**Summer 2013** www.mystudybro.com Mathematics C2 Past Paper This resource was created and owned by Pearson Edexcel 6664 Surname Initial(s) Centre Paper Reference No. Signature Candidate 6 6 4 () 6 No. Paper Reference(s) 6664/01 Examiner's use only **Edexcel GCE** Team Leader's use only **Core Mathematics C2 Advanced Subsidiary** Ouestion Leave Number Blank Friday 24 May 2013 - Morning 1 Time: 1 hour 30 minutes 2 3 Materials required for examination Items included with question papers 4 Mathematical Formulae (Pink) Nil 5 Candidates may use any calculator allowed by the regulations of the Joint 6 Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation or symbolic differentiation/integration, or have 7 retrievable mathematical formulae stored in them. 8 9 10 **Instructions to Candidates** In the boxes above, write your centre number, candidate number, your surname, initials and signature. Check that you have the correct question paper. Answer ALL the questions. You must write your answer for each question in the space following the question. When a calculator is used, the answer should be given to an appropriate degree of accuracy. **Information for Candidates** A booklet 'Mathematical Formulae and Statistical Tables' is provided.

Full marks may be obtained for answers to ALL questions. The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2). There are 10 questions in this question paper. The total mark for this paper is 75. There are 32 pages in this question paper. Any blank pages are indicated.

#### **Advice to Candidates**

You must ensure that your answers to parts of questions are clearly labelled. You should show sufficient working to make your methods clear to the Examiner. Answers without working may not gain full credit.

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Total

Turn over

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				Leave
1.	The fi	irst three terms of a geometric series are		UIdlik
		18, 12 and <i>p</i>		
	respec	ctively, where $p$ is a constant.		
	Find			
	(a) th	ne value of the common ratio of the series,	(1)	
	(b) th	ae value of n		
	(0) เม	ie value of p,	(1)	
	(c) th	ne sum of the first 15 terms of the series, giving your answer to 3 decimal	places.	
			(2)	



Question Number	Scheme	Marks	
<b>1.</b> (a)	$\{r=\}\frac{2}{3}$	B1 (1)	
<b>(b</b> )	${p=}8$	B1 cao	
(c)	$\left\{\mathbf{S}_{15}=\right\} \frac{18\left(1-\left(\frac{2}{3}\right)^{15}\right)}{1-\frac{2}{3}}$	(1) M1	
	$\{S_{15} = 53.87668\} \Rightarrow S_{15} = awrt 53.877$	A1	
		(2) [4]	
	Notes for Question 1		
(a)	B1: Accept $\frac{12}{18}$ , 0.6 or 0.6 recurring, or even 0.667 (3sf) but not 0.6 or 0.67		
<b>(b)</b>	B1: accept 8 only		
(c)	M1: Applies this formula $S_{15} = \frac{18(1 - (\text{their } r)^{15})}{1 - (\text{their } r)}$ , can be implied by their answer. For this mark		
	they may use any value for $r$ except $r = 1$ or $r = 0$ (even 3/2 or -6 may be used) A1: Answers which round to 53.877		
Alternative method for (c)	M1: (Adding terms is an unlikely method for this question) Need to see 15 terms listed as 18+12+0.06165877 or can be implied by correct answer		
(-/	A1: awrt 53.877 Answer only : 53.9 is M0A0 with no working, but 53.877 with no working is M1A1		

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	$(\mathbf{a})$	Use the binemial theorem to find all the terms of the expansion of	Leave
2.	(a)	ose the omornal theorem to find an the terms of the expansion of	
		$(2+3x)^4$	
		Give each term in its simplest form.	(4)
	(b)	Write down the expansion of	
		$(2-3x)^4$	
		in ascending powers of $x$ , giving each term in its simplest form.	(1)
-			
-			

