks)

Note: Correct answer in any part implies full marks for that part

(a)

B1 y^3 Condone $(y)^3$. Ignore once correct answer seen.

(b)

M1 For correct application of the addition/subtraction law so award for eg:

$\dfrac{1}{3^x \times 3^{-2}}$ or $\dfrac{1}{3^x \div 3^2}$ or $\dfrac{1}{\left(\dfrac{3^x}{3^2}\right)}$ or $\dfrac{1}{y \times 3^{-2}}$ or $\dfrac{3^2}{3^x}$ or sight of 9 or $\dfrac{1}{y}$ oe

A1 For $\dfrac{9}{y}$ or $9y^{-1}$ but NOT expressions that still contain $\div$ or fractions within fractions or $3^2 y^{-1}$. Ignore once correct answer seen.

(c)

M1 For simplifying the indices to expressions of the form $9^{\cdots}$ or $3^{\cdots}$ (not as a denominator) so award for 9^{3x}, $\left(9^x\right)^3$, 3^{6x}, $\left(3^x\right)^6$, or $k \times y^6$, $k \neq 0$ which must come from correct working. Also allow unsimplified equivalent expressions of the final answer eg $\dfrac{1}{y^{-6}}$ as long as it in terms of y

A1 y^6 only (not eg $\dfrac{1}{y^{-6}}$). Ignore once correct answer seen. Condon $(y)^6$

Note: In all parts they may work from $y = 3^x$ and manipulate both sides to the given answer which is acceptable.

Eg part (b): $y = 3^x \Rightarrow y \times 3^{-2} = 3^{x-2}$ (M1) $\Rightarrow \dfrac{1}{y \times 3^{-2}} = \dfrac{1}{3^{x-2}} \Rightarrow \dfrac{9}{y} = \dfrac{1}{3^{x-2}}$ (A1)

Eg part (c): $y = 3^x \Rightarrow y^{-6} = 3^{-6x} \Rightarrow 81y^{-6} = 3^{4-6x}$ (M1) $\Rightarrow 81y^{-6} = 9^{2-3x} \Rightarrow \dfrac{81}{9^{2-3x}} = y^6$ (A1)

Question Number	Scheme	Marks
3.(a)	Attempts $\left(\frac{dy}{dx}=\right) 2x+3$ at $x=3$	M1
	At $x=3$ gradient of tangent = 9	A1 **(2)**
(b)	$\left(y_Q=\right) (3+h)^2+3(3+h)-2$	B1
	Gradient $PQ=\frac{(3+h)^2+3(3+h)-2-16}{3+h-3}=\frac{9h+h^2}{h}=9+h$	M1 A1 **(3)**
(c)	States as $h\to 0$ Gradient $PQ\to 9$ = Gradient of tangent	B1 **(1)**
		(6 marks)

(a)

M1 Attempts to find the value of $\left(\frac{dy}{dx}=\right) ax+3,\quad a>0$ at $x=3$. Look for 3 to be substituted into the expression and proceeding to a value.

A1 9 (Answer only scores both marks)

(b)

B1 $\left(y_Q=\right) (3+h)^2+3(3+h)-2$ (seen or implied)

M1 Attempts $\pm\frac{y_Q-16}{x_Q-3}$ condoning slips, but must be a genuine attempt at y_Q. Condone lack of brackets if implied by later working.

A1 $9+h$ with no errors seen and not originating from methods in calculus. This expression may immediately follow a correct simplified expression of $y_Q=h^2+9h+16$

(c)

B1 States as $h\to 0$ Gradient $PQ\to 9$ = Gradient of tangent (oe)

They must have achieved $9+h$ in (b) and 9 in (a)

There should be reference to "limit" or "as *h* tends to 0" (words or symbols) and linked to part (a) (so same gradient, or showing the answers agree). But be generous with the explanation beyond these contraints.