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Pearson Edexcel International International </th <th></th> <th></th> <th></th>			
Core Mathematics C12 Advanced Subsidiary Tuesday 10 January 2017 – Morning Time: 2 hours 30 minutes	Pearson Edexcel	Centre Number	Candidate Number
Time: 2 hours 30 minutes		ICIIAL	
	Advanced Subsidia	- Morning	Paper Reference

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 125.
- 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.

Turn over 🕨



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Mathematics C12

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This resource was created and owned by Pearson Edexcel Past Paper WMA01 Leave blank 1. Given $y = \frac{x^3}{3} - 2x^2 + 3x + 5$ (a) find $\frac{dy}{dx}$, simplifying each term. (3) (b) Hence find the set of values of x for which $\frac{dy}{dx} > 0$ (4) 2 P 4 8 3 2 4 A 0 2 5 2

Question Number		Scheme	Marks
1(a)	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right) = \frac{3x^2}{3} - 2 \times 2x + 3$	M1: $x^n \rightarrow x^{n-1}$ or $5 \rightarrow 0$ A1: Any 3 of the 4 terms differentiated correctly - this could be 2 terms correct and $5 \rightarrow 0$ (allow simplified or un-simplified for this mark_including $3x^0$ for 3)	M1A1
	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right) x^2 - 4x + 3$	Cao. All 3 terms correct and simplified and on the same line and no + 0. (Do not allow $1x^2$ for x^2 or x^1 for x or $3x^0$ for 3). Condone poor notation e.g. omission of $dy/dx =$ or if they use $y =$	A1
	Candidates who mult	iply by 3 before differentiating:	
	e.g. $\left(\frac{x}{3} - 2x^2 + 3x + 5\right) \times 3 =$	$x^{3}-6x^{2}+9x+15 \Longrightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = 3x^{2}-12x+9$	
	Scores M1A0A0 but could	recover in (a) if they then divide by 3	
	If they persist with $\frac{dy}{dx} = 3x^2 - 3x$	-12x+9 in (b), allow full recovery in (b)	
			(3)
(b)	$x^2 - 4x + 3 = 0 \Longrightarrow x = 1, 3$	M1: Attempt to solve their 3TQ from part (a) as far as $x =$ (see general guidance for solving a 3TQ). If no working is shown and the roots are incorrect for their 3TQ, score M0 here but the second method mark below is still available. A1: Correct values (may be implied by their inequalities e.g. a correct quadratic followed by just $x > 1$ and $x > 3$ could score M1A1 here)	M1A1
	<i>x</i> <"1", <i>x</i> >"3"	Chooses outside region ($x <$ their lower limit $x >$ their upper limit). Do not award simply for diagram or table.	M1
	Correct answer. Allow the convertee separately and allow of allow $1 > x > 3$ or $x < 1$ and x e.g. $x > 3$, $x < 1$ followed by $x > 3$ (or) $x < 1$ can so working scores both marks. As $\leq x \geq 1$ lose final marks	x < 1, x > 3 orrect regions separated by a comma or ther notation e.g. $(-\infty,1) \cup (3,\infty)$. Do not x > 3 (These score M1A0). ISW if possible 1 > x > 3 can score M1A1. $x > 3, x > 1score M1A1. Fully correct answer with nonswers that are otherwise correct but userk as would [-\infty,1] \cup [3,\infty].$	A1
			(4)
			(7 marks)

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This resource was created and owned by Pearson Edexcel 2. A circle, with centre C and radius r, has equation $x^2 + y^2 - 8x + 4y - 12 = 0$ Find (a) the coordinates of *C*, (2) (b) the exact value of *r*. (2) The circle cuts the *y*-axis at the points *A* and *B*. (c) Find the coordinates of the points A and B. (3) 4 P 4 8 3 2 4 A 0 4 5 2