Question Number	Scheme	Marks		
	$(2+3x)^4$ - Mark (a) and (b) together			
<b>2.</b> (a)	$2^{4} + {}^{4}C_{1}2^{3}(3x) + {}^{4}C_{2}2^{2}(3x)^{2} + {}^{4}C_{3}2^{1}(3x)^{3} + (3x)^{4}$			
	First term of 16	B1		
	$\left( {}^{4}C_{1} \times \times x \right) + \left( {}^{4}C_{2} \times \times x^{2} \right) + \left( {}^{4}C_{3} \times \times x^{3} \right) + \left( {}^{4}C_{4} \times \times x^{4} \right)$	M1		
	$=(16 + )96x + 216x^{2} + 216x^{3} + 81x^{4}$ Must use Binomial – otherwise A0,	A1 A1		
	A0			
	$(2, 2)^4$ 10 00 $(2, 2)^2$ 210 $(3, 2)^4$	(4)		
(b)	$(2-3x)^{2} = 16 - 96x + 216x^{2} - 216x^{2} + 81x^{2}$	Blft (1)		
		5		
Alternative method (a)	$(2+3x)^4 = 2^4 (1+\frac{3x}{2})^4$			
	$2^{4} \left(1 + {}^{4}C_{1}\left(\frac{3x}{2}\right) + {}^{4}C_{2}\left(\frac{3x}{2}\right)^{2} + {}^{4}C_{3}\left(\frac{3x}{2}\right)^{3} + \left(\frac{3x}{2}\right)^{4}\right)$			
	Scheme is applied exactly as before			
	Notes for Question 2			
(a)	B1: The constant term should be 16 in their expansion			
	(4) (4)			
	${}^{4}C_{1} \text{ or } \begin{pmatrix} 4\\1 \end{pmatrix}$ or 4 as a coefficient, and ${}^{4}C_{2} \text{ or } \begin{pmatrix} 4\\2 \end{pmatrix}$ or 6 as another Pascal's triangle may be			
	used to establish coefficients.			
	A1: Any two of the final four terms correct (i.e. two of $96x + 216x^2 + 216x^3 + 81x^4$ ) in exp	pansion		
	following Binomial Method. A1: All four of the final four terms correct in expansion (Accept answers without $\pm$ signs, cal	n he		
	listed with commas or appear on separate lines)			
<b>(b</b> )	B1ft: Award for correct answer as printed above or ft their previous answer provided it has f	five		
	terms ft and must be subtracting the x and $x^3$ terms			
	Allow terms in (b) to be in descending order and allow $+-96x$ and $+-216x$ in the series. (Acception answers without $+$ signs, can be listed with commas or appear on separate lines)	pt		
	e.g. The common error $2^4 + {}^4C_12^3x + {}^4C_22^2x^2 + {}^4C_22^1x^3 + 3x^4 = (16) + 96x + 72x^2 + 24.$	$x^{3} + 3x^{4}$		
	would earn B1, M1, A0, A0, and if followed by $=(16) - 96x + 72x^2 - 24x^3 + 3x^4$ gets B	1ft so		
	3/5			
	Fully correct answer with no working can score B1 in part (a) and B1 in part (b). The question state the Dinomial theorem and if there is no evidence of its use then M mails and hence A marks second the	ited use		
	Squaring the bracket and squaring again may also earn B1 M0 A0 A0 B1 if correct	earned.		
	<b>Omitting the final term</b> but otherwise correct is B1 M1 A1 A0 B0ft so 3/5			
	If the series is divided through by 2 or a power of 2 at the final stage after an error or omission	n		
	resulting in all even coefficients then apply scheme to series before this division and ignore su work (isw)	ibsequent		

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3.	$f(x) = 2x^3 - 5x^2 + ax + 18$
	where <i>a</i> is a constant.
	Given that $(x - 3)$ is a factor of $f(x)$ ,
	(a) show that $a = -9$
	(b) factorise $f(x)$ completely.
	Given that

$$g(y) = 2(3^{3y}) - 5(3^{2y}) - 9(3^{y}) + 18$$

(c) find the values of y that satisfy g(y) = 0, giving your answers to 2 decimal places where appropriate.

(3)

(2)

(4)

**Mathematics C2** 

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Question Number	Scheme		Marks			
<b>3.</b> (a)	Either (Way 1) : Attempt $f(3)$ or $f(-3)$	Or (Way 2): Assume $a = -9$ and attempt f(3) or f(-3)	M1			
	$f(3) = 54 - 45 + 3a + 18 = 0 \implies 3a = -27 \implies a = -9 *$	f(3) = 0 so (x - 3) is factor	A1 $*$ cso (2)			
	Or (Way 3): $(2x^3 - 5x^2 + ax + 18) \div (x - 3) = 2x^2 + px + ax + 18)$	-q where p is a number and q	M1			
	Sets the remainder $18+3a+9=0$ and solves to give $a = -9$					
(b)	Either (Way 1): $f(x) = (x - 3)(2x^2 + x - 6)$ = $(x - 3)(2x - 3)(x + 2)$		M1A1 M1A1 (4)			
	Or (Way 2) Uses trial or factor theorem to obtain $x = -2$ of Uses trial or factor theorem to obtain both $x = -2$ and $x = 3$ Puts three factors together (see notes below) Correct factorisation : $(x - 3)(2x - 3)(x + 2)$ or $(3 - x)(3 - 2(x - 3)(x - \frac{3}{2})(x + 2)$ oe	or $x = 3/2$ 3/2 2x)(x + 2) or	M1 A1 M1 A1 (4)			
	Or (Way 3) No working three factors $(x - 3)(2x - 3)(x - $	+ 2) otherwise need working	M1A1M1A1			
(c)	$\{3^y = 3 \Rightarrow\} y = 1$ or $g(1) = 0$		B1			
	$\{3^{y} = 1.5 \Rightarrow \}\log(3^{y}) = \log 1.5 \text{ or } y = \log_{3} 1.5$					
	$\{y = 0.3690702\} \Rightarrow y = awrt 0.37$		A1 ( <b>3</b> )			
	Natas for Orest	ion 2	[9]			
(a)	M1 for attempting either $f(3)$ or $f(-3)$ – with <b>numbers</b>	substituted into expression				
	A1 for applying $f(3)$ correctly, setting the result equal to 0, and manipulating this correctly to give the					
	result given on the paper i.e. $a = -9$ . (Do not accept $x = -9$ ) Note that the answer is given in part (a).					
	If they <b>assume</b> $a = -9$ and <b>verify</b> by factor theorem or divident equals at each $a \in OED$ or a tight	sion they must state $(x - 3)$ is a factor	tor for A1			
(b)	(or equivalent such as QED of a tick). $1^{\text{st}}$ M1: attempting to divide by $(x - 3)$ leading to a 3TO b	peginning with the correct term usu	ally $2r^2$			
	(Could divide by $(3 - x)$ , in which case the quadratic would begin $-2x^2$ .) This may be done by a variety of methods including long division, comparison of coefficients, inspection etc.					
	1° A1: usually for $2x^2 + x - 6$ Credit when seen and use isw if miscopied 2 <sup>nd</sup> M1: for a <i>valid</i> * attempt to factorise their quadratic (* see notes on page 6 - General Principles for Core Mathematics Marking section 1) 2 <sup>nd</sup> A1 is cao and needs all three factors together. Ignore subsequent work (such as a solution to a quadratic equation.) NB: $(x - 3)(x - \frac{3}{2})(x + 2)$ is M1A1M0A0, $(x - 3)(x - \frac{3}{2})(2x + 4)$ is M1A1M1A0, but $2(x - 3)(x - \frac{3}{2})(x + 2)$ is M1A1M1A1					
(c)	B1: $y = 1$ seen as a solution – may be spotted as answer –	no working needed. Allow also for	g(1) = 0.			
	B1: $\underline{y=1}$ seen as a solution – may be spotted as answer – no working needed. Allow also for $g(1) = 0$ . M1: Attempt to take logs to solve $3^y = \alpha$ or even $3^{ky} = \alpha$ , but not $6^y = \alpha$ where $\alpha > 0$ and $\alpha \neq 3$ & was a root of $f(x) = 0$ (ft their factorization) A1: for an answer that rounds to 0.37. If a third answer is included (and not "rejected") such as ln(-2) lose final A mark					

