Please check the examination details bel	ow before ente	ering your candidate in	formation
Candidate surname		Other names	
Centre Number Candidate N	umber		
Pearson Edexcel Inter	nation	al Advanc	ed Level
Time 1 hour 30 minutes	Paper reference	WFM	02/01
Mathematics			0
International Advanced S	uhsidiar	v/Advanced	Level
	•	y/Advanced	
Further Pure Mathematics	5 F2		
			J
You must have:  Mathematical Formulae and Statistics	al Tables (Ye	llow) calculator	Total Marks
matienatical i official and statistical			

Candidates may use any calculator permitted by Pearson regulations. 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).
- **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.
- Inexact answers should be given to three significant figures unless otherwise stated.

## Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 9 questions in this question paper. The total mark for this paper is 75.
- The marks for **each** question are shown in brackets
  - use this as a guide 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.









- **1.** Given that  $y = \ln(5 + 3x)$ 
  - (a) determine, in simplest form,  $\frac{d^3y}{dx^3}$

(3)

(b) Hence determine the Maclaurin series expansion of ln(5 + 3x), in ascending powers of x up to and including the term in  $x^3$ , giving each coefficient in simplest form.

**(2)** 

(c) Hence write down the Maclaurin series expansion of ln(5-3x), in ascending powers of x up to and including the term in  $x^3$ , giving each coefficient in simplest form.

**(1)** 

(d) Use the answers to parts (b) and (c) to determine the first 2 non-zero terms, in ascending powers of x, of the Maclaurin series expansion of

$$\ln\left(\frac{5+3x}{5-3x}\right)$$

**(2)** 

****
$\times\!\!\times\!\!\!\cdot\!\!\!\cdot$
ARE/
<u> </u>
<b>4</b>
× va×
Z
$\times$
(X)
OT W
W
$\otimes \mapsto \otimes \blacksquare$
ō.
×o×
۵
×××××
*****
******
XXXXXXX
111 100
Va I
20
$\otimes  \otimes $
XX <b>==</b> XX
×2×
<<>>i
$\otimes$
× 65×
WR
T WR
T WR
T WR
NOT WR
O NOT WR
O NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
DO NOT WR
S AREA DO NOT WR
HIS AREA DO NOT WR
HIS AREA DO NOT WR
THIS AREA DO NOT WR
N THIS AREA DO NOT WR
IN THIS AREA DO NOT WR
E IN THIS AREA DO NOT WR
TE IN THIS AREA DO NOT WR
ITE IN THIS AREA DO NOT WR
SITE IN THIS AREA DO NOT WR
RITE IN THIS AREA DO NOT WR
WRITE IN THIS AREA DO NOT WR
I WRITE IN THIS AREA DO NOT WR
I WRITE IN THIS AREA DO NOT WR
I WRITE IN THIS AREA DO NOT WR
NOT WRITE IN THIS AREA DO NOT WR
NOT WRITE IN THIS AREA DO NOT WR
O NOT WRITE IN THIS AREA DO NOT WR
DO NOT WRITE IN THIS AREA DO NOT WR
O NOT WRITE IN THIS AREA DO NOT WR
DO NOT WRITE IN THIS AREA DO NOT WR

uestion 1 continued



Question 1 continued	

		×				
	,	7				
١		Š		4	Ì	r
C	i		2			
		7	e	9	٠	b
١	ì	ĸ.		S.	À	
	l			Ľ	3	
	۹	,	۳	7	ę	۲
	í			ы		ĸ
				r	2	
	,	9		9	۰	r
C			2	ú		ĸ
2			e			
	3		×	۹		ì
	ı,			2		
			a	r	7	Б
	Į	٩		r	Ч	ŀ
	i	'n	ú	è	ú	ı.
	1			S		
	3	,		۲	۹	
١		S		Ь	2	
C	Ą	۰	,	e	7	ĸ
			l	2	ς	J
١				۰	P	В.
	Į					
	ľ				C	
	9	e	۰			Ķ.
/	á	а		r	5	
	I	ņ	ø	=	μ	r
C	í	i	è	ú	ì	ſ.
2		7		7		
		s				
				г	1	Ľ
		b				
	٤					
		B	'n	ú	è	r
Ś		ŀ		ġ	į	ĸ
>	ļ	ì		Ž		K
5				2		5
>				2		1
5				Ź		1000
5						K 16 K
	1					
			>	S	2	
		ŀ	>	S	2	
		ŀ	2			
		ŀ	2			
		ŀ	2			
		ŀ	2			
		ŀ	2			
		ŀ	2			
		ŀ	2			
			2	S		
			2			
			2			
		ŀ	2			
			2			

Question 1 continued	
(Tratal P	on Overtion 1 is 8 months)
(10tal f	or Question 1 is 8 marks)



2. (a) Express

$$\frac{1}{(2n-1)(2n+1)(2n+3)}$$

in partial fractions.

**(2)** 

(b) Hence, using the method of differences, show that for all integer values of n,

$$\sum_{r=1}^{n} \frac{1}{(2r-1)(2r+1)(2r+3)} = \frac{n(n+2)}{a(2n+b)(2n+c)}$$

where a, b and c are integers to be determined.

