



MATHEMATICS STANDARD LEVEL PAPER 1

International Baccalaureate® Baccalauréat International Bachillerato Internacional

	Cai	Taladic	sessio	TITIOTT	~ ·	_
0	0					

Examination code

1

1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- You are not permitted access to any calculator for this paper.
- Section A: answer all questions in the boxes provided.
- answer all questions on the answer sheets provided. Write your session number Section B: on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the number of sheets used in the appropriate box on your cover sheet.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the *Mathematics SL* information booklet is required for this paper.
- The maximum mark for this examination paper is [90 marks].





Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

SECTION A

Answer all questions in the boxes provided. Working may be continued below the lines if necessary.

1.	[Maximum	mark	J	67
ماد	[IVIUNIIIIIII	muin	V.	0

Let
$$A = \begin{pmatrix} 0 & 3 \\ -2 & 4 \end{pmatrix}$$
 and $B = \begin{pmatrix} -4 & 0 \\ 5 & 1 \end{pmatrix}$.

(a) Find AB.

[3 marks]

(b) Given that X - 2A = B, find X.

[3 marks]

* 3		•		•	٠	•	*0	•	*	٠	٠	*	٠		•	•	• •		•	٠	٠	*			٠	•	•	• •	• •	•	٠	ĸ	٠	* *	٠	*	• 9	• :•	٠	٠	٠	• •		•	•	• •	•	•		•	•		•	* *	٠	* :	200 - 23		1 //3	٠
•		٠	•		•	•	•	٠	٠	٠	٠	٠	٠	٠	٠	•	• •		٠	٠	٠	•			٠	٠		•			•	٠	٠		•	٠	• 0		•	•	•		٠	٠			٠	•	٠	•	 ٠	٠	•	٠.	٠	٠	•	• •		•
* 1			•	•		•	*	*	×	•	٠		•		•	٠	•	6) •	6 10	٠	*	* :)*	•		•	•			٠	*		•	•	• 0	•	•	(0.00)	•	• •		*	* 1	• •		•	٠	•		٠	٠		٠	٠	* :		E 100	•
• 1	•	٠	•	•		•	•	٠	٠	٠	•	•	•	٠	•	•	•		٠	٠	Ř	•			•	٠	•		•	6 1		٠	٠		•	•	•		٠	٠				٠	•		٠	٠	٠	•		٠	•		*	9	• /	•	•	•
o	•		•	٠	•	•:	٠		٠	*	*		*	•	•	•	•	ю.		*	٠	•				•	•	•	•			٠	٠			9		•	•		•			٠		• •	,	•	•	•)		*	*		· (*		•	•	•0000	•
•		•	٠	•	•	9	•	٠	•	•	•	•	•	•	٠	•	•		•	•	•	•	•		•	•	•	٠	•	•	•	٠	٠			٠	•	• •	•	•	•		٠	٠	٠	• •		٠	٠		 ٠	•	•		•		•		•	
(* 5)	•		•	•	•	*	*	*	*	×	*		•	•	•	٠	•10	0. 5	•	٠		•	• •			•	•	•	•				٠	•	136	٠	•	•		(C. •)	e	* *	•				•	٠		•	 *	٠	*	* (*	:•	9	٠		• (1)	,
•	•	٠	•	•	•	•	٠	٠		•	•	٠	•	•	٠	•	•				٠	•	• (٠	٠	•	•	•			•	•	•	•	•	•			٠	•		٠	٠	•	•		٠	٠		 ٠	٠	٠		9	٠	•		•	•
3 . 3	• 3	•	•	•	•	•	٠		×	٠	•		•	•	٠	•0	•	• •			•		. 9		٠	•	•	•	•			٠		. € 0	• •	•	•	•	•	•	٠	* *		٠	*	· 0		•	•	٠		•			•	(a)•(1)			•9	,
•	•	٠	٠	•	•	•	•	•	٠	•	ě	٠	٠	•	٠	•	•		•	٠	٠	•	•	•	•	٠	٠	•	•	• •		٠	•	•		٠	•		•	٠	٠	•	•		٠	٠	• •	٠	٠	•	 ٠	٠	٠	•	•	٠	•	•	•	•
9-3	• 2	• /	•	•	•	•	٠	•		•			•	٠	•)	•	•	e .			٠	•	•) (•)	•	•	٠	•	•		٠	٠	• 0	•	•	•5//	•	6 6	•	٠	* *				•		٠	•	٠		٠		• •	•	70.00	•	*: 1	•	
		•	•	٠	•	٠	٠	٠	٠	•	•	•	•		•	•	•			•	•		•	٠.	•	٠	٠	٠	•			٠	•			٠				٠	٠			٠	•			٠	٠	٠		٠	٠	•		•	•	٠	•	