4.

# Mathematics C2

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Leave blank  $y = \frac{5}{(x^2 + 1)}$ (a) Complete the table below, giving the missing value of y to 3 decimal places. 0 1 2 0.5 1.5 2.5 3 х 5 4 2.5 1 0.690 0.5 y (1) *y* 5 R 3 0 х



Figure 1 shows the region *R* which is bounded by the curve with equation  $y = \frac{5}{(x^2 + 1)}$ , the *x*-axis and the lines x = 0 and x = 3

- (b) Use the trapezium rule, with all the values of y from your table, to find an approximate value for the area of R.
- (c) Use your answer to part (b) to find an approximate value for

$$\int_0^3 \left(4 + \frac{5}{(x^2 + 1)}\right) \mathrm{d}x$$

giving your answer to 2 decimal places.

(2)

(4)



Question Number	Scheme						Marks			
1	<i>x</i>	0	0.5	1	1.5	2	2.5	3		
4.	у	5	4	2.5	1.538	1	0.690	0.5	]	
(a)	$\left\{ At \ x = 1 \right.$	.5, y = 1	.538 (only)	)						B1 cao
										[1]
(b)	$\frac{1}{2} \times 0.5$ ;					B1 oe				
	{5	+ 0.5 + 2(-	4 + 2.5 + t	heir 1.538	+1+0.690)}		For structu	<u>re of </u> {	};	M1 <u>A1ft</u>
	$\frac{1}{2} \times 0.5 \times$	(5 + 0.5)	+2(4+2.	5 + their 1	.538 + 1 + 0.6	$90)\} \left\{=\frac{1}{4}\right\}$	(24.956) =	5.239 = av	vrt 6.24	A1
	-	<u> </u>								[4]
(c)	Adds Are	a of Recta	ngle or fir	st integral	$= 3 \times 4$ or [	$4x \Big]_0^3$ to <b>pr</b>	evious ans	wer		M1
	So require	ed estimat	$e = {"6.23}$	<sup>3</sup> 9" + 12 =	"18.239"} = "a	wrt 18.24	" (or 12 + p	revious ans	swer).	A1ft
	N.B. $7 \times 4$	4 + previou	is answer	s M0A0 (	added 4 seven	times beca	ause 7 numl	pers in table	e)	[2]
					Notes for (	Duestion 4	•			
(a)	B1: 1.538	3								
<b>(b)</b>	B1: for using $\frac{1}{2} \times 0.5$ or $\frac{1}{4}$ or equivalent.									
	M1: requires the correct $\{\dots, \}$ bracket structure. It needs the first bracket to contain first y value <b>plus</b> last									
	y value ar	nd the seco	ond bracke	t to be mu	ltiplied by 2 at	nd to be th	ne summatio	on of the re	maining y	values in
	bracket th M mark h	nis may be nowever).	regarded a MO if valu	as a slip ar es used in	nd the M mark brackets are x	c can be all values ins	lowed (An attended of y va	extra repea lues	ted term fo	rfeits the
	Alft for	the correct	t bracket ∫	) follo	wing through	candidate <sup>3</sup>	's v value fo	und in nart	(a)	
	A1: for a	nswer whi	ch rounds	to 6.24.	, ming un ough	culturate	s y valae ie	und in pur	(u).	
	NB: Sepa	rate trapez	zia may be	used : B1	for 0.25, M1	for 1/2 <i>h</i> ( <i>a</i>	(+ b) used :	5 or 6 times	s (and A1ft	if it is all
	correct)	Then A1 a	s before.		,			、		
	Special ca	ase: Brack	eting mist	ake $0.25 \times$	(5+0.5)+2(-	4 + 2.5 + t	heir 1.538 +	(1+0.690)	scores B1	M1 A0
	A0 unless given) $\Delta$	s the final and the final and the final and the final sector of th	answer $1m$	plies that t	the calculation	has been or	done correc	tly (then fu	ll marks ca	n be
(c)	M1: Rela	tes <b>previo</b>	us answer	( not inte	egral of previo	ous answe	<b>r</b> ) to this qu	estion by in	ntegrating 4	4
	between l	imits, and	adding, or	by using	geometry to fi	nd rectang	le and addi	ng.		
	Altt: tor	12 + answ	er to (b)	e for part	(h)- using the	able from	(a) with $4$ a	dded to eau	ch cell of th	ne table
Alternative method	Get: M1 f	for " <i>their</i>	$\frac{1}{4}$ "× {9 + 4	5+2(8+6)	6.5 + their  5.5	38 + 5 + 4.	(4) (str $690$ ) = (str	ucture mus	t be correct	t – allow
(c)	one convi	ing error o	nlv)	``			/)			
	And A1ft	: for awrt	18.24 (or	12 + previ	ious answer).					