**(4)** 


*****
*****
*****
*****
******
*****
$\otimes \mathbf{m} \otimes$
_CC
×va×
$\times = \times$
$\times$
$\times\!\!\times\!\!\!\simeq\!\!\times\!\!\!\times$
X 5 X I
$\times\!\!\times\!\!\times\!\!\times$
$\otimes \otimes \otimes$
$\times \otimes \times$
$\otimes$
****
XXXXX
$\times\!\!\times\!\!\times\!\!\times$
****
*****
*****
*****
******
*****
*****
*****
*****
$\times$ MM $\times$
$\times$
XXXXXXX
× co×
×× <b>×</b> ××
$\times$
$\times$
$\times$
$\times$
$\times$
WRITE
WRITE
WRITE
OT WRITE
WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
OT WRITE
IOT WRITE
IOT WRITE
DO NOT WRITE!
DO NOT WRITE!
A DO NOT WRITE!
A DO NOT WRITE!
A DO NOT WRITE!
A DO NOT WRITE!
A DO NOT WRITE!
A DO NOT WRITE!
A DO NOT WRITE!
A DO NOT WRITE!
THIS AREA DO NOT WRITE!
THIS AREA DO NOT WRITE!
THIS AREA DO NOT WRITE!
THIS AREA DO NOT WRITE!
E IN THIS AREA DO NOT WRITE!
E IN THIS AREA DO NOT WRITE!
E IN THIS AREA DO NOT WRITE!
E IN THIS AREA DO NOT WRITE!
VRITE IN THIS AREA DO NOT WRITE!
WRITE IN THIS AREA DO NOT WRITE!
WRITE IN THIS AREA DO NOT WRITE!
WRITE IN THIS AREA DO NOT WRITE!
WRITE IN THIS AREA DO NOT WRITE!
NOT WRITE IN THIS AREA DO NOT WRITE!
NOT WRITE IN THIS AREA DO NOT WRITE!
O NOT WRITE IN THIS AREA DO NOT WRITE!
O NOT WRITE IN THIS AREA DO NOT WRITE!
NOT WRITE IN THIS AREA DO NOT WRITE!
O NOT WRITE IN THIS AREA DO NOT WRITE!
O NOT WRITE IN THIS AREA DO NOT WRITE!
O NOT WRITE IN THIS AREA DO NOT WRITE!

Question 2 continued



Question 2 continued

$\sim$		$\supset$	€	>	
	$\sim$	$\supset$		$\rangle$	
$\Diamond \Diamond$	×	5	Č	>	
$\sim$	×	×	2		
$\sim$	×	×	2	Ś	
$\times$		×	?		
$\times \times$	×,	×,			
$\times$	X	×			
88i	É	۳	Þ	ς	
$\times \times$	7	4	v	ς	
	Ú	ď	Þ		
$\times \times 1$	ы	Ħ		0	
$\times \times$	m	è	١,		
$\langle \times \rangle$	نپا	Š	í,	>	
$\langle \times \rangle$	è	è		$\geq$	
	54	ķ		$\rangle$	
$\Diamond \Diamond$		5		$\geq$	
	Ú	Ä	Ĉ	>	
88	4	Ŋ		>	
$\triangle S$	7	=	γ		
$\otimes$	H	Ħ		Ś	
$\times\times$	М	¥	P	ς	
$\times \times 1$	ы	×	$\geq$		
	К	$\overline{}$	Þ		
$\otimes$	×				
$\times\!\!\times\!\!$	Z	È	>		
88	7			(	
$\times \times^{1}$	$\hat{\lambda}$	$\hat{\chi}$		?	
	×	2		?	
$\sim$	ú	ш	K		
88		$\overline{}$	۲,	>	
	۴	۰	К	>	
$\circ\circ$	~~			$\geq$	
		٠	ĸ	×	
$\times$	à	B	2	>	
88	Š.	S	?	5	
88	ĕ	8			
		ä	þ		
$\approx$				(	
$\times \times$	Ê	Ž	Þ	Č	
	Ķ.	Z	>		
$\otimes$	ê	ø	S		
$\bigcirc$	×	a	ζ		
		2	6	>	
$\times$	æ	2	Κ	>	
$\Diamond \Diamond$	V			>	
$\circ\circ$	2	2	C	S	
88	X	7	ľ	5	
$\sim$	è	ĸ,	2		
$\times \times$	Z	ч	2	ί	
$\times\!\times$	ĸ	¥			
$\otimes$		X	>		
$\times \times$		X	>	(	
$\times \times$		X	S		
	×	×		?	
$\Diamond \Diamond$	×	$\geq$	ς		
$\langle \rangle \rangle$	×	$\bigcirc$	⟨	$\rangle$	
$\sim$	×	$\supset$	◁	$\rangle$	
$\Diamond \Diamond$	X	2		$\geq$	
$\sim$	$^{\sim}$	2		$\geq$	
$\Diamond \Diamond$	X	>		>	
$\sim$		5	1	S	
$\times$	$\times$	S	2		
$\times$	X	×,			
$\times \times$	Χ.				
			2	Ś	
$\times\!\!\times$	×	2	S	>	
$\times$	Ŷ.	2	ξ	>	
$\otimes$	Ŷ.	3	ξ	>	
$\times \times \times$	X	3		>	
$\otimes$	X	3		>	
$\overset{\times}{\sim}$	X	3		>	
*	× ×	3		>	
		3		>	
*	× ×	3		>	
*		3		>	
*		3		>	
				>	
	× ×				
*					