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Question	eme) This resource wa	as created and owned	by Pearson Edexcel	WMA0 Marks
Number		Scheme		IVIAIKS
2 (a)	Μ	lark (a) and (b) tog	ether	
		Attempts to com	plete the square on x and y	or
	$(x \pm 4)(y \pm 2)$	sight of $(x \pm 4)$ a	and $(y \pm 2)$. May be implied	1 M1
		by a centre of $(\pm $	$4,\pm 2$). Or if considering	
		$x^2 + y^2 + 2gx + 2$	$fy + c = 0$, centre is $(\pm g, \pm g)$	<i>f</i>).
	Centre $C = (4, -2)$	Correct centre (a	llow $x = 4, y = -2$)	A1
	Commo	But not $g =, f =$	$p = \dots$ or $p = \dots, q = \dots$ etc.	
	Corre	ct answer scores Do		(
(b)			Must reach•	(2
		$r^2 =$	$(+2)^{2}$ + their $(+2)^{2}$ + their $(+2)^{2}$	$2)^2$
		, -	(± 4) + then (± 2)	.)
		r —	$\frac{12}{12 + \text{thoir}(\pm 4)^2 + \text{thoir}(\pm 4)^2}$	$\overline{2}$
		$r = \sqrt{1 + 1}$	$\int 12 + \text{ulem}(\pm 4) + \text{ulem}(\pm 2)$	2)
			of II considering $r^2 + v^2 + 2ar + 2fr + a = 0$	
	$r^2 = 12 + (+4)^2 + (-1)^2 +$	$(+2)^{2}$	x + y + 2gx + 2Jx + c = 0, $x^2 - a^2 + f^2 = a$	M1
	$V = 12 + (\pm \tau) + (\pm \tau)$	<u>-</u> 2)	r = g + f - c	1411
			$\frac{\text{or}}{\sqrt{2} + 2^2}$	
			$r = \sqrt{g^2 + f^2} - c$	
		M	ust clearly be identifying the	e
		Mar	radius or radius ²	a at
		May	radius or awrt 5 66	act
			$\frac{1}{22} \text{A scart super subject}$	
		$\gamma = \sqrt{1}$	152. Accept exact equivalents	Ś
	$r = \sqrt{32}$	such	As $4\sqrt{2}$. $r = \dots$ not needed but clearly be the radius. Do not	A1
		allow	$+\sqrt{32}$ unless minus is reject	ed
	Corre	ct answer scores be	th marks	
	Corre			(2
(c)	0 2 4 4	Corre	ect quadratic. Allow	
	$x=0 \Rightarrow y^2+4y-1$	2 = 0 16+	$(y+2)^2 = 32$	B1
		Atter	npts to solve a 3TQ that has	s
		come	from substituting $x = 0$ or	
	$(v+6)(v-2)=0 \rightarrow$	y = 0) into the given equation or	M1
	$(y+0)(y-2)=0 \Rightarrow$	their	'changed' equation. May be	e wii
		impli	ed by correct answers for	
		their	quadratic.	
		Corre	with y values of coffect lingtes. Accept sight of the	
		for a	1 3 marks if no incorrect	»C
	v = 2, -6 or $(0, 2)$ and	1(0,-6)	ing seen but must clearly be	ev A1
	, , , , , , , , , , , , , , , , , , ,	value	es or correct coordinates. Th	nis
		may	be implied by the correct ro	oots
		of a c	juadratic in y.	
				(3
				(7 marks