### **Mathematics C2**



9 A

0

8

5

Question	Scheme	Marks		
Number	Mark (a) and (b) together.			
<b>5.</b> (a)	Usually answered in radians: Uses either $\frac{1}{2}ab\sin(\text{angle})$ or $\frac{1}{2}(12)^2(\text{angle})$ or both	M1		
	Area = $\frac{1}{2}(23)(12)\sin 0.64$ or $\frac{1}{2}(12)^2(\pi - 0.64)$ {= 82.41297091 or 180.1146711}	A1		
	Area = $\frac{1}{2}(23)(12)\sin 0.64 + \frac{1}{2}(12)^2(\pi - 0.64)$ {= 82.41297091 + 180.1146711}	A1		
	{Area = $262.527642$ } = awrt 262.5 (m <sup>2</sup> ) or 262.4(m <sup>2</sup> ) or 262.6 (m <sup>2</sup> )	A1 (4)		
(b)	$CDE = 12 \times (angle), = 12(\pi - 0.64) \{ \Rightarrow CDE = 30.01911 \}$	M1, A1		
	$AE^2 = 23^2 + 12^2 - 2(23)(12)\cos(0.64) \Rightarrow AE^2 = \text{or } AE = $ { $AE = 15.17376$ }	M1		
	Perimeter = $23 + 12 + 15.17376 + 30.01911$	M1		
	= 80.19287 = awrt 80.2 (m)	A1		
		(5) [9]		
	Notes for Question 5			
(a)	M1: uses either area of triangle formula as given in mark scheme, or area of sector or both (may be implied by answer)			
	A1: one correct area expression (with correct angle used) $\frac{1}{2}(23)(12)\sin 0.64$ or $\frac{1}{2}(12)^2(\pi - 1)$	0.64) or		
	see awrt 82.4 or awrt 180 (180 may be split as 226.2(semicircle) minus 46.1(small sector)) A1: two correct area expressions (with correct angles) <b>added together</b> (allow 2.5 as implyin $\pi - 0.64$ ) or see awrt 82.4 + awrt 180 (or 226 - 46)	g		
	A1: answers which round to 262.5 or 262.4 or 262.6			
(b)	1 <sup>st</sup> M1 for attempt to use $s = r \theta$ (any angle) 1 <sup>st</sup> A1 for $z = 0.64$ in the formula (or 2.5)			
	1 AT 101 $\pi = 0.04$ in the formula (of 2.5) 2 <sup>nd</sup> M1: Uses correct cosine rule to obtain AE or AE <sup>2</sup> (this may appear in part (a))			
	$3^{rd}$ M1( <b>independent</b> ): Perimeter = $23 + 12 + $ their $AE + $ their $CDE$			
	2 <sup>nd</sup> A1: awrt 80.2 (ignore units – even incorrect units)			
Degrees (a)	Uses either $\frac{1}{2}ab\sin(\text{angle})$ or $\frac{\text{anglein degrees}}{360} \times \pi (12)^2$ or both for M1			
	Area = $\frac{1}{2}(23)(12)\sin 36.7$ or $\frac{(180-36.7)}{360} \times \pi (12)^2 \{= awrt \ 82.4 \text{ or } 180\}$ A1			
	Area = $\frac{1}{2}(23)(12)\sin 36.7 + \frac{(180-36.7)}{360} \times \pi(12)^2  \{= awrt \ 82.4 + 180\}$ A1			
	Final mark as before			
(b)	$CDE = \frac{\text{Angle in degrees}}{360} \times 24\pi, = \frac{180 - 36.7}{360} \times 24\pi \{ \Rightarrow CDE = 30.01268 \} \text{ M1, A1}$			
	Final three marks as before			