Question 2 continued	
(Total for Q	uestion 2 is 6 marks)



3. (a) Show that the transformation  $y = \frac{1}{z}$  transforms the differential equation

$$x^2 \frac{\mathrm{d}y}{\mathrm{d}x} + xy = 2y^2 \tag{I}$$

into the differential equation

$$\frac{\mathrm{d}z}{\mathrm{d}x} - \frac{z}{x} = -\frac{2}{x^2} \tag{II}$$

(b) Solve differential equation (II) to determine z in terms of x.

**(4)** 

(c) Hence determine the particular solution of differential equation (I) for which  $y = -\frac{3}{8}$  at x = 3

Give your answer in the form y = f(x).

**(2)** 



	×		×			<	
		X					,
×		×	×	>		2	×
×	K	×	×			Š	
$\otimes$	K	×					,
×	×	×	×	>	Ś	<	
X	×	×	×			<	
$\Diamond$	×	×				2	
X	×	×	×	>			
X	Ś		į	è	ļ	í	
X	1	Ę	ē	1	Ę	×	
×		Ľ	Ĵ	Ľ	1	ŀ	×
$\times$	i	ë	į	ï	Ş	k	
$\otimes$	1	ķ		5	È	Š	,
×	ì	Ę	Č	3	Ē	2	×
$\times$	×		×	3	2	2	
$\otimes$	j	Ĺ	d	Ø	1	Ė	١
X	j	i	ģ	è	4	į	×
	Į		ì	Ì	5	į	
X		É	4	5	7	١	,
X		P	×	7	Š	8	×
$\times$	4	ĕ	į	Ì	ĺ	K	`
$\otimes$	1	í	ŝ	,	ė	ŕ	١
×	1	7	×	7	Š	8	×
$\times$	1	Ľ	1	Ĺ	ĺ	k	
$\otimes$		k	7	2	Z	Š	,
×		R		2	3	2	×
×		è	۹	7	Ş	k	
X	1	į		2	Š	5	
×	4	ě		2		8	
$\times$	4	ě	ŕ	Š	7	Ŗ	
$\langle \cdot \rangle$	j	k	2		2	S	,
×	ļ	Ş		2	ζ	2	
$\otimes$	1	Ç	ě		d	ķ	١
X	į	7	ě	į	į	į	,
×	į		į	-	9	Ė	
$\otimes$	í	ĝ	ì	9	ì	Š	١
×	1	ķ	ų	è	d	į	>
×	i	ľ	7		9	ķ	
$\otimes$	4	×		5	₹	5	,
×		×		>		2	>
X	×		×			<	
$\otimes$	×	X	×			<	
×						2	
×	×	ÿ	×			<	
X		×	×	5		S	,
×		×	>			2	
$\times$	×		×			<	
$\otimes$		×		۶		S	,
×	K		×			2	
$\otimes$	×	×	×			<	
X		×	×	>		S	,
×	K		×			è	
	×	×	×			<	۰
×		×		>			
×	×		×			Ś	
$\otimes$	K	×	×			S	
×		×	×	2	Ś	2	×
$\otimes$	Į	Ę	Ş	1	G	\$	
$\otimes$	j	k	j	Ĺ	j	ĺ	
×	4	ř	۱	Ž	Š	R,	
X	Į	Š	ł	2	þ	Š	,
X	j	e					
			è		ľ	Š	
$\otimes$	X	X	į			8	
$\otimes$	4	Ž	į				>
	×						× × ×
× ×	×4						
× ×	1						× × × × ×
× ×	1						
× ×	1						
× ×	1						

Question 3 continued	



Question 3 continued

	×	$\circ$			
	٧.	$^{\wedge}$			
5		¥	2	d	ľ
C	×				
		77	9	ь	b
۱		bri	S	ä	
	М	В	ĸ	3	
		7	7	e	Ę
	Χ		ш		Ĺ
	V	ß	к	Z	
	0	7	=	•	P
C	>	ಎ	ú		ľ
2	SJ				
		$\nabla$	9		
	S				
		Š	2	٤	
	4	Li	ĸ	Я	ŀ
		•	ĸ.	¥	P
		4	è	6	ŭ
	Z	$\overline{z}$	S		
	V	ă	r	۹	,
5		M	ь	4	
0	V	_	₹	7	۲
	SI	Q K 5	2	9	J
١	4	r	۰	,	ŀ
	N	٣)			
		×		(	
					Ĭ,
/	\	X	r	٦	
	0	<del>,</del>	,	۰	ŋ
	И		ú	n	
		$\sim$			
		S.			
$\rangle$			b	4	
?	S	Ď	t	9	Į
?	8	K	Š	2	ļ
?	8	K	ì	2	Ķ
?		K	ì	3	
	₹		2		
3	₹		2		
	Š	â	2		
3	Š	â	2	S	ķ
	Š	â	2	S	ķ
3	Š	â	2	S	ķ
3	Š	â	2		ķ
?	Š	â	2	S	ķ
?	Š	â	2	S	ķ
?	Š	â	2	S	ķ
	Š	â	2	S	ķ
	Š	â	2	S	ķ
	Š	â	2	S	ķ
	Š	â	2	S	ķ
			2	S	ķ
	Š		2	S	ķ
			2	S	ķ
			2	S	ķ
			2	S	ķ
			2	S	ķ
			2	S	ķ
			2	S	ķ
					ķ
					ķ
					ķ
					ķ
					ķ
					ķ
					ķ
					ķ
					ķ
					ķ

