## <u>Differential Equations – 2021 A2 Nov P3</u>

1.		/2021/Paper_9709/31/No.7 Given that $y = \ln(\ln x)$ , show that	
		$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{x \ln x}.$	[1]
		20	••••
	The	e variables $x$ and $t$ satisfy the differential equation	
		$x \ln x + t \frac{\mathrm{d}x}{\mathrm{d}t} = 0.$	
	It is	given that $x = e$ when $t = 2$ .	
	<b>(b)</b>		our [7]
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Hence state what happens to the value of $x$ as $t$ tends to infinity.	[1

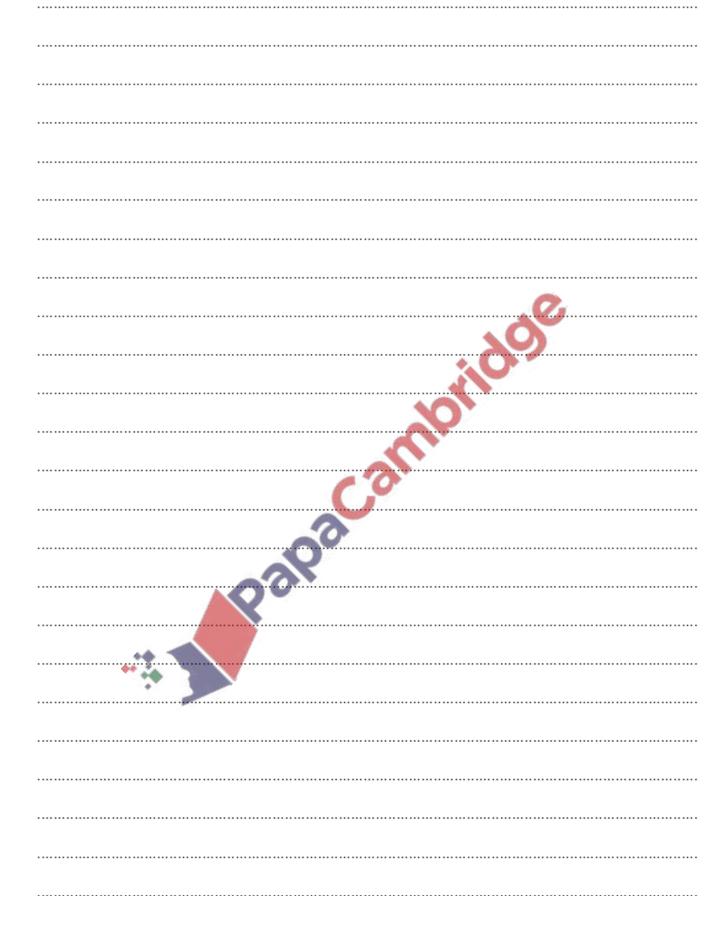
**(c)** 

2.	Nov/2021/Paper_9709/32/No.7
	The variables $x$ and $y$ satisfy the differential equation

$$e^{2x}\frac{\mathrm{d}y}{\mathrm{d}x} = 4xy^2,$$

and it is given that y = 1 when x = 0.

Solve the differential equation, obtaining an expression for $y$ in terms of $x$ .	[7]
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3.	Nov/2021/Paper_	9709/33/No.10
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A large plantation of area  $20 \,\mathrm{km^2}$  is becoming infected with a plant disease. At time t years the area infected is  $x \,\mathrm{km^2}$  and the rate of increase of x is proportional to the ratio of the area infected to the area not yet infected.

When t = 0, x = 1 and  $\frac{dx}{dt} = 1$ .

**(b)** 

(	a	) Show	that x and	t	satisfy	the	differential	equation
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$\frac{\mathrm{d}x}{\mathrm{d}t} = \frac{19x}{20 - x}.$	[2]
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Solve the differential equation and show that when $t = 1$ the value of $x$ satisfies the $x = e^{0.9+0.05x}$ .	equation [5]
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c)	Use an iterative formula based on the equation in part (b), with an initial value of 2, to determine <i>x</i> correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]
	<u>O</u>
d)	Calculate the value of $t$ at which the entire plantation becomes infected. [1]