# **Mathematics C2**





Question Number	Scheme	Marks		
<b>6.</b> (a)	Seeing -4 and 2.	B1		
(b)	$x(x+4)(x-2) = x^3 + 2x^2 - 8x$ or $x^3 - 2x^2 + 4x^2 - 8x$ (without simplifying)	(1) <u>B1</u>		
	$\int (x^3 + 2x^2 - 8x)dx = \frac{x^4}{4} + \frac{2x^3}{3} - \frac{8x^2}{2} \{+c\} \qquad \text{or } \frac{x^4}{4} - \frac{2x^3}{3} + \frac{4x^3}{3} - \frac{8x^2}{2} \{+c\}$	M1A1ft		
	$\left[\frac{x^4}{4} + \frac{2x^3}{3} - \frac{8x^2}{2}\right]_{-4}^0 = (0) - \left(64 - \frac{128}{3} - 64\right) \text{ or } \left[\frac{x^4}{4} + \frac{2x^3}{3} - \frac{8x^2}{2}\right]_{-4}^0 = \left(4 + \frac{16}{3} - 16\right) - (0)$	dM1		
	One integral = $\pm 42\frac{2}{3}$ (42.6 or awrt 42.7 ) or other integral = $\pm 6\frac{2}{3}$ (6.6 or awrt 6.7)	A1		
	Hence Area = " <i>their</i> 42 $\frac{2}{3}$ "+ " <i>their</i> 6 $\frac{2}{3}$ " or Area = " <i>their</i> 42 $\frac{2}{3}$ "- "- <i>their</i> 6 $\frac{2}{3}$ "	dM1		
	$= 49\frac{1}{3} \text{ or } 49.3 \text{ or } \frac{148}{3}  (\text{NOT} - \frac{148}{3})$	A1		
	(An answer of $= 49\frac{1}{3}$ may not get the final two marks – check solution carefully)	(7)		
		[8]		
(a)	<b>Notes for Question 6</b> B1: Need both $A$ and $2$ May see $(A 0)$ and $(2 0)$ (correct) but allow $(0, A)$ and $(0, 2)$ or $A = A$ .	-2 or		
(a)	indeed any indication of -4 and 2 – check graph also	- 2 01		
(b)	indeed any indication of -4 and 2 – check graph also B1: Multiplies out cubic correctly (terms may not be collected, but if they are, mark collected terms here) M1: Tries to integrate their expansion with $x^n \rightarrow x^{n+1}$ for at least one of the terms A1ft: completely correct integral <b>following through</b> from their CUBIC expansion (if only quadratic or quartic this is A0) dM1: (dependent on previous M) substituting EITHER -a and 0 and subtracting either way round OR similarly for 0 and b. <b>If their limits</b> -a and b are used in ONE integral, apply the Special Case below. A1: Obtain <b>either</b> $\pm 42\frac{2}{3}$ (or 42.6 or awrt 42.7) <i>from the integral from</i> -4 to 0 or $\pm 6\frac{2}{3}$ (6.6 or awrt 6.7) <i>from the integral from 0 to 2;</i> NO follow through on their cubic (allow decimal or improper equivalents $\frac{128}{3}$ or $\frac{20}{3}$ ) isw such as subtracting from rectangles. This will be penalized in the next two marks, which will be M0A0. dM1 (depends on first method mark) <b>Correct</b> method <b>to obtain shaded area</b> so adds two positive numbers (areas) together or uses their <b>positive</b> value minus <b>their negative</b> value, <b>obtained from</b> two separate <b>definite integrals</b> . A1: Allow 49.3, 49.33, 49.333 etc. Must follow correct logical work with <b>no errors</b> seen. For full marks on this question there must be <b>two definite integrals</b> , from -4 to 0 and from 0 to 2, though the evaluations for 0 may not be seen. (Trapezium rule <b>gets no marks after first two B marks</b> )			
(b)	<b>Special Case: one integral only from</b> – <i>a</i> to <i>b</i> : B1M1A1 available as before, then $\left[\frac{x^4}{4} + \frac{2x^3}{3} - \frac{8x^2}{2}\right]_{-4}^2 = (4 + \frac{16}{3} - 16) - \left(64 - \frac{128}{3} - 64\right) = -6\frac{2}{3} + 42\frac{2}{3} = \dots \text{ dM1 for correct use of } 1 \text{ limits } -a \text{ and } b \text{ and subtracting either way round.}$ A1 for 36: NO follow through. Final M and A marks not available. Max 5/7 for part (b)	of their		

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		Leave
7. (i)	Find the exact value of x for which	blank
	$\log_2(2x) = \log_2(5x+4) - 3$	(4)
		(+)
(ii)	Given that	
	$\log v + 3\log 2 = 5$	
	$S_a$	
	express y in terms of a. Give your answer in its simplest form	
	Give your answer in its simplest form.	(3)

