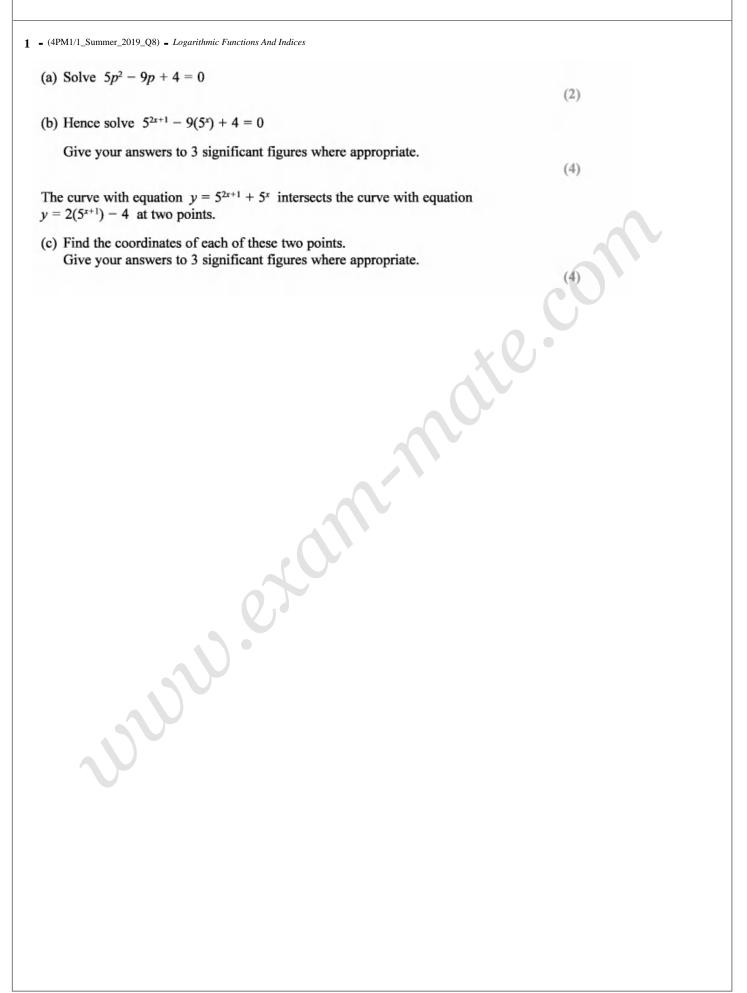
## IGCSE (9-1) Edexcel Past Papers

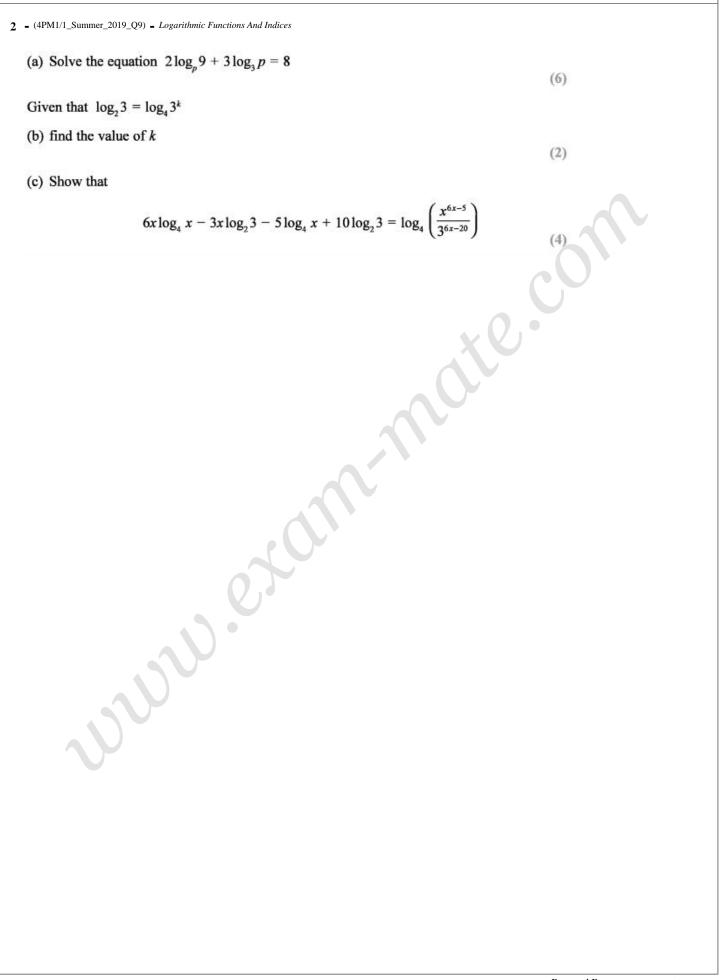
# FURTHER PURE MATHEMATICS

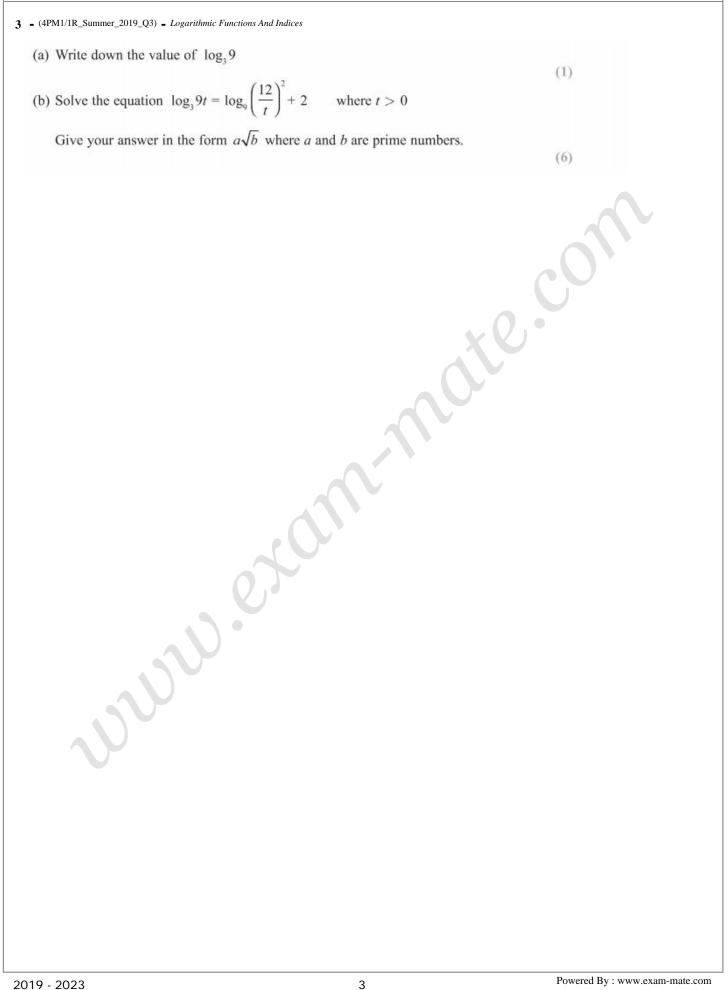
Paper 1, 1R

2019 - 2023

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(4)

(6)

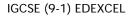
**4** • (4PM1/1R\_Summer\_2019\_Q4) • *Logarithmic Functions And Indices* 

