Write your name here Surname	Other nar	mos
Surname	Other hai	nes
Pearson	Centre Number	Candidate Number
<b>Edexcel GCE</b>		
<b>Core Mat</b>	hematic	s <b>(</b> 3
Advanced		
Advanced  Tuesday 19 June 2018 –	Afternoon	Paper Reference
Advanced	Afternoon	

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

## Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
   there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

## Information

- The total mark for this paper is 75.
- The marks for each question are shown in brackets
   use this as a quide as to how much time to spend on each question.

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶



P51520A ©2018 Pearson Education Ltd.



1.	Given $y = 2x(3x - 1)^5$ , (a) find $\frac{dy}{dx}$ , giving your answer as a single fully factorised expression.	
	(b) Hence find the set of values of $x$ for which $\frac{dy}{dx} \le 0$	(2)
_		
_		
_		
_		
_		
_		

٠.		ė	d	ø
1		S	1	Ŀ
			7	3
1	ŀ		ŀ	
1	ķ	8	ķ	8
-1	ø	ь	d	β
J	Ŀ	3	c	_
•	Ŧ	7	7	Ξ
j	ø	ø		۳
ĕ	٩	٠		
			-	7
ì	r	ì	á	ú
1	L		r	
	9	7		5
ì	-	•	-	•
3	Ŧ		Ħ	
			L	
J	•	÷	-	7
ł	Ŀ			
1	۲	•	7	•
	•			
11 11	ė		ė	i
	ä	ø	Р	-
1	ş	'n	ę	8
4	ė		ė	
ì	Þ	î	r	í
ł	L		L	
ŝ				
J			×	
1	ı.			
1	Ŧ		ę	
d	ġ	ь	á	ρ
1	Ŀ	3	E	
į	Ξ	Ξ	7	7
Č	3	3		h
1			S	3
1	d	á	P	,
1				
	L			
1	þ	Ų		ą
۰	5		d	
j	۲	"	7	
٦	ь	ú	ė	ø
ı,	_		Ξ	_
٩	1			p
ì			i	ė
	à		ě	L
Ì	۲	1	7	
٦	b	ě	d	ø
	â	í	S	ŀ
J	۲	1	4	٩
1	ь	ė		

		Leave
Question 1 continued		blank
Ancount I continued		
		Q1
	.1.6 1.5	
('Tot	al 6 marks)	



blank

**2.** The function f is defined by

$$f(x) = \frac{6}{2x+5} + \frac{2}{2x-5} + \frac{60}{4x^2 - 25}, \quad x > 4$$

- (a) Show that  $f(x) = \frac{A}{Bx + C}$  where A, B and C are constants to be found. (4)
- (b) Find  $f^{-1}(x)$  and state its domain. (3)



Question 2 continued		Lea bla
Activity 2 Collimated	n 2 continued	Dia
	in 2 continued	
· · · · · · · · · · · · · · · · · · ·		



estion 2 continued	

Question 2 continued		blar
		Q2
	(Total 7 marks)	



3. The value of a car is modelled by the formula

$$V = 16000e^{-kt} + A, \qquad t \geqslant 0, t \in \mathbb{R}$$

where V is the value of the car in pounds, t is the age of the car in years, and k and A are positive constants.

Given that the value of the car is £17500 when new and £13500 two years later,

(a) find the value of A,

**(1)** 

(b) show that  $k = \ln\left(\frac{2}{\sqrt{3}}\right)$ 

**(4)** 

(c) Find the age of the car, in years, when the value of the car is £6000

Give your answer to 2 decimal places.

**(4)** 


	blank
Question 3 continued	Dialik
Question 5 continued	



estion 3 continued	

		-	d	d
3		•		
•	7	۹		b
5		÷		6
1				
1	Ŧ	•	ę	•
-4	á	١.	à	d
1	r		۳	
1				
		_	å	à
Ĵ		Р		
ē	٩			
				7
1	r	1	ρ	٠
Л	ы	ø		
ì		3.		
	-	-	۰	-
٦		٠		×
3	7		Г	
î	-		H	÷
	=	-	7	7
ł	Ŀ			_
1	۰	•	۰	•
	۳			
	÷			
3		۰		
		ø	r	
1		'n	۱	п
	÷	_	÷	_
2	÷	-	Ŧ	-
1	Þ			
ł	L		L	
e	-	-	•	-
1	L		_	
4	۰	۰	۰	۰
1	B.			
1				
	à	١.	à	a
1	r		۲	-
4	н		h	
į	6		ż	
1			2	3
П	Ξ	3		
3	9	٠		
1	L			
4	۴	۰	d	۹
4	ĸ,	_	ż	
2	ρ	ø	4	b
4	1			
4	٩	ú		ď
÷	_	Ξ	_	_
1	٦			۲
ì		z	_	_
J	-	÷	•	=
٠,	á		ń	
1	۲		7	
А	L	٠		d
	۹	d	ø	۲.
-		,		ĸ
1	r			
1	b			

Question 3 continued	Leave blank
	Q3
(Total 9 marks)	



4.

