1. Solve the equation

$$9^x = 3^{x+2}.$$ **(3)**

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2. Solve the inequality

$$x(2x + 1) \leq 6.$$ **(4)**

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3. The curve C has the equation $y = (x - a)^2$ where a is a constant.

Given that

$$\frac{dy}{dx} = 2x - 6,$$

(a) find the value of a, **(4)**

(b) describe fully a single transformation that would map C onto the graph of $y = x^2$. **(2)**

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4. *(a)* Find in exact form the coordinates of the points where the curve $y = x^2 - 4x + 2$ crosses the x-axis. **(4)**

(b) Find the value of the constant k for which the straight line $y = 2x + k$ is a tangent to the curve $y = x^2 - 4x + 2$. **(3)**

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5. The curve C with equation $y = (2 - x)(3 - x)^2$ crosses the x-axis at the point A and touches the x-axis at the point B.

(a) Sketch the curve C, showing the coordinates of A and B. **(3)**

(b) Show that the tangent to C at A has the equation

$$x + y = 2.$$ **(7)**

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6. $$f(x) = 9 + 6x - x^2.$$

(a) Find the values of A and B such that

$$f(x) = A - (x + B)^2.$$ **(4)**

(b) State the maximum value of $f(x)$. **(1)**

(c) Solve the equation $f(x) = 0$, giving your answers in the form $a + b\sqrt{2}$ where a and b are integers. **(3)**

(d) Sketch the curve $y = f(x)$. **(2)**

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7. *(a)* An arithmetic series has a common difference of 7.

Given that the sum of the first 20 terms of the series is 530, find

(i) the first term of the series,

(ii) the smallest positive term of the series. **(5)**

(b) The terms of a sequence are given by

$$u_n = (n + k)^2, \quad n \geq 1,$$

where k is a positive constant.

Given that $u_2 = 2u_1$,

(i) find the value of k,

(ii) show that $u_3 = 11 + 6\sqrt{2}$. **(6)**

Turn over

8. The straight line l_1 passes through the point A $(-2, 5)$ and the point B $(4, 1)$.

(a) Find an equation for l_1 in the form $ax + by = c$, where a, b and c are integers. **(4)**

The straight line l_2 passes through B and is perpendicular to l_1.

(b) Find an equation for l_2. **(3)**

Given that l_2 meets the y-axis at the point C,

(c) show that triangle ABC is isosceles. **(4)**

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9. The curve C has the equation $y = \mathrm{f}(x)$ where

$$\mathrm{f}'(x) = 1 + \frac{2}{\sqrt{x}}, \quad x > 0.$$

The straight line l has the equation $y = 2x - 1$ and is a tangent to C at the point P.

(a) State the gradient of C at P. **(1)**

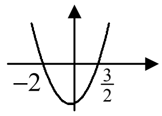
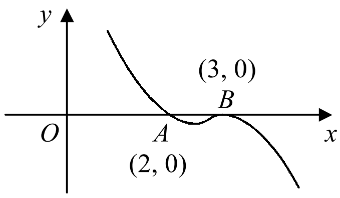
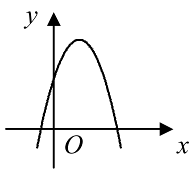
(b) Find the x-coordinate of P. **(3)**

(c) Find an equation for C. **(6)**

(d) Show that C crosses the x-axis at the point $(1, 0)$ and at no other point. **(3)**

