Differentiation 1 - Marking Scheme

Q1.

(i)	Use quotient or product rule to differentiate $(1-x)/(1+x)$	M1	
	Obtain correct derivative in any form	A1	
	Use chain rule to find $\frac{dy}{dx}$	M1	
	Obtain a correct expression in any form	A1	
	Obtain the gradient of the normal in the given form correctly	A1	[5]
(ii)	Use product rule	M1	
	Obtain correct derivative in any form	A1	
	Equate derivative to zero and solve for x	M1	
	Obtain $x = \frac{1}{2}$	A1	[4]

Q2.

(i)	*EITHER*:	State or imply $\frac{1}{y}\frac{dy}{dx}$ as derivative of $\ln y$	B1	
		State correct derivative of LHS, e.g. $\ln y + \frac{x}{y}\frac{dy}{dx}$	B1	
		Differentiate RHS and obtain an expression for $\frac{dy}{dx}$	M1	
		Obtain given answer	A1	
	OR 1:	State $\ln y = \frac{2x+1}{x}$, or equivalent, and differentiate both sides	M1	
		State correct derivative of LHS, e.g. $\frac{1}{y}\frac{dy}{dx}$	B1	
		State correct derivative of RHS, e.g. $-1/x^2$	B1	
		Rearrange and obtain given answer	A1	
	OR 2:	State $y = \exp(2+1/x)$, or equivalent, and attempt differentiation by chain rule	M1	
		State correct derivative of RHS, e.g. $-\exp(2+1/x)/x^2$	B1 + B1	
		Obtain given answer	A1	[4]
		[The B marks are for the exponential term and its multiplier.]		
(ii)	State or imply $x = -\frac{1}{2}$ when $y = 1$		B1	
	Substitute and obtain gradient of –4		B1√	
	Correctly form equation of tangent		M1	
	Obtain final answer $y + 4x + 1 = 0$, or equivalent		A1	[4]

Differentiation 1 - Marking Scheme

Q3.

Use of correct quotient or product rule to differentiate x or t		M1	
Obtain correct $\dfrac{3}{(2t+3)^2}$ or unsimplified equivalent		A1	
Obtain $-2e^{-2t}$ for derivative of y		B1	
Use $\dfrac{dy}{dx} = \dfrac{dy}{dt} \Big/ \dfrac{dx}{dt}$ or equivalent		M1	
Obtain -6	cwo	A1	[5]

Alternative:

Eliminate parameter and attempt differentiation $\left(y = e^{\frac{-6x}{1-2x}}\right)$		B1	
Use correct quotient or product rule		M1	
Use chain rule		M1	
Obtain $\dfrac{dy}{dx} = \dfrac{-6}{(1-2x)^2} e^{\frac{-6x}{1-2x}}$		A1	
Obtain -6	cwo	A1	

Q4.

(i)	Obtain $\dfrac{k\cos 2x}{1+\sin 2x}$ for any non-zero constant k	M1	
	Obtain $\dfrac{2\cos 2x}{1+\sin 2x}$	A1	[2]
(ii)	Use correct quotient or product rule	M1	
	Obtain $\dfrac{x\sec^2 x - \tan x}{x^2}$ or equivalent	A1	[2]

Q5.

(i)	Use at least one of $e^{2x} = 9$, $e^{y} = 2$ and $e^{2y} = 4$	B1	
	Obtain given result $58 + 2k = c$ **AG**	B1	[2]
(ii)	Differentiate left-hand side term by term, reaching $ae^{2x} + be^{y}\dfrac{dy}{dx} + ce^{2y}\dfrac{dy}{dx}$	M1	
	Obtain $12e^{2x} + ke^{y}\dfrac{dy}{dx} + 2e^{2y}\dfrac{dy}{dx}$	A1	
	Substitute (ln 3, ln 2) in an attempt involving implicit differentiation at least once, where RHS = 0	M1	
	Obtain $108 - 12k - 48 = 0$ or equivalent	A1	
	Obtain $k = 5$ and $c = 68$	A1	[5]

Differentiation 1 - Marking Scheme

Q6.