Question Number	Scheme	Marks	
7. (i) Method 1	$\log_2\left(\frac{2x}{5x+4}\right) = -3 \text{ or } \log_2\left(\frac{5x+4}{2x}\right) = 3, \text{ or } \log_2\left(\frac{5x+4}{x}\right) = 4 \text{ (see special case 2)}$	M1	
	$\left(\frac{2x}{5x+4}\right) = 2^{-3} \text{ or } \left(\frac{5x+4}{2x}\right) = 2^{3} \text{ or } \left(\frac{5x+4}{x}\right) = 2^{4} \text{ or } \left(\log_2\left(\frac{2x}{5x+4}\right)\right) = \log_2\left(\frac{1}{8}\right)$	M1	
	$16x = 5x + 4 \implies x =$ (depends on previous Ms and must be this equation or equivalent)	dM1	
	$x = \frac{4}{11}$ or exact recurring decimal 0.36 after correct work	A1 cso (4)	
7(i)	$\log_2(2x) + 3 = \log_2(5x + 4)$		
Method 2	So $\log_2(2x) + \log_2(8) = \log_2(5x + 4)$ (3 replaced by $\log_2 8$ )	2 <sup>nd</sup> M1	
	Then $\log_2(16x) = \log_2(5x + 4)$ (addition law of logs)	1 <sup>st</sup> M1	
(ii)	Then final M1 A1 as before	dM1A1	
(11)	$\log_a y + \log_a 2^a = 5$	MI dM1	
	$1_{5}$	ulvii	
	$y = \frac{1}{8}a^3$	Alcao	
		(3)	
	Notes for Question 7	[/]	
(i)	$1^{\text{st}}$ M1: Applying the subtraction or addition law of logarithms correctly to make <b>two</b> log <b>terms in</b> x		
	<b>Into one</b> log term in x 2 <sup>nd</sup> M1: For RHS of either 2 <sup>-3</sup> , 2 <sup>3</sup> , 2 <sup>4</sup> or $\log_2\left(\frac{1}{8}\right)$ , $\log_2 8$ or $\log_2 16$ i.e. using connection between		
	log base 2 and 2 to a power. This may follow an earlier error. Use of $3^2$ is M0 $3^{rd}$ dM1: Obtains correct linear equation in <i>x</i> . usually the one in the scheme and attempts <i>x</i> = A1: cso Answer of 4/11 with <b>no</b> suspect log work preceding this.		
( <b>ii</b> )	M1: Applies power law of logarithms to replace $3\log_a 2$ by $\log_a 2^3$ or $\log_a 8$		
	dM1: (should not be following M0) Uses addition law of logs to give $\log_a 2^3 y = 5$ or $\log_a 8y = 5$		
(i)	Special case 1: $\log_2(2x) = \log_2(5x+4) - 3 \Rightarrow \frac{\log_2(2x)}{\log_2(5x+4)} = -3 \Rightarrow \frac{2x}{5x+4} = 2^{-3} \Rightarrow x = \frac{4}{11}$ or		
	$\log_2(2x) = \log_2(5x+4) - 3 \Rightarrow \frac{\log_2(2x)}{\log_2(5x+4)} = -3 \Rightarrow \log_2\frac{2x}{5x+4} = -3 \Rightarrow \frac{2x}{5x+4} = 2^{-3} \Rightarrow x = \frac{4}{11} \text{ each}$		
	attempt scores M0M1M1A0 – special case		
	Special case 2: $\log_2(2x) = \log_2(5x + 4) - 3 \implies \log_2 2 + \log_2 x = \log_2(5x + 4) - 3$ is M0 until the two log terms	sare	
	combined to give $\log_2\left(\frac{5x+4}{r}\right) = 3 + \log_2 2$ . This earns M1	ure	
	Then $\left(\frac{5x+4}{x}\right) = 2^4$ or $\log_2\left(\frac{5x+4}{x}\right) = \log_2 2^4$ gets second M1. Then scheme as before.		

# **Mathematics C2**

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t Paper	This resource was created and owned by Pearson Edexcel	666
<b>8.</b> (i	) Solve, for $-180^\circ \leq x < 180^\circ$ ,	Leave
	$\tan(x - 40^{\circ}) = 1.5$	
	giving your answers to 1 decimal place.	(3)
(i	i) (a) Show that the equation	
	$\sin\theta\tan\theta = 3\cos\theta + 2$	
	can be written in the form	
	$4\cos^2\theta + 2\cos\theta - 1 = 0$	(3)
	(b) Hence solve, for $0 \le \theta < 360^{\circ}$ ,	
	$\sin\theta\tan\theta = 3\cos\theta + 2$	
	showing each stage of your working.	(5)
22	$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 $	1