END

C1 Paper G – Marking Guide

1.		$(3^2)^x = 3^{x+2}$	M1	
		$2x = x + 2, \quad x = 2$	M1 A1	**(3)**
2.		$2x^2 + x - 6 \leq 0$		
		$(2x - 3)(x + 2) \leq 0$	M1	
		critical values: $-2, \frac{3}{2}$	A1	
			M1	
		$-2 \leq x \leq \frac{3}{2}$	A1	**(4)**
3.	*(a)*	$y = x^2 - 2ax + a^2$	B1	
		$\frac{dy}{dx} = 2x - 2a = 2x - 6$	M1 A1	
		$\therefore \; a = 3$	A1	
	(b)	translation by 3 units in the negative x-direction	B2	**(6)**
4.	*(a)*	$x^2 - 4x + 2 = 0$		
		$x = \frac{4 \pm \sqrt{16-8}}{2} = \frac{4 \pm 2\sqrt{2}}{2}$	M2	
		$x = 2 \pm \sqrt{2}, \quad \therefore \; (2 - \sqrt{2}, 0), (2 + \sqrt{2}, 0)$	A2	
	(b)	$x^2 - 4x + 2 = 2x + k, \quad x^2 - 6x + 2 - k = 0$		
		tangent $\therefore$ equal roots, $b^2 - 4ac = 0$		
		$(-6)^2 - [4 \times 1 \times (2 - k)] = 0$	M1 A1	
		$36 - 4(2 - k) = 0, \quad k = -7$	A1	**(7)**
5.	*(a)*		B3	
	(b)	$y = (2 - x)(9 - 6x + x^2)$	M1	
		$y = 18 - 12x + 2x^2 - 9x + 6x^2 - x^3$	M1	
		$y = 18 - 21x + 8x^2 - x^3$	A1	
		$\frac{dy}{dx} = -21 + 16x - 3x^2$	M1 A1	
		grad $= -21 + 32 - 12 = -1$		
		$\therefore \; y - 0 = -(x - 2)$	M1	
		$x + y = 2$	A1	**(10)**
6.	*(a)*	$f(x) = 9 - [x^2 - 6x]$	M1	
		$= 9 - [(x - 3)^2 - 9]$	M1	
		$= 18 - (x - 3)^2, \quad A = 18, B = -3$	A2	
	(b)	18	B1	
	(c)	$18 - (x - 3)^2 = 0, \quad x - 3 = \pm\sqrt{18}$	M1	
		$x = 3 \pm 3\sqrt{2}$	M1 A1	
	(d)		B2	**(10)**

7.	*(a)*	*(i)*	$\frac{20}{2}[2a + (19 \times 7)] = 530$	M1	
			$2a + 133 = 53,\ a = -40$	M1 A1	
		(ii)	$= -40 + 7k = -40 + 42 = 2$	M1 A1	
	(b)	*(i)*	$u_1 = (1 + k)^2,\ u_2 = (2 + k)^2$	B1	
			$(2 + k)^2 = 2(1 + k)^2$	M1	
			$4 + 4k + k^2 = 2 + 4k + 2k^2$		
			$k^2 = 2$	M1	
			$k > 0\ \therefore\ k = \sqrt{2}$	A1	
		(ii)	$u_3 = (3 + \sqrt{2})^2 = 9 + 6\sqrt{2} + 2 = 11 + 6\sqrt{2}$	M1 A1	**(11)**
8.	*(a)*		$\text{grad} = \frac{1-5}{4-(-2)} = -\frac{2}{3}$	M1 A1	
			$\therefore\ y - 5 = -\frac{2}{3}(x + 2)$	M1	
			$3y - 15 = -2x - 4$		
			$2x + 3y = 11$	A1	
	(b)		$\text{grad } l_2 = \frac{-1}{-\frac{2}{3}} = \frac{3}{2}$	M1 A1	
			$\therefore\ y - 1 = \frac{3}{2}(x - 4)$ $\quad [\ 3x - 2y = 10\ ]$	A1	
	(c)		at C, $x = 0\ \therefore\ y = -5 \ \Rightarrow\ C(0, -5)$	B1	
			$AB = \sqrt{(4+2)^2 + (1-5)^2} = \sqrt{36+16} = \sqrt{52}$	M1 A1	
			$BC = \sqrt{(0-4)^2 + (-5-1)^2} = \sqrt{16+36} = \sqrt{52}$		
			$AB = BC\ \therefore$ triangle ABC is isosceles	A1	**(11)**
9.	*(a)*		2	B1	
	(b)		$1 + \frac{2}{\sqrt{x}} = 2$	M1	
			$\sqrt{x} = 2$	M1	
			$x = 4$	A1	
	(c)		$x = 4\ \therefore\ y = 2(4) - 1 = 7$	B1	
			$y = \int (1 + \frac{2}{\sqrt{x}})\ dx$		
			$y = x + 4x^{\frac{1}{2}} + c$	M1 A2	
			$(4, 7)\ \therefore\ 7 = 4 + 8 + c$		
			$c = -5$	M1	
			$y = x + 4x^{\frac{1}{2}} - 5$	A1	
	(d)		$x + 4x^{\frac{1}{2}} - 5 = 0$		
			$(x^{\frac{1}{2}} + 5)(x^{\frac{1}{2}} - 1) = 0$	M1	
			$x^{\frac{1}{2}} = -5$ (no real solutions), 1	A1	
			$x = 1\ \therefore\ (1, 0)$ and no other point	A1	**(13)**
				Total	**(75)**