Surname	Other	names
Pearson Edexcel International Advanced Level	Centre Number	Candidate Number
Further Pu Mathema Advanced/Advance	tics F1	
71011011000,71011010	a sabsiaiai y	
Monday 14 May 2018 – Aft Time: 1 hour 30 minutes		Paper Reference WFM01/01

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 guide as to how much time to spend on each guestion.

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 ▶



P51514A ©2018 Pearson Education Ltd. 1/1/1/1/1/



(4)

1. Use the standard results for $\sum_{r=1}^{n} r$ and for $\sum_{r=1}^{n} r^2$ to show that, for all positive integers n,

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



			۰	
1		ä	ä	ø
4	Ş	9	L	ċ
,	ï	£	ī	3
4	Ŀ		5	ı
Ġ	Ξ		Ξ	2
1	r		۳	•
1	Ŧ	•		9
i	á	ø	P	ø
ĕ	٩	ч	ь	
			Г	
ì	r	À	A	ĺ.
1	Ŀ	I	ij)
ì	i	÷	ė	i
ì	=	-	=	ä
	7		7	
3		e		ij
ì	Ŀ	_	Ŀ	
1	۲	-	7	۰
3	ė	5		β
1	d		_	
Ė				3
3	7	-		۰
٠,		_		÷
ł	L		1	ı
ŝ	7		7	7
J	h		ė	ı
1	Ŀ			
3	₹	-	7	3
1	۴	ч	ρ	P
1	Ė	á	Ė	ı
į	ь	6	ė	
1	g		9	•
ī	ä	3		B
1	ī			•
1	L			۰
1	۲	7	۰	ŧ
٠,	à	ø	6	
J	ľ		η	0
	٩	ü	ø	,
1	ę	ė		ß
ì	d		_	
÷	1	7	1	₹
	á		٤	
Ì	ľ	7	٦	h
٦	٩	ė	ø	ø
÷,	á	á	b	ċ
1	Ľ		1	١
3	4	÷	4	ij

Question 1 continued	Leave
	Q1
(Total 4 marks)	



2. The transformation represented by the 2×2 matrix **P** is an anticlockwise rotation about the origin through 45 degrees.

(a) Write down the matrix \mathbf{P} , giving the exact numerical value of each element.

(1)

$$\mathbf{Q} = \begin{pmatrix} k\sqrt{2} & 0 \\ 0 & k\sqrt{2} \end{pmatrix}$$
, where k is a constant and $k > 0$

(b) Describe fully the single geometrical transformation represented by the matrix \mathbf{Q} .

The combined transformation represented by the matrix **PQ** transforms the rhombus R_1 onto the rhombus R_2 .

The area of the rhombus R_1 is 6 and the area of the rhombus R_2 is 147

(c)	Find	the	value	of	the	constant	k
-----	------	-----	-------	----	-----	----------	---

(4)



uestion 2 continued	



estion 2 continued	

Question 2 continued	Leave
Question 2 continued	
	Q2
(Total 7 marks)	



3.

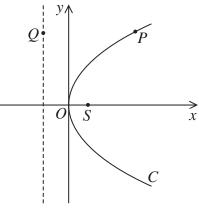


Figure 1

Figure 1 shows the parabola C which has cartesian equation $y^2 = 6x$. The point S is the focus of C.

(a) Find the coordinates of the point S.

(1)

The point P lies on the parabola C, and the point Q lies on the directrix of C. PQ is parallel to the x-axis with distance PQ = 14

(b) State the distance SP.

(1)

Given that the point P is above the x-axis,

(c) find the exact coordinates of P.