Question Number	Scheme	Marks	
<b>8.</b> (i)	$( \alpha  = 56.3099)$		
	$x = \{\alpha + 40 = 96.309993\} = $ <b>awrt 96.3</b>	B1	
	$x - 40^{\circ} = -180 + "56.3099"$ or $x - 40^{\circ} = -\pi + "0.983"$	M1	
	$x = \{-180 + 56.3099 + 40 = -83.6901\} = $ <b>awrt -83.7</b>	A1	
		(3)	
(ii)(a)	$\sin\theta \left(\frac{\sin\theta}{\cos\theta}\right) = 3\cos\theta + 2$	M1	
	$\left(\frac{1-\cos^2\theta}{\cos\theta}\right) = 3\cos\theta + 2$	dM1	
	$1 - \cos^2 \theta = 3\cos^2 \theta + 2\cos \theta \implies 0 = 4\cos^2 \theta + 2\cos \theta - 1^*$	A1 cso *	
		(3)	
(b)	$\cos\theta = \frac{-2 \pm \sqrt{4 - 4(4)(-1)}}{4 - 4(4)(-1)}$		
	$\frac{8}{(2-2)(2-2)(2-2)(2-2)(2-2)(2-2)(2-2)(2-2$	M1	
	or $4(\cos\theta \pm \frac{1}{4}) \pm q \pm 1 = 0$ , or $(2\cos\theta \pm \frac{1}{2}) \pm q \pm 1 = 0$ , $q \neq 0$ so $\cos\theta =$	A 1 A 1	
	One solution is $72^{\circ}$ or $144^{\circ}$ , 1 we solutions are $72^{\circ}$ and $144^{\circ}$	AI, AI	
	$\theta = \{12, 144, 210, 200\}$	MI AI (5)	
		[11]	
	Notes for Question 8		
(1)	<ul> <li>B1: 96.3 by any or no method</li> <li>M1: Takes 180 degrees from arctan (1.5) or from their "96.3" May be implied by A1. (Could be obtained by adding 180, then subtracting 360).</li> <li>A1: awrt -83.7</li> <li>Extra answers: ignore extra answers outside range. Any extra answers in range lose final A mark (if</li> </ul>		
	earned)	× ·	
	Working in radians – could earn M1 for $x - 40^{\circ} = -\pi + "0.983"$ so B0M1A0		
(ii) (a)	M1: uses $\tan \theta = \frac{\sin \theta}{\cos \theta}$ or equivalent in equation (not just $\tan = \frac{\sin}{\cos}$ , with no		
	argument) dM1: uses $\sin^2 \theta = 1 - \cos^2 \theta$ (quoted correctly) in equation		
	A1: completes proof correctly, with no errors to give printed answer*. Need at least three steps in proof and need to achieve the correct quadratic with all terms on one side and "=0"		
(b)	M1: Attempts to solve quadratic by correct quadratic formula, or completion of the square . Factorisation attempts score M0. 1 <sup>st</sup> A1: Either 72 or 144, 2 <sup>nd</sup> A1: both 72 and 144 (allow 72.0 etc.) M1: 360 – "a previous solution" (provided that cos was being used) (not dependent on previous M)		
	( <b>Premature approximation</b> : e.g. 71.9, 144.1, 288.1 and 215.9 – lose first A1 then ft other angles) Do <b>not</b> require degrees symbol for the marks <b>Special case: Working in radians</b>		
	M1: as before, A1 for either $\theta = \frac{2}{5}\pi$ or $\theta = \frac{4}{5}\pi$ or decimal equivalents, and 2 <sup>nd</sup> A1: both		
	M1: $2\pi - \alpha_1$ or $2\pi - \alpha_2$ then A0 so 4/5		

ape	er This resource was created and owned by Pearson Edexcel				
•	The curve with equation				
	$y = x^2 - 32\sqrt{x} + 20,  x > 0$ has a stationary point P				
	(a) to find the eventine to a f D				
	(a) to find the coordinates of P,	(6)			
	(b) to determine the nature of the stationary point <i>P</i> .				
		(3)			
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Question Number	Scheme	Marks	
<b>9.</b> (a)	$\left\{\frac{\mathrm{d}y}{\mathrm{d}x}=\right\} 2x - 16x^{-\frac{1}{2}}$	M1 A1	
	$2x - 16x^{-\frac{1}{2}} = 0 \implies x^{\frac{3}{2}} = , x^{-\frac{3}{2}} = , \text{or } 2x - =16x^{-\frac{1}{2}}$ then squared then obtain $x^3 = $ [or $2x - 16x^{-\frac{1}{2}} = 0 \implies x = 4$ (no wrong work seen)]	M1	
	$(x^{\frac{3}{2}} = 8 \implies) x = 4$	A1	
	$x = 4$ , $y = 4^2 - 32\sqrt{4} + 20 = -28$ (ignore $y = 100$ as second answer)	M1 A1	
(b)	$\left\{\frac{\mathrm{d}^2 y}{\mathrm{d}x^2}\right\} + 8x^{-\frac{3}{2}}$	(6) M1 A1	
	$(\frac{d^2 y}{dx^2} > 0 \Rightarrow) y$ is a minimum ( there should be no wrong reasoning)	A1	
		(3) [9]	
(b)	<u>Alternative Method: Gradient Test:</u> M1 for finding the gradient either side of their <i>x</i> -value from part (a). A1 for <u>both gradients calculated correctly to 1 significant figure</u> , then <u>using <math>&lt; 0</math> and <math>&gt; 0</math> resp</u> <u>maybe by use of sketch or table</u> . (See appendix for gradient values. This is <b>not ft their</b> <i>x</i> ) A1 states minimum needs M1A1 to have been awarded.	<u>ectively</u>	
	Notes for Question 9		
(a)	1 <sup>st</sup> M1: At least one term differentiated correctly, so $x^2 \rightarrow 2x$ , or $32\sqrt{x} \rightarrow 16x^{-\frac{1}{2}}$ , or $20 \rightarrow 0$ A1: This answer or equivalent e.g. $2x - \frac{16}{\sqrt{x}}$		
	2 M1: Sets their $\frac{1}{dx}$ to 0, and solves to give $x^2 = x^2 = or^2 x^2 = arter correct squaring or s (NB \left\{\frac{d^2y}{dx^2} = 0\right\} so 2 + 8x^{-\frac{3}{2}} = 0 is M0 )$	spots $x = 4$	
	N.B. Common error: Putting derivative = 0 and merely obtaining $x = 0$ is M0A0, then M0A0 for next two marks. (The first two marks in (a) and marks for second derivative may be earned in part (b).) A1: $x = 4$ cao [ $x = -4$ is A0 and $x = \pm 4$ is also A0]		
	3 <sup>rd</sup> M1: Substitutes their positive found x (NOT zero) into $y = x^2 - 32\sqrt{x} + 20$ , $x > 0$ .SI	hould	
	follow attempting to set $\frac{dy}{dx} = 0$ and not setting $\frac{d^2y}{dx^2} = 0$		
(b)	A1: -28 cao (Does not need to be written as coordinates) M1: Attempts differentiation of their first derivative with at least one term differentiated corr Should be seen or referred to (in part (b)) in determining the nature of the stationary point.	rectly.	
	A1: Answer in scheme or equivalent A1: States minimum (Second derivative should be correct- can follow incorrect positive x. Needs M1A1 to have been awarded- should not follow incorrect reasoning – (need not say		
	$\frac{d^2 y}{dx^2} > 0$ but should not have said $\frac{d^2 y}{dx^2} = 0$ for example )		