*		
	f(x) = 7 - 2x and $g(x) = x + 3$.	. Let f
(2)	Find $(g \circ f)(x)$.	(a)
(1)	Write down $g^{-1}(x)$.	(b)
(2) (Total 5 marks)	Find $(f \circ g^{-1})(5)$.	(c)
		The second secon
	* * * * * * * * * * * * * * * * * * * *	

		80	8 3		15	×	×	4	0	8 3	F	Ħ	×	8	8 6	. 3	×	59	8.	4 3	\$6	(3)	8	E 8	100	3	£	6 5 6	6 \$	E	150	80 E		٠	19 19	1 8	٠	+ +	S 60		1 14	*	•		*	JN 18	• +	4	e 3	e 16	٠	86 H	25 (7	,	h à		
er) feelili																																																										
COMMUNICATION OF THE PROPERTY	*	ą.	8 3	2 2	¥	8	4	î			4	Ç.	4	8		6 16	¥	ę.	40			27	4	1 1	6	3	£) if	*	9	÷ 6	8	60	4) (4)	4	:4	96 A	i s	*	jo 19	ė	ié: 1	er be	4	A. N	v	W	ide na	к е		16. 1	× 10		4	A 20		
accessor.																																																										
	0.1	e.	13	1 3	14.	55	70	į.		į	7	à.	35					*	4.		×	11	*			ă-	×			*	2	7 9	*			4	8	ė ·	4	a	4 9	-	2 .	e +	-4	4. 4	v .6	ψ	+ •					4	4.	e: 5	ŝ	
		20	77	e 3	- 12	3		a	2 3	6 6	1 74		22	22					i :	0.14	٠	*	46	e. 5		36	. 6			Ų.	di.					. 18	2			2		Y	ır :		*	*	6 2	4	4.	0.4					i.			
				16 00	- 16	181		8	s 1	e 10		18	364	200	atir s	4 3	- 12	4	2	1 0		4	54				167				160			161			30.			20	N					24		+		2 2		a.	10 49	4	ų.	4. 4		
1.0																																																										
· very production of the control of				esconorea.	SILVE		020		D 10			-		1000				-		ov . se		-		S 2		70.2	32	2. 1		-	90.	u 2			600		*	2010			201100		144	e .		-				or at	e i Taor	90			9.7	91. 5		
are sooner	>× -		-					100		*		16	99		03 (0			e e				3		2. 4	- 60	200	730			- 201	*	20. 1			*******	0 30		201.2	E: 200	30	V66 16		cec:	ec. 10														
any entire)																		450.0				500	100			ed.	201			200	40				20 0		160	40.00			90 0					-					. 40				- 100			
1	10	•	27			- 6	- 35	-53	*	2 0		*	**	- 35-			1	*				*	**		*	150	56	er e	8: 22:	20.	22	200		*	N 1		*	* *	0 20	*	* .		*			*	•		**		4		en e		~	300.10		
T ag	*	4	*	•	4			43	*		*	e d	*					*	*	40		8	i.	9. 3	×	95	9	2		*	૾	8.3	1 18	×	15 1		A	× 1		11	* 1	-	W			*	H •	*	960	* 2	99	*	y	-		56: 0	5.	
i.																																																										
	ħ.	5	?		ė į	ř		n	4	\$ 15	1 15	÷	•	N	4	4 3	- 12	Ť	4	A 3		Æ.	80	10 1	*	*	w	*	4 8		3	7. 1		4	87	* *	×	* *	* *	÷	8 3	8 8	8	2 :	100	*	K 5	- 8	8 1	8 8	8	*	8 8	t d	8			
1																																																										
Tri and	150	*	0	21		- 4	18	7	2	30.5	1135	f) F	2	10.0	(A) (B	20	.30	3	8 3	2	4	S.	96.3	8	*	**	38 3	* *		*	* 1		•		. 4	42	* 1	* 31	32	t i	1 3	1	è s	· ·	*		A	1	2. 55		2	2 :	2	3	3		
ON THE PROPERTY OF THE PROPERT																																																										
4	*	·m.	14	ik.			1	iv.	+	*	1 3	×	ř		d.	9 3	14	2	×	9.3	18	40	46	le a		8	62.	100	9 8	166	34	× 1	e és	34	x =	8 8	38	99	* *	×	38. 3	e, ie	(44)	* 9	s - %	×	2 3	9	*		- 25	39	25. 3	9 138	A	38 1	E	
100																																																										
	37	w	œ				٠	×	e.	(6)		*		+	36.5	in 15		A	*			×	*	4. 9	38	4.1	6	7	8 %	1	36	8		14	¥ į	5 1	35	* 1		0	* 4	P	196	×	6. 8	×	× 3	88	16	* 4	1 181	*	* 3	£ 75	-3	19	e:	
10.																																																										
1042																																																										
8,7																																																										
All Address of the Ad																																																										
two contracts																																																										
SAU-																																																										
The same of the sa																																																										
-																																																										
E.,	*****	east.	NOSO	ingen	9000			50.50	300	1197	1073	War.	2000	988	9.80	5000	HH P		m382	V 887000	000100	baree			ALC: TO	****	110 M	(2013))	etcesso)	to King	101474	(C) 20	2020	Marine.		-	- Krit		-	Causer)	mary	*****	*****	21,510			*****	weens	999455	68 VICES	assaus	(22962)	SERVE	Name of	(X)		25(0)	