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Question Number	Sch	Marks	
3 (a)	$S = r\theta = 7 \times 0.8 = 5.6 (\mathrm{cm})$	M1: Uses $S = r\theta$ A1: 5.6 oe e.g. 28/5	M1A1
	Note that if the 0.8 is converted to this angle may be rounded or $\frac{45.8366}{360} \times 2 \times \pi \times 7$ for the	degrees e.g. $0.8 \times \frac{180}{\pi} = 45.8366$, or truncated when attempting M1 so allow A1 for awrt 5.6	(2)
(b)	$\angle POC = \frac{\pi}{2} - 0.8 = \text{awrt } 0.771$	M1: Attempts to find $\frac{\pi}{2} - 0.8$ or $\pi - \frac{\pi}{2} - 0.8$. Allow an attempt to find θ from $\theta + \frac{\pi}{2} + 0.8 = \pi$. Accept as evidence awrt 0.77 A1: awrt 0.771	(2) M1A1
	Answers in degrees e.g. 180–90–0.8	only can score M1A0 $\times \frac{180}{\pi} (= 44.163)$	
(c)	$4^{2} + 5^{2} - 2 \times 4 \times 5 \cos' 0.771'$ or $\sqrt{4^{2} + 5^{2} - 2 \times 4 \times 5 \cos' 0.771'}$	Correct use of the cosine rule to find <i>CP</i> or <i>CP</i> ² . NB 0.771 radians is awrt 44 degrees. Ignore lhs for this mark and look for e.g. $4^2 + 5^2 - 2 \times 4 \times 5 \cos' 0.771$ or 44'	(2) M1
	$CP^{2} = 4^{2} + 5^{2} - 2 \times 4 \times 5 \cos 0.771$ or $CP = \sqrt{4^{2} + 5^{2} - 2 \times 4 \times 5 \cos 0.771}$	A correct expression for CP or CP^2 with lhs consistent with rhs. Allow awrt 0.77 radians or awrt 44 degrees. (May be implied if a correct numerical value is used in subsequent work)	A1
	Perimeter = $4+5+2\times7+5.6+3.5$	$4+5+2\times7$ + their AQ + their CP . Need to see all 6 lengths but may be implied by e.g. $23+5.6+3.5$	M1
	= 32.11 (cm)	Awrt 32.11 (ignore units)	A1
			(4)
			(ð marks)

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			Leav	ve
4.	An arithmetic	series has first term <i>a</i> and common difference <i>d</i> .		IK
	Given that the	sum of the first 9 terms is 54		
	(a) show that			
		a + 4d = 6	(2)	
	Given also tha	t the 8th term is half the 7th term,		
	(b) find the va	lues of a and d .		
			(4)	

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WMA01

Question Number	Sch	Marks	
4 (a)	$S_{9} = 54$ $\Rightarrow 54 = \frac{9}{2}(2a + 8d)$ or $\Rightarrow 54 = \frac{9}{2}(a + a + 8d)$	Uses a correct sum formula with $n = 9$ and $S_9 = 54$	M1
	$\Rightarrow a + 4d = 6^*$	cso	A1*
	List	ting:	
	a+a+d+a+2d	++a+8d = 54	
	$\Rightarrow 9a + 36a$	d = 54	
	Scores M1 for attempting to su	um 9 terms (both lines needed)	
	a+a+d+a+2d+a+3d+a+4d+	a + 5d + a + 6d + a + 7d + a + 8d = 54	
	Scores M1 on its own and then	A 1 if they complete correctly.	
		-	(2)
(b)	$a+7d = \frac{1}{2}(a+6d)$ or $\frac{1}{2}(a+7d) = a+6d$	Uses $t_8 = \frac{1}{2}t_7$ or $\frac{1}{2}t_8 = t_7$ to produce one of these equations.	M1
	$\Rightarrow 6 - 4d + 7d = \frac{1}{2}(6 - 4d + 6d)$ $\Rightarrow d = \dots$	Uses the given equation from (a) and their second linear <u>equation</u> in a and d and proceeds to find a value for either a or d .	M1
	$\Rightarrow d = -1.5, a = 12$	A1: Either $d = -1.5$ (<i>oe</i>) or $a = 12$ A1: Both $d = -1.5$ (<i>oe</i>) and $a = 12$	A1A1
	Note that use of $\frac{1}{2}t_8 = t_7$ in	(b) gives $a = 30$ and $d = -6$	
			(4)
			(6 marks)

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(3)

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5. (a) Given that

 $y = \log_3 x$

find expressions in terms of y for

(i)
$$\log_3\left(\frac{x}{9}\right)$$

(ii) $\log_3 \sqrt{x}$

Write each answer in its simplest form.