(i)	*EITHER*:	State $\frac{dx}{dt} = \sec^2 t / \tan t$, or equivalent	B1	
		State $\frac{dy}{dt} = 2\sin t \cos t$, or equivalent	B1	
		Use $\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$	M1	
		Obtain correct answer in any form, e.g. $2\sin^2 t \cos^2 t$	A1	
	OR:	Obtain $y = e^{2x} / (1 + e^{2x})$, or equivalent	B1	
		Use correct quotient or product rule	M1	
		Obtain correct derivative in any form, e.g. $2e^{2x} / (1 + e^{2x})^2$	A1	
		Obtain correct derivative in terms of t in any form, e.g. $(2\tan^2 t) / (1 + \tan^2 t)^2$	A1	[4]

(ii)	State or imply $t = \frac{1}{4}\pi$ when $x = 0$	B1	
	Form the equation of the tangent at $x = 0$	M1	
	Obtain correct answer in any horizontal form, e.g. $y = \frac{1}{2}x + \frac{1}{2}$	A1	[3]

[SR: If the *OR* method is used in part **(i)**, give B1 for stating or implying $y = \frac{1}{2}$ or $\frac{dy}{dx} = \frac{1}{2}$ when $x = 0$.]

Q7.

Use correct quotient or product rule	M1	
Obtain correct derivative in any form, e.g. $-\frac{3\ln x}{x^4} + \frac{1}{x^4}$	A1	
Equate derivative to zero and solve for x an equation of the form $\ln x = a$, where $a > 0$	M1	
Obtain answer $\exp(\frac{1}{3})$, or 1.40, from correct work	A1	[4]

Differentiation 1 - Marking Scheme

Q8.

EITHER:	Use chain rule	M1	
	obtain $\dfrac{dx}{dt} = 6\sin t\cos t$, or equivalent	A1	
	obtain $\dfrac{dy}{dt} = -6\cos^2 t\sin t$, or equivalent	A1	
	Use $\dfrac{dy}{dx} = \dfrac{dy}{dt} \div \dfrac{dx}{dt}$	M1	
	Obtain final answer $\dfrac{dy}{dx} = -\cos t$	A1	
OR:	Express y in terms of x and use chain rule	M1	
	Obtain $\dfrac{dy}{dx} = k(2 - \dfrac{x}{3})^{\frac{1}{2}}$, or equivalent	A1	
	Obtain $\dfrac{dy}{dx} = -(2 - \dfrac{x}{3})^{\frac{1}{2}}$, or equivalent	A1	
	Express derivative in terms of t	M1	
	Obtain final answer $\dfrac{dy}{dx} = -\cos t$	A1	[5]

Q9.

2	Use correct quotient or product rule or equivalent	M1	
	Obtain $\dfrac{(1+e^{2x}).2e^{2x} - e^{2x}.2e^{2x}}{(1+e^{2x})^2}$ or equivalent	A1	
	Substitute $x = \ln 3$ into attempt at first derivative and show use of relevant logarithm property at least once in a correct context	M1	
	Confirm given answer $\frac{9}{50}$ legitimately	A1	[4]

Differentiation 1 - Marking Scheme

Q10.

8	**(i)**	Differentiate y to obtain $3\sin^2 t\cos t - 3\cos^2 t\sin t$ o.e.	B1	
		Use $\frac{dy}{dx} = \frac{dy}{dt} / \frac{dt}{dx}$	M1	
		Obtain given result $-3\sin t\cos t$	A1cwo	[3]
	(ii)	Identify parameter at origin as $t = \frac{3}{4}\pi$	B1	
		Use $t = \frac{3}{4}\pi$ to obtain $\frac{3}{2}$	B1	[2]
	(iii)	Rewrite equation as equation in one trig variable e.g. $\sin 2t = -\frac{2}{3}$, $9\sin^4 x - 9\sin^2 x + 1 = 0$, $\tan^2 x + 3\tan x + 1 = 0$	B1	
		Find at least one value of t from equation of form $\sin 2t = k$ o.e.	M1	
		Obtain 1.9	A1	
		Obtain 2.8 and no others	A1	[4]