Question 3 continued	
(Total for Ques	etion 3 is 9 marks)



4.

$$\frac{\mathrm{d}y}{\mathrm{d}x} = y^2 - x$$

(a) Show that

$$\frac{\mathrm{d}^4 y}{\mathrm{d}x^4} = Ay \frac{\mathrm{d}^3 y}{\mathrm{d}x^3} + B \frac{\mathrm{d}y}{\mathrm{d}x} \frac{\mathrm{d}^2 y}{\mathrm{d}x^2}$$

where A and B are integers to be determined.

**(4)** 

Given that y = 1 at x = -1

(b) determine the Taylor series solution for y, in ascending powers of (x + 1) up to and including the term in  $(x + 1)^4$ , giving each coefficient in simplest form.

**(3)** 



12	V	۲	
$\wedge$	$^{\wedge}$		١.
v	É	2	
		а	
	79	비	ь
X.		7	$\sim$
v.	×		P
$\langle \rangle$			
		r/	
Vi	~	_	4
	-		
X		7	S
8		Ž	Š
	É	Ý	2
	ŝ	Ý	
		Ý	

Question 4 continued
(Total for Question 4 is 7 marks)



5.	In this question you must show all stages of your working.
	Solutions relying entirely on calculator technology are not acceptable.

Use algebra to determine the set of values of x for which

$$\frac{x^2 - 9}{|x + 8|} > 6 - 2x$$

**(6)** 

X	×	×	୬
X			2
×>	Š	Š	<
×	2		S
X		×	2
$\sim$	Ş	Ç	<
×	2		S
×	Χ	×	Þ
X	Š	Č	2
×>	੭	्र	ĸ
X	Ę	Į	š
X	И	И	P
$\times$	ä	ø	R
$\otimes$	P	Ģ	ii,
X	ď	T	5
X	8	8	8
×	ŭ	Ř	ĸ
X	Z	C	S
×	H	H	Ď
X	у	¥	R
X	e	Ŷ	ĸ
×	2	S	S
X	ä	2	2
×		4	K
X	2	Ω	S
×	Ц	ч	Þ
X	Ķ	ě	R
$\otimes$	ì	Ŷ	ĸ,
X	Ö	e	5
83	Ä	Z	2
×>	ĕ	ζ	K
×	Ŷ	X	5
X	Ľ	$^{\vee}$	Š
X	K	X	2
X	Q	ä	K
X	2	5	Ď
X		4	۶
X	X	š	8
X	Ø	g	K
X	ñ	Ŕ	S
X	K	Y	ŀ
×	Š	Ś	8
×	$\geq$	Ŷ	S
$\otimes$	X		S
X	Š	X	2
×	Ó	Ś	8
X	X	X	S
×	Χ	×	>
X	S	Č	2
$\otimes$	Ŷ		S
×	X	×	S
X	X		2
×>	Ş	Ö	<
×	2	Q	S
×			Ď
X	ŏ	Č	2
$\approx$	$\hat{\mathbf{x}}$	Q	S
$\approx$			S
X	X	×	2
	S		2
~/		X	
X	٥	×	5
8	Ŝ	X	
$\stackrel{\times}{>}$		× 1	
		X 11 12 X 2 X	
		X 1 1 2 X 2 X 1 X	
		X 1 2 X 2 X 1 X 1	

<							\
							>
					\	1	8
							C
							2
							>
							2
					>		5
					<		
							2
2							S
->							
		١	2	۱			/
					7	4	è
				Ì	e		S
		٩	ì	7	7	۹	
				ú	7	6	ì
2					⊴		j
		1	2	٦	z	7	Z
					۹		ņ
					á		Ĺ
		١,				2	Ź
3				ú	ξ		7
-2				9	٠		L.
		١				2	7
						C	>
					3		٩
		5	1	۹	ø	К,	d
				4	_	4	ä
				7	Z	Z	Σ
		\		щ	я		è
				í	Ľ	Ľ	5
				2	₹	7	₹
		/	/	ĺ	2	$^{\prime}$	Z
					7	•	É
		2					
Ş		1		ş	4	2	6
					7		
				á			٤
						3	
		?		ń	ζ	Ş	Ş
3	8	3		Š		2	
ξ	8	ζ		Š		2	
	5	?		Š		Þ	3
	8	3		Š			4
	3	3		Š		Þ	3
	3	?		ì			4
	3	3		ì			4
3	3	3		Š			4
3	3	3		ì			4
3		?					4
3		?					4
3							4
3		?					4
3							4
3							4
3							
3							4
3							
3							