		(Total 7
	тто се 1943 (1943) под 1948 (1945) на применения применения на применения пр	energen angeleng ander ergena gebenggg
a - k - e e e e e e e e e e e e e e e e e	* * * * * * * * * * * * * * * * * * * *	* * * * * * * * * * *
3 1 4 4 4 4 4 4 4 5 5 4 4 5 9 9		
	# * * * * * * * * * * * * * * * * * * *	

***********		. ~
3 A 2 6 6 6 6 6 6 7 8 7 8 7 8 8 8 8 8 8 8 8 8	******************	
e		6 % & # 1 2 % V V V
* # * * * # # # # # # # # # # # # # # #		
* * * * * * * * * * * * * * * * *	************************	******

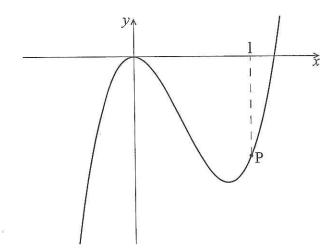
Solve the equation $2\cos x = \sin 2x$, for $0 \le x \le 3\pi$.

3.

IB Questionbank Maths SL

4. [Maximum mark: 6]

Part of the graph of $f(x) = ax^3 - 6x^2$ is shown below.



The point P lies on the graph of f. At P, x = 1.

(a) Find f'(x).

[2 marks]

(b) The graph of f has a gradient of 3 at the point P. Find the value of a

[4 marks]