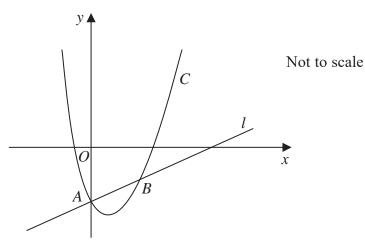


Figure 1

Figure 1 shows a sketch of part of the curve C with equation

$$y = e^{-2x} + x^2 - 3$$

The curve C crosses the y-axis at the point A.

The line l is the normal to C at the point A.

(a) Find the equation of l, writing your answer in the form y = mx + c, where m and c are constants.

**(5)** 

The line *l* meets *C* again at the point *B*, as shown in Figure 1.

(b) Show that the x coordinate of B is a solution of

$$x = \sqrt{1 + \frac{1}{2}x - e^{-2x}}$$

**(2)** 

Using the iterative formula

$$x_{n+1} = \sqrt{1 + \frac{1}{2}x_n - e^{-2x_n}}$$

with  $x_1 = 1$ 

(c) find  $x_2$  and  $x_3$  to 3 decimal places.

**(2)** 

	blank
Oraștian A continued	Diank
Question 4 continued	



estion 4 continued	

٠.		ä	á	ø
4		a	L	
		7	7	9
п				п
э	Ŧ	•	P	н
d	ρ	ы	å	ø
4	Ŀ		ì	۰
			3	a
ì		3	ľ	_
	7	٦	7	ų
		٦	_	
1	L	ı	7	b
í	_	:	_	Ξ
	=	Ξ	Ξ	Ξ
ì	-		۰	-
'n	-			ė
				7
ł	'n		ė	=
ı	ŀ			
ì		1	ı	_
	=			μ
1		í	ì	
G	÷	=	Ě	=
7	7	7		-
٠.		_		÷
Į	L			ı
ς		7	7	7
ł	ь		ė	
1	г			
1	Ŧ		ļ	
-1	įΑ	ы	ġ	ø
1	Ŀ		ì	۰
ñ	5			
1	=			р
-	9	9	3	ń
J	ø	۲	4	ť
1	Ь	÷		ė
1				4
4	ø	e	۹	k
4	ĸ.	L	1	z)
. '	۰	•	,	۲.
э	7			μ
ì			_	i
÷	1	7		₹
	ä		Ġ	
1	۳	-	7	ń
٩	ь	÷	d	g
٠,	â	ă	í	
1	r		۹	ø
1	ь		i	ď

Q4 (Total 9 marks)	Question 4 continued	Leave blank
(Total 9 marks)		Q4
	(Total 9 marks)	



5.

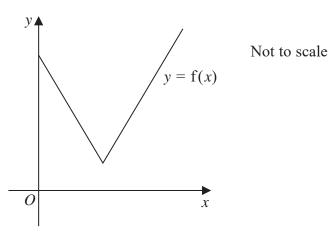


Figure 2

Figure 2 shows part of the graph with equation y = f(x), where

$$f(x) = 2|5-x|+3, x \ge 0$$

Given that the equation f(x) = k, where k is a constant, has exactly one root,

(a) state the set of possible values of k.

**(2)** 

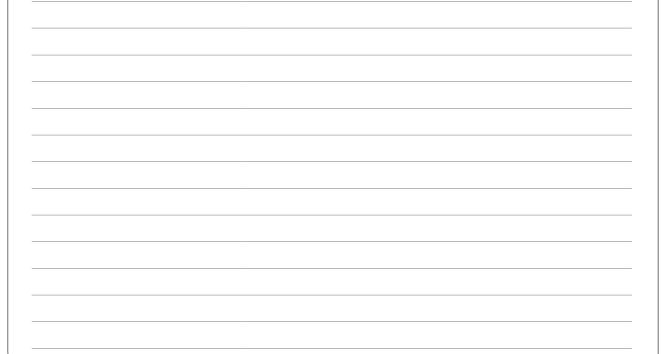
(b) Solve the equation  $f(x) = \frac{1}{2}x + 10$ 

**(4)** 

The graph with equation y = f(x) is transformed onto the graph with equation y = 4f(x - 1). The vertex on the graph with equation y = 4f(x - 1) has coordinates (p, q).