Question 5 continued



Question 5 continued

		×		>		
١,	/			۷.	d	ŀ
	K		Ą		rs	
		9	۹		ĸ	0
ί		١.		S	2	
2	Я	r	J	Ρ	q	
	Л					
	Š	Ć	Σ		Z	2
			3		۳	
	×		ä		è	í.
				7	₹	
	7.		á	id		F,
	S					
	S					
					2	
	×					
	Ά			S		
		7				
			2			
	8					
	Ø					
	И					
		ě			ø	
		2	ú	2	á	ľ
	Х					
	/					
	à	k		S	2	
	Ì	k	>	\$		K
S	B	ŀ	2	S	2	
>		ŀ	2			
		ŀ	2			
5		į				k
						k
	8	2				
	8	2				
	8					
	8	2				
	8	2				
	8	2				
	8	2				
	8	2				
	8	2				
>					Ž	
					Ž	
	8				Ž	
					Ž	
					Ž	
					Ž	
					Ž	

Question 5 continued	
	(Total for Question 5 is 6 marks)



**6.** A complex number z is represented by the point P in an Argand diagram.

Given that

$$|z - 2i| = |z - 3|$$

(a) sketch the locus of P. You do **not** need to find the coordinates of any intercepts.

**(2)** 

The transformation T from the z-plane to the w-plane is given by

$$w = \frac{iz}{z - 2i} \qquad z \neq 2i$$

Given that T maps |z - 2i| = |z - 3| to a circle C in the w-plane,

(b) find the equation of C, giving your answer in the form

$$\left| w - \left( p + qi \right) \right| = r$$

where p, q and r are real numbers to be determined.

**(6)** 



2					
Z					ς
2		?	Ś		S
2	Š		ŝ	?	S
Č	>		>		
Č	×		>		$\rangle$
	>	C	>		
<	×		>		
Ç					
ς			>		$\rangle$
ς.			>		
S	>	S	2	S	à
S	K	Ę	ä		P
S	ă	'n	Ì	S	d
S	3	þ	d	ķ	d
S	3	ρ	9	й	ė
×	2	,	ŧ	7	3
>	ű	ĕ	é		r
$\rangle$	C	×	7	7	Á
$\geq$	(	è		2	6
×	Į	ķ	d	ŗ	q
×	ű	ù	ģ	è	á
Z	J	×		ř	٩
2	ú	ì	d	μ	Ĺ
2	y	Ľ		2	S
Č	y	ŗ	>		
ζ.	×	6	è	é	ì
Č	k	á		c	5
◁	S	=	ě	ζ	ì
◁	×	Ś	S		
S	K	ĺ	j	Ĺ	j
Ç	d	í	9	Š	2
ς	k		7	5	7
S	ď	į	è	Ś	è
S	3	ř	9	ÿ	è
S	S	9	ë	9	ė
S	ď	3	3	à	ä
S	8			S	i
×	ď	7	7	5	
S	Ĭ	k	_	2	4
$\rangle$	1		Z	Σ	ζ
$\rangle$	Ĵ	f	7	7	۹
$\geq$	Ç	9	ģ	è	ę
×	9	7			Į
×	ý	ı	Ę	è	6
Z	S	2	Ś	2	S
2	k	٢	5	7	3
Č	ķ	3	þ	ė	9
Č	k	ř	5	7	٩
ζ.	y	ĕ	þ	e	ij
Č	×		>		
⟨	×		>		$\rangle$
€	×		>		
ζ	×		>		
ς	×		>		
S			?		è
S	?	Ś	?		
S	>		?		2
S	?				
S		×	?	>	
×	C	×	(		
×		×		>	
$\geq$		×			
$\rangle$	C	×		>	
×	Ç	×	ζ		
×		×		>	
Z					Ś
×	Š		S	2	
2	×	×	Ś		
2	×		>		
Č	×		>		5
Č	×	Ć	>		
<	×		>		
S	×	į	è	ú	è
S	d	Š	ė	ij	ij
S	ð	k	j	Ĺ	j
×	Š		i	2	Š
×	1				Š
×	Č	Š	Š	ž	ź
$\geq$	1	ij	ś		ß
×		×		Ž	ď
×	ý	r	ý	P	ý
×	5	2		2	4
Z	3	2	Š	Ź	Š
Š	8	2		ľ	Š
Č	d	ř	Š	ď	ď
Č.	k	e	,	ė	þ
Ć.	×	ľ	>	<	
¢	×	į	7		Į
Ç	K	ę	É	é	è
S	K	ģ	þ	ę	þ
5	ķ	í	ì	S	à
ς	K	ú	į	Ĺ	į
S	j	Ú	2	S	Ž
S	k		2	Š	Š
S	K	ġ	ė	5	ė
5	j		3	ľ	d
×	d	Ś	ś	Š	3
×	Š	í		ğ	ę
\		Š	á	ä	į
S	Č	2			<

