A2 Assignment zeta Cover Sheet **Name:**

	Question	Done	Back		Topic	Comment
Drill	Aa)				C4 Integration Reverse chain	$\frac{1}{6}(2x-1)^3+c$
	Ab)				C4 Integration Inspection	$\frac{1}{2}x^2-\frac{1}{2}\sec 2x+c$
	Ac)				C4 Integration Inspection	$\frac{1}{2}\ln x+c$
	Ba)				C3 Differentiation – product rule & chain rule	$3e^{5x}(1+5x)$
	Bb)				C3 Differentiation – product rule & chain rule	$-e^{-3x}(3\cot x+\operatorname{cosec}^2 x)$
	Bc)				C3 Differentiation – product rule & chain rule	$\ln(2-x)-\frac{x}{2-x}$
	Bd)				C3 Differentiation – product rule & chain rule	$2x^{-1}\ln 3x$
	Ca)				C3 Functions – Inverse, domain and range	$f^{-1}(x)=1+\sqrt{x-4}$
	Cb)				C3 Functions – Inverse, domain and range	$f^{-1}(x)=-2+\sqrt{x+5}$
	Cc)				C3 Functions – Inverse, domain and range	$f^{-1}(x)=\sqrt{x+4}-2$
	Da)				C3 Trig equations	$\frac{\pi}{3},\frac{5\pi}{3},1.82,4.46$
	Db)				C3 Trig equations	$\frac{\pi}{8},\frac{3\pi}{8},\frac{5\pi}{8},\frac{7\pi}{8},\frac{9\pi}{8},\frac{11\pi}{8},\frac{13\pi}{8},\frac{15\pi}{8}$
Current Work	1a				C3 Differentiation – all types	$\cos x\ln 2x+\frac{1}{x}\sin x$
	1b				C3 Differentiation – all types	$36x\sec(6x^2+5)\tan(6x^2+5)$
	1c				C3 Differentiation – all types	$-3\cos^5\left(\frac{x}{2}\right)\sin\left(\frac{x}{2}\right)$
	1d				C3 Differentiation – all types	$e^{2x}(2\ln 2x+x^{-1})$
	1e				C3 Differentiation – all types	$2x\sec^2(x^2+3)$
	1f				C3 Differentiation – all types	$4\sec^2 2x\tan 2x$
	1g				C3 Differentiation – all types	$\frac{5}{x}$
	1h				C3 Differentiation – all types	$4-\frac{1}{4}e^x$
	1i				C3 Differentiation – all types	$-\frac{2}{x^3}-\frac{3}{x^4}$
	1j				C3 Differentiation – all types	$\frac{1}{x}$
	1k				C3 Differentiation – all types	$2e^x-\frac{4}{x}$
	1l				C3 Differentiation – all types	$\frac{3-3\sin x+3x\cos x}{(1-\sin x)^2}$
	1m				C3 Differentiation – all types	$\frac{e^x(x\ln x-1)}{x(\ln x)^2}$

	1n					C3 Differentiation – all types	$\frac{2}{x}$
	1o					C3 Differentiation – all types	$\frac{5}{2x}$
	2a					C3 e and natural log equations	$\frac{1}{6}(e-1)$
	2b					C3 e and natural log equations	$\frac{1}{3}(\ln 2+1)$
	2c					C3 e and natural log equations	$2\ln 2$
	2d					C3 e and natural log equations	$\frac{1}{3}(\ln 28-1)$
	3					C3 Differentiation – stationary points and tangent	$\left(e^{-1/2}, -0.5e^{-1}\right)$ $y = 3ex - 2e^2$
	4					C3 Differentiation –tangent and triangle	$\frac{1}{4e}$
	5					C2 Integration	$k = 16$
	6a					C3 Algebraic fractions	Proof
	6b					C3 Functions - range	$f \in \Re : f \neq 0$
	6c					C3 Functions – inverse & domain	$f^{-1}(x) = \frac{4-x}{2x}, x \in \Re : x \neq 0$
	6d					C3 Functions – inverse & range	$f^{-1}(x) > 1$
	7a					C3 Trig identities	PROOF
	7b					C3 Trig identities	PROOF
	8					C3 Algebraic fractions	$\frac{2x}{x-5}$
	9					Diff eq	5.9 mins
M1 Practice	10					M1 Force diagrams with friction.	(a) 820 N (b) 870 N
Challenge						Circles inscribed in a triangle.	1:9
Extra questions						C3 Differentiation x = …	Show that
						C3 Differentiation - find tangent and y coordinate	a) show b) k = -1/4
						C3 Trig proof & Solve	a) i) show ii) $\frac{\sqrt{6}}{2}$ b) 210, 330

α	β	γ	δ	ε	**ζ**	η	θ	ι	κ	λ	μ	ν	ξ	o	π	ρ	σ	τ	υ	φ	χ	ψ	ω

"The mathematician's patterns, like the painter's or the poet's, must be beautiful: the ideas, like the colours or the words, must fit together in a harmonious way. Beauty is the first test."