	1	П	le	Ł	31	d	Р	11	()1		,	1	10	ID	•	ı	Ŗ1	a	·u	10	. I.	ΙL	U	, 1.	J		11	· L	11		Ρ		LL	ll	1		1	11.	10		11	_	Υ.	aı	ıu		U		u	•										L	7	11	ı	11 1
-		-	_	-					_					_	-				-						-						205											-								_						-									-
			۶.			•		•								•	•	•	•	.			•	*:		٠	*	• ;					m.k)	•	٠	•		•	•	•			٠		•	•		•		•	•		٠		٠	•	• •		٠	10 4 10	•	e:	•	•	
	•	•		•	٠	٠	٠		•		•	•	•	•	•	•	• (1)	•	٠	•	٠	•	20	ř					•			600 -	•	•	٠	•		*	٠	*	. ,		:•	•		•		s •s	÷	*		٠				•	•	•	98.J e .		٠	•	*	•	
	•	•		٠	٠			٠	*		٠		:*	٠	•	۰	•	•	•				•	*	÷	٠		•	•	•	1000		•	ě	•	٠	•		•		• •		•	٠	è	•			٠	٠		·	٠	•	•	•	•			- 13		•		•	
				٠	•	•	٠		٠	•	•	•	•	•	•	•	٠			•	•	٠	÷	•	₩			•	•	•00				¥	ě	×		٠	٠	×			•	•	٠	•		. *	*	٠						•	•				*	٠		•	
	2.	e •	10. •					*	9	٠	•	٠	•	0.0	•	•	•	•							÷		•	•		•	. ;			٠	•	•	•	•	•	•	•				•	200				*	• •	٠	•	٠	٠	•		1		e 12	•	•			
	,							٠	٠	•	٠	•	•	•	•	•	٠	٠	•			•	ě.			•	•	•	•	20	6 0 1				٠	*		- 194	•	٠	•		•	(•)	٠	٠			*	(* :			927.	•	10. 5 0	51	×	51 5				2		•	
					1 14				•	•		٠		•	*		٠	•	•	• :						٠		50		•		. ,		٠	*	•	•		•	٠	•	•		•	٠	٠	•		٠	٠	•		9 -		21	ş	÷				٠	•	3 4 69		
	į								•	•	٠	٠	٠	•	•	•	٠	٠						٠	•	٠	•	*)		•	•	•		*	*	•	•	•	•	٠	•	•			٠	*	•			•	•	•			•	٠	•	. :			÷	•		•	
	,							•					٠	٠	٠	*	*	:5	• :	* 8	• :			•		•	•	٠	•	٠	٠	•		٠	•	٠	٠			•	٠	•			٠	*	٠	• •	•	٠	•				٠	٠	٠					•	•	•	
		•	•			•	•		§ •				•	٠	•	•	9	6		2 /	•			•		٠		*	•		٠	•	. 1	•	٠	•	•	•		•	147	•			٠		•		•	٠	•	• •					٠		• :			٠	•	•	
					• 6	•	•	•6 •						٠	:	19		٠	•	•	•	•				٠	•	•	•	٠	•	•	•		٠	٠		• •		•	•	•	•		•	٠	•	•	•		¥C.				٠	*	•		1 15			•	6	*	
			9			•	•					٠	•	٠			•	1140	•			•			8 ¥	- 10	•	٠	×	•		•		• •		•	•	•			*	٠	•			(€)		•	•		*	• •	• •			1.5	٠	٠	•			•	٠	٠	

5.	[Ma	aximum mark: 6]	
	Let	$\sin 100^{\circ} = m$. Find expressions for each of the following in terms of	m
	(a)	cos100°;	[3 marks]
	(b)	tan100°;	[1 mark]
	(c)	$\sin 200^{\circ}$.	[2 marks]
		<u> </u>	

	1		

 $\frac{1}{2} \frac{1}{2} \frac{1}$



-	[Maximum	7	0.7
6.	I Marinain	mark.	\times 1
110	I IVIUNIIIIUIII	mul iv.	\cup

The line L passes through the point (5, -4, 10) and is parallel to the vector $\begin{pmatrix} 4 \\ -2 \\ 5 \end{pmatrix}$.

1	1	Write	down	9	vector	equation	for	line	Τ.
(?	a)	WITTE	down	d	Vector	equation	TOT	HIIC	L.

[2 marks]

(b) The line L intersects the x-axis at the point P. Find the x-coordinate of P.