(3)



'n	ف	ø	
٩		ų,	
ì	н	НÍ	
1	۳	뺸	
1	n	P	
4	H	₩	
j	ø	Р	
ſ	7	ņ.	
1		٦	
'n	è	-i	
ì	×	,	
'n	4	-	
î	Ľ		
1	_	_	
i	_		
1	3	~	
1	F	_	
4		₹	
٠	. 4	ı.	
1	ч	ч	
ì	Ŀ		
1	_	_	
1		=	
1	ስ	P	
3	×		
č	3	3	
i	5	Si	
J	7	7	
ī			
1		7	
ú	ja	•	
į	Ŀ	J	
	=	É	
ì	e	=	
÷	f	₹	
٠,	'n	Ė.	
Ï	į.	2	
	3	₹.	
4	Ì	٦	
ı	-	=	

	Leave blank
Question 3 continued	
	Q3
(Total 5 marks)	
(Total 5 marks)	



4.

$$\mathbf{A} = \begin{pmatrix} 2p & 3q \\ 3p & 5q \end{pmatrix}$$

where p and q are non-zero real constants.

(a) Find A^{-1} in terms of p and q.

(3)

Given XA = B, where

$$\mathbf{B} = \begin{pmatrix} p & q \\ 6p & 11q \\ 5p & 8q \end{pmatrix}$$

(b) find the matrix \mathbf{X} , giving your answer in its simplest form.

(4)

	blank
Question 4 continued	Dialik
Question 4 continued	



estion 4 continued	

'n	ف	ø	
٩		ų,	
ì	н	НÍ	
1	۳	뺸	
1	n	P	
4	H	₩	
j	ø	Р	
ſ	7	ņ.	
1		٦	
'n	è	-i	
ì	×	,	
'n	4	-	
î	Ľ		
1	_	_	
i	_		
1	3	~	
1	F	_	
4		₹	
٠	. 4	ı.	
1	ч	ч	
ì	Ŀ		
1	_	_	
1		=	
1	ስ	P	
3	×		
č	3	3	
i	5	Si	
J	7	7	
ī			
1		7	
ú	ja	•	
į	Ŀ	J	
	=	É	
ì	e	=	
÷	f	₹	
٠,	'n	Ė.	
Ï	į.	2	
	3	₹.	
4	Ì	٦	
ı	-	=	

Question 4 continued	Leave blank
	Q4
(Total 7 marks)	



5. Given that

$$z^4 - 6z^3 + 34z^2 - 54z + 225 \equiv (z^2 + 9)(z^2 + az + b)$$

where a and b are real numbers,

(a) find the value of a and the value of b.

(2)

(b) Hence find the exact roots of the equation

$$z^4 - 6z^3 + 34z^2 - 54z + 225 = 0$$

(4)

(c) Show your roots on a single Argand diagram.

(2)

estion 5 continued	



Leave blank **Question 5 continued** Q5 (Total 8 marks)



6.

$$f(x) = \frac{2(x^3 + 3)}{\sqrt{x}} - 9, \quad x > 0$$

The equation f(x) = 0 has two real roots α and β , where $0.4 < \alpha < 0.5$ and $1.2 < \beta < 1.3$

(a) Taking 0.45 as a first approximation to α , apply the Newton-Raphson procedure once to f(x) to find a second approximation to α , giving your answer to 3 decimal places.

(5)

(b) Use linear interpolation once on the interval [1.2, 1.3] to find an approximation to β , giving your answer to 3 decimal places.

(4)



	Leave blank
Question 6 continued	
	1



estion 6 continued	

1		è	ø	ø
4	Ş	í		ċ
٠	í	i		ì
4	Ŀ		Ŀ	
Ġ	ä		Ξ	ā
1	c		c	
3	7		₹	3
ì	ø	ø		•
č	9	٩	ě	٩
4	r	ı	ρ	١
1	b	ø		Ą
ì		ė		Ė
ì	ŧ	ė	×	ė
٠			L	
		7	-	7
ł	Ŀ		÷	
ı	F			
ì.				_
111	7		7	,
1		í	÷	ė
4	ė	i	ė	i
ł	٢	ì		
1	b	d	b	ē
1	L			
1	۲	•	-	•
ŝ	i	i	ė	i
d	à	6	ä	á
J	E	1	Ľ	
1	5	3	-	
ï	2	ä	7	,
1	٩	۹	3	ú
J	P	7	-	
,	ï			
J	þ	ij		ą
ŀ	L		ú	ı
j	۲	•	7	
٩	ŧ	ė	ø	P
٦	ė	í	ė	i
Ġ	á	ė	9	•
į	=	ę	-	ę
	ż		Ŀ	
Ì	۴	•	9	Ñ
٩	b	i	d	ø
	â	i	ś	ċ
i	r		7	
Į	b	Ę		ģ