Question Number	Scheme	Marks	
<b>10.</b> (a)			
	Equation of form $(x \pm 5)^2 + (y \pm 9)^2 = k$ , $k > 0$	M1	
	Equation of form $(x - a)^2 + (y - b)^2 = 5^2$ , with values for a and b	M1	
	$(x+5)^2 + (y-9)^2 = 25 = 5^2$	Al (2)	
	P(8, -7). Let centre of circle = $X(-5, 9)$	(3)	
(b)	$PX^{2} = (85)^{2} + (-7 - 9)^{2}$ or $PX = \sqrt{(8 - 5)^{2} + (-7 - 9)^{2}}$	M1	
	$(PX = \sqrt{425} \text{ or } 5\sqrt{17})$ $PT^2 = (PX)^2 - 5^2$ with numerical PX	dM1	
	$PT \left\{=\sqrt{400}\right\} = 20$ (allow 20.0)	A1 cso	
		(3) [6]	
Alternative 2 for (a)	Equation of the form $x^2 + y^2 \pm 10x \pm 18y + c = 0$	M1	
	Uses $a^2 + b^2 - 5^2 = c$ with their <i>a</i> and <i>b</i> or substitutes (0, 9) giving $+9^2 \pm 2b \times 9 + c = 0$	M1	
	$x^2 + y^2 + 10x - 18y + 81 = 0$	A1	
		(3)	
Alternative	An attempt to find the point T may result in pages of algebra, but solution needs to reach $\begin{pmatrix} 8 & 2 \end{pmatrix}$		
2 for (b)	(-8, 5) or $\left(\frac{-8}{17}, 11\frac{2}{17}\right)$ to get first M1 (even if gradient is found first)	M1	
	M1: Use either of the correct points with $P(8, -7)$ and distance between two points	dM1	
	formula A1: 20	Alcso	
		(3)	
Alternative 3 for (b)	Substitutes (8, -7) into circle equation so $PT^2 = 8^2 + (-7)^2 + 10 \times 8 - 18 \times (-7) + 81$	M1	
	Square roots to give $PT \left\{=\sqrt{400}\right\} = 20$	dM1A1 (3)	
	Notes for Question 10		
(a)	The three marks in (a) each require a circle equation – (see special cases which are not circles) M1: Uses coordinates of centre to obtain LHS of circle equation (RHS must be $r^2$ or $k > 0$ or a positive value)		
	M1: Uses $r = 5$ to obtain RHS of circle equation as 25 or $5^2$		
	A1: correct circle equation in any equivalent form		
	Special cases $(x \pm 5)^2 + (x \pm 9)^2 = (5^2)$ is not a circle equation so M0M0A0		
	Also $(x \pm 5)^2 + (y-9) = (5^2)$ And $(x \pm 5)^2 - (y \pm 9)^2 = (5^2)$ are not circles and gain MOM	0A0	
( <b>b</b> )	But $(x - 0)^2 + (y - 9)^2 = 5^2$ gains MOM1A0 M1: Attempts to find distance from their centre of circle to <i>B</i> (or square of this value). If the	hiaia	
(D)	called $PT$ and given as answer this is M0. Solution may use letter other than X, as centre we labelled in the question.	as not	
	N.B. Distance from $(0, 9)$ to $(8, -7)$ is incorrect method and is M0, followed by M0A0.		
	dM1: Applies the <b>subtraction</b> form of Pythagoras to find $PT$ or $PT^2$ (depends on previous 1 mark for distance from <b>centre to</b> $P$ ) or uses appropriate complete method involving trigono A1: 20 cso	method ometry	