Question 6 continued



Question 6 continued

		>			
		×.	2		
١,	$^{\sim}$		4	d	
_	1	в		15	
		•		Ŀ	
	×	. 2	S	Z	
~	ч	N	ν	ч	
	4				
	×	÷	G	à	
×	и	N	Р	₹	
	4				
			4	à	
	a	ø		г	
	×	94		Ŀ	
	V			7	
×		£	7	2	
	M	rà		9	
	J.			Я	
\			2	Z	
	×	2	7	7	
	(1)				
ζ.	х	А		2	
	VIII				
	ũ				
	я	×	ú	è	
×	ч	K		7	
		~			
	М	4	ú	è	
		S	ð	۳	
	20		L	٠	
У.	9	_	9	-	
		>		>	
₹	4	ŭ	Ľ	3	
×	J	Ц	Ĺ	Į	Į
Š	1	Ľ	5	2	Ę
>				2	į
>		K		2	
8		K	2		
>		K			
>		KKK			
		Z K			

Question 6 continued
(Total for Question 6 is 8 marks)



7. In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

(a) Use de Moivre's theorem to show that

$$\cos 5x \equiv \cos x \left( a \sin^4 x + b \sin^2 x + c \right)$$

where a, b and c are integers to be determined.

**(4)** 

(b) Hence solve, for  $0 < \theta < \frac{\pi}{2}$ 

$$\cos 5\theta = \sin 2\theta \sin \theta - \cos \theta$$

giving your answers to 3 decimal places.

**(4)** 



**************************************	
	ш
**************************************	ш
	ш
	ш
	ш
4	ш
XXXXX	ш
ec m	ш
	ш
	ш
S	ш
	ш
XXX.	ш
	ш
	ш
××××	ш
	ш
$\otimes$	ш
	ш
	ш
	ш
$\times\!\!\!\!+\!\!\!\!\times$	ш
<u>Ö</u>	ш
	ш
	ш
×O×	ш
$\otimes \triangle \otimes$	ш
	ш
	ш
	П
*****	П
	П
	П
	П
*****	ш
	ш
	ш
	ш
*****	ш
	ш
OOOD	ш
	ш
111 000	ш
	ш
8888888 -	ш
<u> </u>	ш
	ш
	ш
	ш
<b>₩<del></del></b>	ш
XXIIIIIXXX -	ш
	ш
	ш
× <del>oz</del> ×	ш
	ш
	ш
6	ш
$\times$	ш
	ш
	ш
DO	ш
	ш
	ш
	П
$\times\!\!\times\!\!\times\!\!\times\!\!\times$	П
	П
*****	П
	П
****	П
	П
	П
	П
	П
	П
XXXX	П
4	П
$\times$	П
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	П
	П
	П
00 <u>77</u> 00 -	П
XXXXXX	П
	П
××××××××××××××××××××××××××××××××××××××	П
XX <b>=</b> XX	П
× × ×	П
124	П
$\times$	П
$\otimes a = \otimes a = \otimes a$	П
	П
	П
	П
$\otimes Q \otimes$	П
×2×	П
	П
<u> </u>	П
	П
$\times$	

Question 7 continued	



Question 7 continued

					Ì	
	2					
				2		
	Į					
		ř	ø	ę	9	۲
	S					
					2	
		4				
		Ĺ			а	ľ
	3	ц	٠	d	ø	
		Ú	2	S	2	
?	à		×		4	
					4	١
			н	Ħ		٢
S						
-						
		>				
		>	S	?		

Question 7 continued	
	(Total for Question 7 is 8 marks)



8.

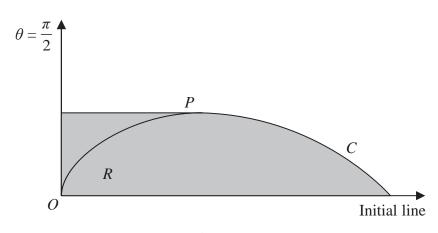


Figure 1

The curve C shown in Figure 1 has polar equation

$$r = 1 - \sin \theta \qquad 0 \leqslant \theta < \frac{\pi}{2}$$

The point *P* lies on *C*, such that the tangent to *C* at *P* is parallel to the initial line.

(a) Use calculus to determine the polar coordinates of P

**(4)** 

The finite region R, shown shaded in Figure 1, is bounded by

- the line with equation  $\theta = \frac{\pi}{2}$
- the tangent to *C* at *P*
- part of the curve C
- the initial line
- (b) Use algebraic integration to show that the area of R is

$$\frac{1}{32}\Big(a + b\sqrt{3} + c\Big)$$

where a, b and c are integers to be determined.