[6 marks]

٠		•	14 1	• 3	•	•	277	a .		٠		•		•	×		•	•	•	•			•	٠	•					3.		٠	•	•	٠	•				•	•			•	٠	•	•		•		•	. 1	•		•	•	e je	•		1 11 1					ŕ	
		٠	•	•	•	•				•	ě	•	3.00		•	•	•	٠	٠	•	•			•	•	•			-		2014	•	٠	140	÷	•								(1 0)		٠	•1	•		*	٠	* 1	• :	• :•		•	::•:	•	•	*:	•	• /			,	
•	•	٠	•			•					*																																																ê	*	٠	•				
•	•	•	2. 2 33	. * S	•	*:				٠	•	•	•	•	•	•	٠	•	٠	380	3	•	•	٠	•									¥			•		• 10			•	•	•		٠					•	•	•	•					٠	*	ž.	•	•		te.	
•	÷	•	3 4 6	ě		•							•	in(*)	•	٠	•	×	*	*		٠	٠	٠	٠	•	•	•	•		9 9		*		•	•	•	•	•					•	٠	•	•		•		•	٠	•	•		•	1		•	*		•	•	•00	1 3	
		•	•:	٠	٠	•	÷			•	•	٠	٠	٠	•	•	•	•	٠	•		•	٠	٠	•	•	•								*		٠	•		•	•000				٠	٠	•	* :			٠	٠	•	•					٠	* 1	•	•	•	•	٠	
9			ě	٠	•	•	* :	• 4				•		•	٠	•	٠	٠	•		•	•	•	•	•	8.	•	•	18	•	• :			e#	e.	•	•	•	•	• '	•		•	•	•		3.5		• •	•	•	•	•	•					8		1	•	•	2 200	•	
809		•	*	•	٠	i.			•	•	•	•	•	٠	٠	•	٠	•	٠		•	٠	•	•	٠	•	-		8 6	•			· 54	100	٠	٠	٠	•	•		•					*		•	•	•	٠	•	•	•	* 1	# #	• •		9.5	200	11.5	٠	٠	ě	•	
		•	٠	•	•	9 .	•	1 27)	•	•			<i>a</i> =			٠	*	•	-		٠	٠	•	•	٠	*	. ()	•	•	*	• :			;.* <u>*</u>		٠	٠	•	•	•	S	•			•	•	•	•	•	•	•	•	٠	8	•	2 1			•	•	•	•	¥	*	ě	
		٠		i#	i.e		٠	•	•							•	•	٠	•	٠	٠	٠	٠	٠	ě	2	•	٠	•	•		•		(1) a	•	٠	٠	•	•	٠			× 3		. 2	•	•	•	•	•	e •	٠	•	*	•	•	•		٠	2250		*	٠	•	•	
			14	**	٠	٠		•	ř	* 1				• •		•	٠		550 =		٠	•	٠	•	*	٠	•	•	•	•	•	•		·	•	٠	٠	•	•	٠	٠	•	•	•		•	٠	•	•	•	•	٠	ě	•		•	•					*	٠	٠	•	
			٠	٠		٠	20	7.0	٠	٠					î	•						•	٠	•	•	•	٠	÷		•	•	•	•05					×	٠	•	٠	•	•	•	• 1	•		•	•	•		•	2	ė		2.00	•	•			•	•	٠	ě	٠	



-	F3 6 .		7	17
7.	[Maximum	mark	7.	h/
/ 0	1 IVICADO DE L'OUTE	II COUL I	v.	0,

The equation $x^2 - 3x + k^2 = 4$ has two distinct real roots. Find the possible values of k.