G H Hardy

A2 Maths with Mechanics Assignment ζ (zeta)

due in w/b 6/11

Drill

Part A Integrate the following with respect to x:

(a) $(2x-1)^2$ (b) $x-\sec 2x \tan 2x$ (c) $\frac{1}{2x}$

Part B Find:

(a) $\frac{\mathrm{d}}{\mathrm{d}x}\left(3xe^{5x}\right)$ (b) $\frac{\mathrm{d}}{\mathrm{d}x}\left(e^{-3x}\cot x\right)$ (c) $\frac{\mathrm{d}}{\mathrm{d}x}\left(x\ln(2-x)\right)$

(d) $\frac{\mathrm{d}}{\mathrm{d}x}\left((\ln 3x)^2\right)$

Part C Find the equations of the inverses of the following functions where each function is defined on its given domain, stating the domain and range of the new inverse functions:

(a) $f(x)=(x-1)^2+4, \quad x\geq 1$ (b)* $f(x)=x^2+4x-1, \quad x\geq -2$

(c)* $f(x)=x^2+4x, \quad x\geq -2$ **complete the square first*

Part D Solve the following equations on the interval $0\leq\theta\leq 2\pi$. Give exact answers where you can, but otherwise give your answers to 3sf:

(a) $\tan^2\theta+2\sec\theta=7$ (b) $\operatorname{cosec}^2 2\theta=2$

Current Work:

1. Differentiate these functions with respect to x:

(a) $y=\sin x\ln 2x$ (b) $y=3\sec(6x^2+5)$ (c) $y=\cos^6\left(\frac{x}{2}\right)$

(d) $y=e^{2x}\ln 2x$ (e) $y=\tan\left(x^2+3\right)$ (f) $y=\sec^2 2x$

(g) $y = 5\ln x$ (h) $y = 4x - \frac{1}{4}e^x$ (i) $y=\frac{x+1}{x^3}$

(j) $y = \ln 8x$ (k) $y = 2e^x - 2\ln x^2$ (l) $y=\frac{3x}{1-\sin x}$

(m) $y = \dfrac{e^x}{\ln x}$ (n) $y = 3\ln x - \ln 3x$ (o) $y = \ln\sqrt{x} - 2\ln(^1/_x)$

2. Find the exact value(s) of x which satisfy the equations:

(a) $\ln(6x + 1) = 1$ (b) $e^{3x-1} = 2$

(c) $e^{2x} = e^x + 12$ (d) $e^{2x}\ \ e^{x+1} = 28$

3. The curve with equation $y = x^2 \ln x$ is defined for positive values of x. Determine the coordinates of the stationary point and find the equation of the tangent at the point $\left(e, e^2\right)$

4. The curve C with equation $y = e^{2x-1}$ meets the y axis at P. The tangent to C at P crosses the x axis at Q. Find the area of the triangle POQ where O is the origin.

5. Given that $\int_2^4 \left(3t^2 - 2t - kt^{-2}\right) dt = 40$, find the value of the constant k.

6. Given that $f(x) = \dfrac{2}{x-1} - \dfrac{6}{(x-1)(2x+1)}$, $x > 1$,

(a) Prove that $f(x) = \dfrac{4}{2x+1}$ (b) Find the range of f.

(c) Find $f^{-1}(x)$ and state its domain. (d) State the range of $f^{-1}(x)$.

7. Prove the following identities:

(a) $\dfrac{\sin x}{1-\cos x} \equiv \cot\dfrac{x}{2}$ (b) $\sin(A + B) + \sin(A - B) \equiv 2\sin A\cos B$

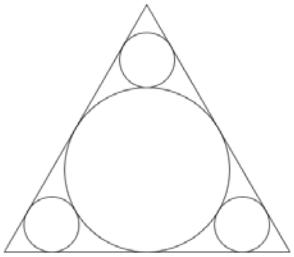
8. Express $\dfrac{x^2 - 8x + 15}{x^2 - 9} \times \dfrac{2x^2 + 6x}{(x-5)^2}$ as a single fraction in its simplest form.

9. A beaker of liquid is heated and then allowed to cool. The temperature of the liquid, θ°C, is related to the time, t minutes, for which it has been cooling by the equation
$\theta = 15 + 65e^{-0.2t}$. Calculate how long it takes the liquid to cool to 35°C, giving your answer, in minutes, correct to 2sf.

M1 Practice (Preparation for M2)

10. A sledge of mass 150 kg is being held on a snowy slope by a rope parallel to the slope. If the slope makes an angle of 35° to the horizontal and the coefficient of friction is 0.02, what is the least force needed to
a) hold it stationary b) start it moving up the slope.

Challenge – why not try this one this week!



11. A circle is inscribed in an equilateral triangle. Small circles are then inscribed in each corner as shown. What is the ratio of the area of a small circle to the area of the large circle?

Extra Questions (optional):

If you did not do well in the tracking test, here are some extra questions you can try to strengthen your weak areas.

A)

Given that

$$x = \sec^2 y + \tan y,$$

show that

$$\frac{dy}{dx} = \frac{\cos^2 y}{2\tan y + 1}.$$ **(4)**

(a) Use the derivatives of $\sin x$ and $\cos x$ to prove that

$$\frac{d}{dx}(\tan x) = \sec^2 x.$$ **(4)**

The tangent to the curve $y = 2x \tan x$ at the point where $x = \frac{\pi}{4}$ meets the y-axis at the point P.

B)

(b) Find the y-coordinate of P in the form $k\pi^2$ where k is a rational constant. **(6)**

(a) *(i)* Show that

$$\sin(x + 30)^\circ + \sin(x - 30)^\circ \equiv a \sin x^\circ,$$

where a is a constant to be found.

(ii) Hence find the exact value of $\sin 75^\circ + \sin 15^\circ$, giving your answer in the form $b\sqrt{6}$. **(6)**

(b) Solve, for $0 \le y \le 360$, the equation

$$2\cot^2 y^\circ + 5\,\text{cosec}\, y^\circ + \text{cosec}^2 y^\circ = 0.$$ **(6)**

C)