**(6)** 

×	$\times \times$	
X	$\times\!\!\times\!\!\times$	
X	$\times\!\!\times\!\!\times$	
$\wedge$	$\otimes \otimes$	
×	XX	
	XX	
×	$\times\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	
X	$\times$	
X	$\times$	
$\times$	$\otimes$	
×Ω	< ≰	
X	10/40	
X		
×		
X	W	
X	32.5	
$\times$	$\propto$	
X	LA.	
X	34	
X	-	
X		
X	4	
$\otimes$	$\times$	
×		
M		
X		
X	Y Y Y	
X		
×	$\Rightarrow$	
$\times$		
X	no.	
×	220	
X		
X		
$\times$	$\approx$	
X	XX	
X	$\circ$	
×	*	
QQ.		
X		
X	DO NOT WRITE IN THIS AREA	
$\times$	∞:	
$\sim$	$\sim$	
KX		
X	$\times \times$	
X	$\times\!\!\!\times\!\!\!\circ$	
X	$\times\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	
X	$\times \times$	
X	$\sim$	
$\otimes$	$\propto \times$	
$\otimes$	$\times\!\!\times$	
×	XX	
X	$\times\!\!\!\times\!\!\!\!\circ$	
X	$\times\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	
$\times$	$\times$	
$\times$	$\times\!\!\times$	
X	$\propto \times$	
X.	$\times\!\!\times\!\!\times$	
×	$\times\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	
X,	$\times \times$	
×	$\times\!\!\times$	
$\stackrel{>}{>}$	$\times$	
$\stackrel{>}{\sim}$	$\otimes$	
*	*	
× ×		
	<b>₹</b>	
	ENA ENA	
	KEA	
	AREA	
	AREA	
	SAREA	
	IS AREA	
	LIS AREA	
	HIS AREA	
	THIS AREA	
	THIS AREA	
	NTHIS AREA	
	IN THIS AREA	
	INTHIS AREA	
	EINTHIS AREA	
	TENNAMIS AREA	
	TEAN THIS AREA	
	THE IN THIS AREA	
	RITE IN THIS AREA	
	KRITE IN THIS AREA	
	WRITE IN THIS AREA	
	WRITE IN THIS AREA	
	WRITE IN THIS AREA	
	T WRITE IN THIS AREA	
	OT WRITE IN THIS AREA	
	OT WRITE IN THIS AREA	
	NOT WRITE IN THIS AREA	
	NOT WRITE IN THIS AREA	
	ONOT WRITE IN THIS AREA	
	O'NOT WRITEIN THIS AREA	
	30 NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITEIN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE'N THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE'N THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE'N THIS AREA	
	DO NOT WRITE IN THIS AREA	
	NO NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE'N THIS AREA	
	DO NOT WRITE IN THIS AREA	
	NOT WRITE IN THIS AREA	
	DO NOT WRITE IN THIS AREA	
	DO NOT WRITE'N THIS AREA	
	A DO NOT WRITE'IN THIS AREA	

				۲.			7
	1				1	1	V
							C
							×
		2					
1	l						
		⋖					
				>			
	2				?		
	/		/				١,
			<				
	١,	7					◟
						\	
					۷	ú	à
			S				
		/			7	9	
				ú	à	í	н
					Ц		
		/	/	₹	7	₹	7.
					à		ņ
					┙		<u>_</u>
		١	/	$^{<}$	7	7	
	Ŋ			4	à		P
				姼	6	J	
	2			⋖	2	₹	9
		2			١		
				è			6
			2	٧.	d	К	١
	۲	2		2	S		
>	6			븨	μ	۲	ø
	>	≺			è	ú	è
		2			Я	Ρ	
				ы	d		ĸ.
			N	Z			
					6	ù	6
1	2						
	1			Ş			7
				ù	ú	ò	ú
	2			ς	2		ζ
		5	2	5	Z	3	Z
	S	>		ń	þ	ė	Ç
3	8	3		ń	þ	ė	
3	8	3		ń	þ	ė	2
3	3	?		ń	þ	ė	4
3	5	3		ń	þ	ė	1
3	3	3		ń	þ	ė	1
3	3	?		ń			1
3		3		ń			1
3	3	?		ń			1
3	3	3		ń			1
3		?					1
3		?					1
3		?					1
3		\ \ \					
3							1
3		?					
3		\ \ \ \					
3							
3							
3							
3							
3							
3							
3							
3							
3							
3							
3							
3							
3							
3							
3							
3							
3							

Question 8 continued



Question 8 continued

12		2			
			Ì		
K)					
×	ø	۳	₹	7	
VĬ	ĸ.				
			5		
: X	ú	d		š	
$\times$ I		ť.	2	4	
K)		2	S	а	ĺ
$\wedge$	7	٧	ø	۲	
	۰	×	ь	×	
(N	ť	7	۲	7	ė
$\sim$	ú	à	b	ù	
×		7	7	۶	١
v 1		2	/	d	í
$\sim$	×	۹		и	
×	s	á	b	ĸ	
$\langle \cdot \rangle$			ď		
		6	۵	4	
	٠	7	٠	7	4
Λ.					
v					
$\sim$					
V			5		

Question 8 continued	
	-
	_
	_
	_
	-
	-
	-
	_
	_
	_
	-
	-
	_
	_
	_
	_
	-
	-
	_
	_
	_
	-
	-
	_
	_
	_
	-
	-
/m / 16 O // 01 10 1 1	-
(Total for Question 8 is 10 marks)	-