Question 6 continued	Leave blank
	Q6
(Total 9 marks)	



7. It is given that α and β are roots of the equation $5x^2 - 4x + 3 = 0$ Without solving the quadratic equation,

(a)	find the exact value of $\frac{1}{\alpha^2} + \frac{1}{\beta^2}$	
	α^2 β^2	(5)

(b) find a quadratic equation which has roots $\frac{3}{\alpha^2}$ and $\frac{3}{\beta^2}$

giving your answer in the form $ax^2 + bx + c = 0$, where a, b and c are integers to be found.

(4)

Question 7 continued	Leave
	Q7
(Total 9 marks)	



8. Prove by induction that, for $n \in \mathbb{Z}^+$

$$\begin{pmatrix} a & 0 \\ 1 & b \end{pmatrix}^n = \begin{pmatrix} a^n & 0 \\ \frac{a^n - b^n}{a - b} & b^n \end{pmatrix}$$

where a and b are constants and $a \neq b$.	(5)



	l t
uestion 8 continued	



	Leave
Organian 8 continued	blank
Question 8 continued	

4				
Ì				
1				
ì				
1				
ì				
ł				
3				
1				
Ì				
1				
1				
1				
į				
	d		ø	9
1	d	á		ø
+	-	8		
1	L			
3				۹
1	ĸ.			
í.	à	ſ	ń	
1	۲		7	
1	ĸ.	ı.	ú	
	ч		ø	"
1	-	ė		-
•	7	5		p
4	d	е	_	
1	=	d	d	=
	4		٤	
7		ø	۹	ĸ
1	г			
٦		ė	d	ρ
	c		•	
i		μ		к
4	r			
1	ь	ė	ė	
ď	-	7	-	-

Question 8 continued		Leav
		Q8
	(Total 5 marks)	



9. Given that

$$\frac{z - ki}{z + 3i} = i$$
, where k is a positive real constant

- (a) show that $z = -\frac{(k+3)}{2} + \frac{(k-3)}{2}i$ (4)
- (b) Using the printed answer in part (a),
 - (i) find an exact simplified value for the modulus of z when k = 4
 - (ii) find the argument of z when k=1. Give your answer in radians to 3 decimal places, where $-\pi < \arg z < \pi$ (4)

	Lea
	blaı
Question 9 continued	
	_
	_
	_
	_
	-
	_
	_
	_
	_
	_
	_
	_
	_
	_
	_
	_
	_
	_
	_
	-
	_
	_
	_
	_
	-
	_
	_
	_
	_
	-
	_
	1



estion 9 continued	

Leave

Question 9 continued	blank
	00
	Q9
(Total 8 marks)	



10. The rectangular hyperbola *H* has equation xy = 144. The point *P*, on *H*, has coordinates $\left(12p, \frac{12}{p}\right)$, where *p* is a non-zero constant.

(a) Show, by using calculus, that the normal to H at the point P has equation

$$y = p^2 x + \frac{12}{p} - 12p^3$$

(5)

Given that the normal through P crosses the positive x-axis at the point Q and the negative y-axis at the point R,

- (b) find the coordinates of Q and the coordinates of R, giving your answers in terms of p. (3)
- (c) Given also that the area of triangle OQR is 512, find the possible values of p. (5)

estion 10 continued	



stion 10 continued	

	Leave blank
Question 10 continued	
	1



uestion 10 continued	Leave blank	
	Q10	
(Total 13 marks)		
TOTAL FOR PAPER: 75 MARKS		
END		