Y	Q	Differentiation	
2024	4	Given $y = \dfrac{3x}{1+x^2}$, find $\dfrac{dy}{dx}$ and simplify your answer.	3
2024	6	A function is defined on a suitable domain by $f(x) = \operatorname{cosec}^2(3x)$. Evaluate $f'\left(\dfrac{\pi}{4}\right)$.	3
2024	9	The velocity, $v\,\text{m s}^{-1}$, of a particle is defined by $3v + t^2 e^v = 9$, where t is the time in seconds, and $t > 0$. Use implicit differentiation to determine the instantaneous acceleration of the particle when $v = 0$.	5
2024	16	A curve is defined parametrically by $x = e^{3t} - e^{2t}$, $y = e^{3t} + e^{2t}$. Find the coordinates of the point where the gradient of the curve is 2.	4
2023	2	Differentiate $f(x) = \ln(\sec 2x)$ and simplify your answer.	3
2023	7	Given $f(t) = \dfrac{5t}{t^2 + 3}$, find the value of k when $f'(k) = 0$, where $k > 0$.	3
2023	12	A bead travels along a wire modelled by part of the curve with equation $x^3 + y^2 + 2x - 4y = 33$. The bead passes through two points with coordinates of the form $(2, k)$. Determine the value of k for which the gradient is positive.	5
2022	13	A function is defined as $f(x) = \dfrac{\sec x}{\tan x + 1}$, where $0 \le x < \dfrac{\pi}{2}$. (a) Show that $f'(x) = f(x)\left(\dfrac{\tan x - 1}{\tan x + 1}\right)$, given that $1 + \tan^2 x = \sec^2 x$. (b) Hence find $\displaystyle\int \dfrac{\tan x - 1}{\tan x + 1}\,dx$.	3 2
2019	2	(a) If $f(x) = xe^{-3x}$, find the exact value of $f'(-1)$. (b) Given $g(t) = \dfrac{3t}{(2t+1)^2}$, find $g'(t)$, simplifying your answer.	3 3
2019	7	A function, f, is defined on a suitable domain by $f(t) = \ln(\sec 2t + \tan 2t)$. Differentiate $f(t)$ and simplify your answer.	4
2019	10	A curve is defined implicitly by $3y + x^2 e^{2y} = 9$, $x > 0$. Find the gradient of the tangent to the curve when $y = 0$.	4
2018	4	A function is defined as $f(x) = e^{\sec^2 x}$ where $0 \le x < \dfrac{\pi}{2}$. Find the exact value of $f'\left(\dfrac{\pi}{4}\right)$.	3

2018	8	The motion of a particle is defined by the equations $$x = t(t+4) \text{ and } y = t(1-t)^3$$ where t is the time elapsed since the start of motion. Find the speed of the particle when $t = 3$.	4
2017	2	(a) If $f(x) = \dfrac{\ln x}{2x^2}$, $x \neq 0$, find $f'(x)$. Fully simplify your answer. (b) If $y = \operatorname{cosec}^2 3x$, show that $$\frac{dy}{dx} + 6y\cot 3x = 0.$$	3 3
2017	11	A curve is defined by $3y^2 - x^2y = 4$, $x \geq 0$, $y \geq \dfrac{2}{\sqrt{3}}$. Use implicit differentiation to find the gradient of the tangent when $x = 2$.	5
2016	4	Find the equation of the tangent to the curve $y = x \ln x$ at the point where $x = e$.	3
2016	10	A stone is thrown from the top of a cliff and the subsequent motion can be modelled in the xy plane by the equations $x = 4t$ and $y = 20 + 2t - 5t^2$. (a) Use parametric differentiation to find $\dfrac{dy}{dx}$ in terms of t. (b) (i) Find the angle of projection of the stone. (ii) By considering $\dfrac{dy}{dx}$ find the value of t when the stone is moving at 45° below the horizontal.	2 2 2
2016 Spec	2	Given $y = e^{x^2} \cos x$ find $\dfrac{dy}{dx}$.	3
2016 Spec	7	Calculate the gradient of the tangent to the curve $xy^2 - 4xy = 5$ at the point $(1,5)$.	4