- **9.** (a) Given that  $x = t^{\frac{1}{2}}$ , determine, in terms of y and t,
  - (i)  $\frac{dy}{dz}$
  - (ii)  $\frac{d^2y}{dx^2}$

**(5)** 

(b) Hence show that the transformation  $x = t^{\frac{1}{2}}$ , where t > 0, transforms the differential equation

$$x\frac{d^{2}y}{dx^{2}} - (6x^{2} + 1)\frac{dy}{dx} + 9x^{3}y = x^{5}$$
 (I)

into the differential equation

$$4\frac{\mathrm{d}^2 y}{\mathrm{d}t^2} - 12\frac{\mathrm{d}y}{\mathrm{d}t} + 9y = t \tag{II}$$

(c) Solve differential equation (II) to determine a general solution for y in terms of t.



**(2)** 

(d) Hence determine the general solution of differential equation (I).





$\sim$		
×		×
$\Diamond$		×
X	×	7
×	×	
X	×	ζ
X	×	S
X		Ś
X		×
$\langle \times$		×
X.		×
X	k	è
X	Š	7
×	ł	Ľ
×	Š	á
$\approx$	k	Ļ
X	×	ė
X	K	S
$\langle \times$	×	è
$\langle \times$	1	ķ
$\propto$	Ĵ	è
×	ļ	7
×	ļ	ŕ
X	ł	ŀ
	X	5
X	K	2
$\langle \times$	1	9
$\langle \times$	3	7
×	k	ř
X	Į	÷
×	ł	B
$\approx$	S	į
$\approx$	1	ŕ
$\langle \times$	g	2
$\langle \times$	G	3
×	×	
X	X	2
X	ł	ŀ
	Š	ä
$\approx$	k	ķ
×	Ì	7
$\Diamond$	Ĵ	ď
$\propto$	×	
X	Á	ľ
×	×	d
X	į	ľ
$\otimes$	k	Š
$\otimes$	×	
$\otimes$	×	×
Q.		×
X	2	×
X	×	
×	×	
×	×	
$\times$	×	
$\times$	×	
X		×
$\langle \times$		×
$\propto$		
$\propto$	×	
	×	
X	×	
$\times$	×	
X	×	S
X		×
$\langle \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \!$		×
$\langle \times \rangle$	Ĺ	×
×	×	>
X	×	Š
X	K.	Š
X	'n	į.
	d	
Ø	k	į
炎	k	j
8	k	
× ×		
× ×		
	k	
	k k k	
	K K K K K K K K K K K K K K K K K K K	
	K K K K K K K K K K K K K K K K K K K	
	K K K K K K K K K K K K K K K K K K K	
	X X X X X X X X X X X X X X X X X X X	
	K K K K K K K K K K K K K K K K K K K	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	
	k k	

١		١			
>					
2			١,	i	
l		ς	>		
/					
			>		
1					
4				5	
		C	$\rangle$		
	S		й	ρ	ı
S		S			
			7	₹	Ę
1		А	ß.	J	
S			ŀ		
	ā	S	2	ζ	ď
1		7		7	
S	ø		ø	h	ŧ
		S	a	й	
4		۲		Г	
	7	9	Ħ		
	۷,	2	'n	ĕ	
y		Ы	r	٦	
	7	₹		e	
7	۹	μ	۹	Ħ	
S	6	è	6	ù	ć
	7	q	P	ς	
	ь			ú	
S	6				
		'n	n	ú	ı
1					
S					
	À	į			
	S	d	ц	7	
⊳		þ	۰	٥	
ú	ú	þ	×	Ĥ	
	4	$\geq$	9	ì	
Ų		ч	ν	Ч	
9	,	9	,	۲	
$\geq$					
S		٠	,	۰	
1	3	4	2	2	
×	ď	ø	ď	9	Ì
S		۹	ú	Ħ	
1		4		4	
3			7	7	٩
	۳	ą	8	b	١
	ij			Š	
2	2	Z			
S	۴	3	7		
Ų	ĕ				
1		ú	þ	i	
S		3	ď	Š	
U	á	й	Ì	6	
3			S	a	
S	혱	ú	6	ø	
,	è	S	2	۵	
1	3	d		ρ	d
S	á		_	ì	
	7	₹	7	7	
		2	S		
			ø	٩	í
ĺ				S	
′	y	ø	ij	۴	
$\geq$	ű	ė	Ŕ	ŝ	
S				٦	١
g	ø	ú	ú	ø	
		7			
5	1				
1					
2					

Question 9 continued	
	-
	-
	_
	_
	_
	_
	-
	-
	_
	_
	_
	-
	-
	-
	_
	_
	_
	-
	-
	-
	_
	_
	_
	-
	-
	_
	_
	_
	-



Question 9 continued

Question 9 continued	
	-
	-
	_
	_
	_
	_
	-
	-
	_
	_
	_
	-
	-
	-
	_
	_
	_
	-
	-
	-
	_
	_
	_
	-
	-
	_
	_
	_
	-



Question 9 continued	
	(Total for Question 9 is 13 marks)
	TOTAL FOR PAPER IS 75 MARKS