(c) State the value of p and the value of q.

**(2)** 



1	ø	ρ		۰
3	9	ė		ú
٠,		ı		7
4	Ŀ		ľ	
c		7	3	Ξ
1	Ė		ľ	_
3	÷	-	Ŧ	-
÷		á		ø
į	Ę	S		
ì	r	d		b
1	b	g		Į
ì		ė	i	ė
1	ė	ė	i	á
				ė
3		ē		Ę
ı	Ŀ	_	٠	_
1	Г	7	7	7
j	ı		ı	
3	7		ġ	P
1			i	ú
G	Ť	=	ž	=
1	Þ	j		н
1	Ь		i	ā
1	L			
1	۲	۰		•
ŝ	i		ė	
	ä		ž	-
1	c		ľ	
į	Ξ	3	3	7
í	2	3	3	þ
1	3	9	3	ń
J	7	7	7	6
1				
1	þ	ņ		ą
	L		ć	L
1	r	_	7	3
7	٩	ė	ø	P
1	÷	ė	9	ė
'n	ä	ø	2	3
ţ	=	Ť		ę
	á		٤	
Ì	۴	۰	9	ч
٩	Ь	٠	ì	ð
	2		S	
1	۴	7	۹	٩
1	Ľ	÷		

	blank
Question 5 continued	



estion 5 continued	

		-	d	d
3		•		
•	7	۹		b
5		÷		6
1				
1	Ŧ	•	ę	•
-4	á	١.	à	d
1	r		۳	
1				
		_	å	à
Ĵ		Р		
ē	٩			
				7
1	r	1	ρ	٠
Л	ы	ø		
ì		3.		
	-	-	۰	-
٦		٠		×
3	7		Г	
î	-		H	÷
	=	-	7	7
ł	Ŀ			_
1	۰	•	۰	•
	۳			
	÷			
3		۰		
		ø	r	
1		'n	۱	п
	÷	_	÷	_
2	÷	-	Ŧ	-
1	Þ			
ł	L		L	
e	-	-	•	-
1	L		_	
4	۰	۰	۰	۰
1	B.			
1				
	à	١.	à	a
1	r		۲	-
4	н		h	
į	6		ż	
1			2	3
П	Ξ	3		
3	9	٠		
1	L			
4	۴	۰	d	۹
4	ĸ,	_	ż	
2	ρ	ø	4	b
4	1			
4	٩	ú		p
÷	_	Ξ	_	_
1	٦			۲
ì		z	_	_
J	-	÷	•	=
٠,	á		ń	
1	۲		7	
А	L	٠		d
	۹	d	ø	۲.
-		,		ĸ
1	r			
1	b			

Question 5 continued	blank
	<b>Q5</b>
(Total 8 marks)	



**6.** (i) Using the identity for  $\tan(A \pm B)$ , solve, for  $-90^{\circ} < x < 90^{\circ}$ ,

$$\frac{\tan 2x + \tan 32^{\circ}}{1 - \tan 2x \tan 32^{\circ}} = 5$$

Give your answers, in degrees, to 2 decimal places.

**(4)** 

(ii) (a) Using the identity for  $tan(A \pm B)$ , show that

$$\tan(3\theta - 45^{\circ}) \equiv \frac{\tan 3\theta - 1}{1 + \tan 3\theta}, \qquad \theta \neq (60n + 45)^{\circ}, \, n \in \mathbb{Z}$$
(2)

(b) Hence solve, for  $0 < \theta < 180^{\circ}$ ,

$$(1 + \tan 3\theta) \tan(\theta + 28^\circ) = \tan 3\theta - 1$$
(5)

	blan
Question 6 continued	



estion 6 continued	

٠.	÷	ø
4	U	Ŀ
	Œ	7
J	ш	ш
3	-	≂
1	n	P
4	-	
٠.	_	ø
J	Ы	L
		7
٠,		ď.
1	ш	70
î	_	-
	=	=
ì	ч	_
ì	4	÷
Ì	=	
J	١.	
×	_	÷
	7	~
1	Б	×
4	_	Ė
ı	H	1
ł	ш	4
1		
4	-	-
1	_	-
	5	=
1	9	◩
ã	_	=
	3	bi
1		=
	ø	30
Į	Ľ	_
1		7
-4	įπ	í.
J	Ε.	3
7	4	~
¥		9
ì	e	_
ŧ	-	╡
	_	
1	_	ъ
٦	÷	s
٠,	ã	ĸ.
1		٦
ı	=	4