	•	•						•	•	• 000													•									 													•			į			ų.					٠				
• •																																																												
	•00	•	•	•	• 3	٠	•	٠	•	• :	•	•		•	O. T.	•		•	*		٠	•	•	•	5 5			*	*	•	• •		•	5 1	5.5	*	•	• •		đ		: :	665		٠		8	20	* 1		•	٠	•		٠	٠	•	•	•	
•	•	•	•	•		•	14	340		•			٠	٠	21	ř.			٠	14		•		•				٠		*		•	¥1	21 1		×				٠	¥ 1		٠	•				×			٠	٠			•		٠	٠	٠	
•	•	•	•	•				•		• 13	•		•	•	•	•			•	ė	٠	•		•				÷	đ	e s	•	 9 5	•		٠		٠			•	•		•	•	•		٠	٠			9	٠		• •	1		٠		•	
•	•				2 14			•	•	•	•		•		*	×				*	•	•	٠	2			×				• • •	 8 K				*					•				٠								•	•	e •			×		
3.570	•0	•	*:				•	•	٠	•	•				•	•					.*	•	•	è			٠	٠		•			ě	•			٠			٠	•			•	•			•			•	٠	•		6 8		*	*		
		ži.	ě			•	•	•		1 955	•				¥	×			- 12	(4)		٠	*	•					·	•	***	 	٠			*	×			•	• 3	•		•	•			*				•	•			٠		×	î	
	•	•	•	•		: 1 t	:: •	•	•						•					UT.	٠	٠	•	•				ě	٠	٠	•		٠			•	٠	•		•	•			٠	٠			÷	•				•				٠	•	٠	
A			ě			2005				-					×				14		•	٠	¥0		•			×		•	•	 				*		.)	. :	٠	•			•	•			*	•	• •		•								
	•	*:	•			•		0.57	•	*1		ě		٠	٠	٠			•	٠	•	•	•	•		. ,		•	٠	•	•		٠			•	٠	•			•		•	•	•			٠	٠			•	•				•	٠	٠	
525	20	9	25		4	.00.002	w028	- 20	2.5	20	2	50 %		. 41	2		ror 10				72		20					- 12			_	 											e=11.129			20 00		90												

determines the contract of t



Please do not write on this page.

Answers written on this page will not be marked.



Do NOT write solutions on this page.

SECTION B

Answer all questions on the answer whets provided. Please start each question on a new page.

8. (Maximum mark: 16)

The velocity $v \text{ m s}^{-1}$ of a particle at time t seconds, is given by $v = 2t + \cos 2t$, for $0 \le t \le 2$.

(a) Write down the velocity of the particle when t = 0.

(1)

When t = k, the acceleration is zero.

- (b) (i) Show that $k = \frac{\pi}{4}$.
 - (ii) Find the exact velocity when $t = \frac{\pi}{4}$.

(8)

(c) When $t < \frac{\pi}{4}$, $\frac{dv}{dt} > 0$ and when $t > \frac{\pi}{4}$, $\frac{dv}{dt} > 0$.

Sketch a graph of v against t.

(4)

- (d) Let *d* be the distance travelled by the particle for $0 \le t \le 1$.
 - (i) Write down an expression for d.
 - (ii) Represent d on your sketch.

(3)

(Total 16 marks)

Do NOT write solutions on this page.

9. [Maximum mark: 14]

Let A and B be points such that
$$\overrightarrow{OA} = \begin{pmatrix} 5 \\ 2 \\ 1 \end{pmatrix}$$
 and $\overrightarrow{OB} = \begin{pmatrix} 6 \\ 0 \\ 3 \end{pmatrix}$.

(a) Show that
$$\overrightarrow{AB} = \begin{pmatrix} 1 \\ -2 \\ 2 \end{pmatrix}$$
.

[1 mark]

Let C and D be points such that ABCD is a rectangle.

(b) Given that
$$\overrightarrow{AD} = \begin{pmatrix} 4 \\ p \\ 1 \end{pmatrix}$$
, show that $p = 3$.

[4 marks]

(c) Find the coordinates of point C.

[4 marks]

(d) Find the area of rectangle ABCD.

[5 marks]

Do NOT write solutions on this page.

10. [Maximum mark: 16]

Let
$$f(x) = \frac{6x}{x+1}$$
, for $x > 0$.

(a) Find f'(x).

[5 marks]

Let
$$g(x) = \ln\left(\frac{6x}{x+1}\right)$$
, for $x > 0$.

(b) Show that $g'(x) = \frac{1}{x(x+1)}$.

[4 marks]

[7 marks]

(c) Let $h(x) = \frac{1}{x(x+1)}$. The area enclosed by the graph of h, the x-axis and the lines $x = \frac{1}{5}$ and x = k is $\ln 4$. Given that $k > \frac{1}{5}$, find the value of k.

Please do not write on this page.

Answers written on this page will not be marked.