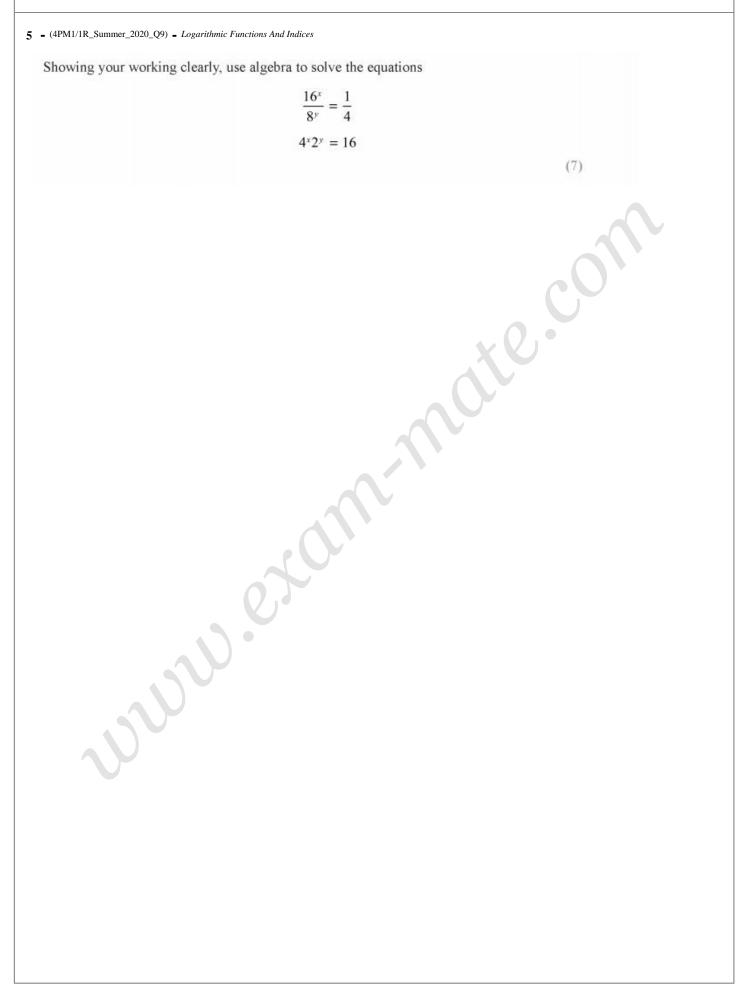
$$f(x) = e^{3x} \sqrt{1 + 2x}$$
$$f'(x) = \frac{2e^{3x}(2 + 3x)}{\sqrt{1 + 2x}}$$

(a) Show that

(b) Find an equation of the normal to the curve with equation y = f(x) at the point on the curve where x = 0

Give your answer in the form ax + by + c = 0 where a, b and c are integers.





# ANSWERS

**1** - (4PM1/1\_Summer\_2019\_Q8) - Logarithmic Functions And Indices

(a)	(5p-4)(p-1)=0	
	$p = \frac{4}{5}, p = 1$	M1A1
(b)	$5^{2x+1} - 9(5^x) + 4 = 0 \Longrightarrow 5 \times 5^{2x} - 9(5^x) + 4 = 0$	[2] M1
	$5^x = 1  x = 0$	A1
	$5^{x} = \frac{4}{5}, \ x \ln 5 = \ln\left(\frac{4}{5}\right) \ x = -0.1386 = -0.139$	M1A1
		[4]
(c)	$5^{2x+1} + 5^x = 2(5^{x+1}) - 4$	
	$5^{2x+1} - 9(5^x) + 4 = 0$	M1
	$x = 0  y = 5 + 1 = 6  (\text{or } y = 2 \times 5 - 4 = 6)  (0, 6)$	A1
	$x = -0.1386 5^{x} = \frac{4}{5}  y = 5 \times \left(\frac{4}{5}\right)^{2} + \frac{4}{5} = 4 \left(\text{ or } y = 10 \times \frac{4}{5} - 4 = 4\right)$	M1
	(-0.139,4)	A1
		[4]

2 - (4PM1/1\_Summer\_2019\_Q9) - Logarithmic Functions And Indices

(a)	$2\log_p 9 + 3\log_3 p = 8$	
	$2\frac{\log_3 9}{\log_3 p} + 3\log_3 p = 8$	M1
	$2\log_3 9 + 3(\log_3 p)^2 = 8\log_3 p$	M1
	$3(\log_3 p)^2 - 8\log_3 p + 4 = 0$	Al
	$(3\log_3 p-2)(\log_3 p-2)=0$	Ml
	$\log_3 p = \frac{2}{3}$ $p = 3^{\frac{2}{3}} = \sqrt[3]{9}$ (= 2.08)	Al
	$\log_3 p = 2  p = 3^2 = 9$	A1 [6]
(b)	$\log_2 3 = \frac{\log_4 3}{\log_4 2} = \frac{\log_4 3}{\frac{1}{2}} = 2\log_4 3 = \log_4 3^2 \Longrightarrow k = 2$	M1A1 [2]
(c)	$6x \log_4 x - 3x \log_2 3 - 5 \log_4 x + 10 \log_2 3$	
	$= 6x \log_4 x - 5 \log_4 x - 3x \log_4 3^2 + 10 \log_4 3^2$	M1
	$= \log_4 x^{6x} - \log_4 x^5 - \log_4 3^{6x} + \log_4 3^{20}$	M1
	$= \log_4 \frac{x^{6x} \times 3^{20}}{x^5 \times 3^{6x}}$	M1
	$= \log_4 \frac{x^{6x-5}}{3^{6x-20}} *$	A1 [4]