Question 6 continued	Le bla	ave ank
		\ <u></u>
		<b>Q6</b>
	(Total 11 marks)	



7.	The curve $C$ has equation	$y = \frac{\ln(x^2 + 1)}{x^2 + 1},$	$x \in \mathbb{R}$

(a) Find  $\frac{dy}{dx}$  as a single fraction, simplifying your answer.

(3)

(b) Hence find the exact coordinates of the stationary points of C.

(6)	

4		S			
ĺ		ī	٩	١	
1	Ŀ		Ŀ		
Ġ	Ξ		3		
1	į		c		
	7		3		
ì	e	ė			
ſ	7	٦	7	١	
٠,	J	ì			
1	L	ı	r,		
ì	i	ì			i
1	ė	ė	i		i
į	_		Ľ		,
ŝ	7	7	7		
ł	þ		Ė		
3		ų	ġ		
á	d		_		
Ė	Ξ	Ξ	7		
			7		
ì	r	j		Ì	ĺ
1	b	d	b	i	
1	L		_		
1	r	7	7		۰
1	ŧ		ŧ		
1	Ė	١	ė	į	
4	Ė	d	b		
1	۹	e	ė		
1	Ę		S		
J	ø	ė	P		
1	þ	ė			į
	L		ú		
]	ľ				
7	٩	Ė	ø		,
3	₹	9			
ì		í	í		i
٠					١
7	ø	ß	۹	į	
4	Ŀ	i	d	į	,
٠.	â	i	S		
1	ľ		1		
1		Ę			į

	b
uestion 7 continued	



estion 7 continued	

Overtion 7 continued	blank
Question 7 continued	
	_
	_
	_
	_
	_
	_
	_
	-
	_
	_
	_
	_
	_
	_
	_
	-
	_
	_
	_
	_
	_
	_
	_
	-
	<b>Q7</b>
(Total 9 marks	$_{\prime}$
( Total 9 marks	·/



**8.** (a) By writing  $\sec \theta = \frac{1}{\cos \theta}$ , show that  $\frac{d}{d\theta}(\sec \theta) = \sec \theta \tan \theta$ 

**(2)** 

(b) Given that

$$x = e^{\sec y}$$
  $x > e$ ,  $0 < y < \frac{\pi}{2}$ 

show that

$$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{x\sqrt{\mathrm{g}(x)}}, \qquad x > \mathrm{e}$$

where g(x) is a function of  $\ln x$ .

**(5)** 

estion 8 continued	



estion 8 continued	

	Leave
Question 8 continued	blank
	<b>Q8</b>
(Total 7 marks)	
(Iotal / Halks)	



9. (a) Express  $\sin \theta - 2\cos \theta$  in the form  $R\sin(\theta - \alpha)$ , where R > 0 and  $0 < \alpha < \frac{\pi}{2}$ Give the exact value of R and the value of  $\alpha$ , in radians, to 3 decimal places.

**(3)** 

$$M(\theta) = 40 + (3\sin\theta - 6\cos\theta)^2$$

- (b) Find
  - (i) the maximum value of  $M(\theta)$ ,
  - (ii) the smallest value of  $\theta$ , in the range  $0 < \theta \le 2\pi$ , at which the maximum value of  $M(\theta)$  occurs.

(3)

$$N(\theta) = \frac{30}{5 + 2(\sin 2\theta - 2\cos 2\theta)^2}$$

- (c) Find
  - (i) the maximum value of  $N(\theta)$ ,
  - (ii) the largest value of  $\theta$ , in the range  $0 < \theta \le 2\pi$ , at which the maximum value of  $N(\theta)$  occurs.

(Solutions based entirely on graphical or numerical methods are not acceptable.)

**(3)** 

nestion 9 continued	



estion 9 continued	

	Leave
	blank
Question 9 continued	



uestion 9 continued	blank	
	00	
	<b>Q9</b>	
(Total 9 marks)		
TOTAL FOR PAPER: 75 MARKS		
END		