3 - (4PM1/1R\_Summer\_2019\_Q3) - Logarithmic Functions And Indices

(a) 
$$\log_3 9 = 2$$
  
(b)  $\log_3 9t = \log_9 \left(\frac{12}{t}\right)^2 + 2 \Rightarrow \log_3 9 + \log_3 t = 2(\log_9 12 - \log_9 t) + 2$   
 $\log_3 9 + \log_3 t = 2\left(\frac{\log_3 12}{\log_3 9} - \frac{\log_3 t}{\log_3 9}\right) + 2$   
 $\Rightarrow \log_3 9 + \log_3 t = \log_3 12 - \log_3 t + 2$   
 $\Rightarrow 2\log_3 t = \log_3 12 \Rightarrow \log_3 t^2 = \log_3 12$   
 $\Rightarrow t^2 = 12 \Rightarrow t = 2\sqrt{3}$   
A1  
M1A1  
[6]

4 - (4PM1/1R\_Summer\_2019\_Q4) - Logarithmic Functions And Indices

(a) 
$$f'(x) = 3e^{3x}(1+2x)^{\frac{1}{2}} + e^{3x} \times \frac{1}{2} \times 2(1+2x)^{\frac{1}{2}}$$
 MIAI  
 $\Rightarrow f'(x) = \frac{3e^{3x}(1+2x) + e^{3x}}{\sqrt{1+2x}} \Rightarrow f'(x) = \frac{2e^{3x}(2+3x)}{\sqrt{1+2x}} *$  MIAI  
(b) When  $x = 0$   
 $f'(0) = \frac{2e^{0}(2+0)}{\sqrt{1+0}} = 4$  Gradient of Normal  $= -\frac{1}{4}$  BIBI  
 $f(0) = e^{0}\sqrt{1+2\times0} = 1$  BI  
Equation of Normal to curve  $y = f(x)$  when  $x = 0$   
 $y-1 = -\frac{1}{4}(x-0)$   
 $\Rightarrow x+4y-4 = 0$  AI  
[6]

**5** - (4PM1/1R\_Summer\_2020\_Q9) - Logarithmic Functions And Indices

$\frac{2^{4x}}{2^{3y}} = \frac{1}{2^2}$	M1
$2^{4x-2y} = 2^{-2}$ ( $\rightarrow 4x - 3y = -2$ )	dM1
$2^{2x}2^{y} = 2^{4}$	M1
$2^{2x+y} = 2^4 \qquad \rightarrow (2x+y=4)$	dM1
A fully correct method using for solving simultaneously leading to either $10x = 10$ or $5y = 10$ $4x - 3y = -2 \implies 10x = 10$ or $4x - 3y = -2 \implies 5y = 10$	ddddM1
$6x + 3y = 12 \qquad \qquad 4x + 2y = 8$	
y = 2 $x = 1$	A1 A1
	[7]
Alternative Method $4^{x} = \frac{16}{2^{y}}$	M1
$\frac{4^{2x}}{8^{y}} = \frac{1}{4}$	M1
$\left(\frac{16}{2^{y}}\right)^{2} \times \frac{1}{8^{y}} = \frac{1}{4}$ $8^{y} \times 2^{2y} = 4 \times 16^{2}$	ddM1
$8^{y} \times 2^{2y} = 4 \times 16^{2}$	dddM1
$2^{3y} \times 2^{2y} = 2^2 \times 2^8$	ddddM1
$(2^{5y} = 2^{10})$ $y = 2$	A1
$2^{3y} \times 2^{2y} = 2^{2} \times 2^{8}$ (2 <sup>5y</sup> = 2 <sup>10</sup> )	Al