(b) Hence or otherwise solve

$$2\log_3\left(\frac{x}{9}\right) - \log_3\sqrt{x} = 2 \tag{4}$$

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ast Paper (Mark S	Scheme) This resource was created and owned by Pearson Edexcel		WMA01
Number	Schen	ne	Marks
5 (a)(i)	$\log_3\left(\frac{x}{9}\right) = \log_3 x - \log_3 9 = y - 2$	M1: $\log_3\left(\frac{x}{9}\right) = \log_3 x - \log_3 9$ or $\log_3\left(\frac{x}{9}\right) = \log_3 x + \log_3 \frac{1}{9}$ Correct use of the subtraction rule or addition rule. Ignore the presence or absence of a base and any spurious "= 0" A1: y-2	M1A1
	An answer left as \log_3	3^{y-2} scores M1A0	
	Note that $\log_3\left(\frac{x}{9}\right) = \log_3 x - \log_3 x$	$g_3 9 = y - \log_3 9 \text{ scores M1A0}$	
(ii)	$\log_{3}\sqrt{x} = \log_{3}x^{\frac{1}{2}} = \frac{1}{2}\log_{3}x = \frac{1}{2}y$	$\frac{1}{2}y$ or equivalent	B1
			(3)
(b)	$2\log_{3}\left(\frac{x}{9}\right) - \log_{3}\sqrt{x} = 2$ Uses their answers from part (a) to creat	$\Rightarrow 2(y-2) - \frac{1}{2}y = 2$	
	poor use of brackets e.g. $2(y-2) = 2y - 2y$	-2 and also the slip $(y-2) - \frac{1}{2}y = 2$	Ml
	for this n	nark)	
	$\Rightarrow y = 4$	Correct value for <i>y</i> .	A1
	Note that arriving at $(y-2)^2 - \frac{1}{2}y = 2$ at	pove scores M0 (not linear) but does	
	have a solution $y = 4$ so look out for y $\log_3 x = 4 \implies x = 3^4$	y = 4 not being derived correctly.Correct method for undoing log.Dependent on the first M	d M1
	$\Rightarrow x = 81$	cao	A1
			(4)
			(7 marks)
	$2\log_3\left(\frac{x}{9}\right) - \log_3\sqrt{x}$	$= \log_{3}\left(\frac{(x/9)^{2}}{\sqrt{x}}\right)$	
	or		M1
	$2\log_3\left(\frac{x}{9}\right) - \log_3\sqrt{x} = 2\log_3 x - $	$\log_3 9 - \log_3 \sqrt{x} = \log_3 \frac{x^2}{\sqrt{x}} + \dots$	
	Combines two log terms in <i>x</i> correctly to obtain a single log term		
Alt 1 (b)	$\log_{3}\left(\frac{\left(x/9\right)^{2}}{\sqrt{x}}\right) = 2$		
	$\log_3\left(\frac{x^2}{\sqrt{x^2}}\right) = 6$	Correct equation	A1
	$\left(\frac{(x/9)^2}{\sqrt{x}}\right) = 3^2 \operatorname{or} \left(\frac{x^2}{\sqrt{x}}\right) = 3^6$	Correct method for undoing log. Dependent on the first M	d M1
	$\Rightarrow x = 81$	cao	A1

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	$2\log_{3}\left(\frac{x}{9}\right) - \log_{3}\sqrt{x} = 2\log_{3}\left(\frac{2}{9}\right)$ Combines logs	$\frac{3^{y}}{9} - \log_{3} 3^{\frac{y}{2}} = \log_{3} \left(\frac{3^{\frac{3y}{2}}}{81} \right)$ correctly	M1
Alt 2 (b) Uses $x = 3^{y}$	$\log_{3}\left(\frac{3^{\frac{3y}{2}}}{81}\right) = 2 \Longrightarrow y = 4$	Correct value for y	A1
	$\log_3 x = 4 \Longrightarrow x = 3^4$	Correct method for undoing log. Dependent on the first M	d M1
	$\Rightarrow x = 81$	cao	A1

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Past	Paper (Mark Scheme) This resource was created and owned by Pearson Edexcel		WMA01	
	Number	Sc	heme	Marks
	6(a)(i)	$\frac{3}{2}$	Accept exact equivalents	B1
	(ii)	$y = 0, 3x + 5 = 0 \Longrightarrow x = -\frac{5}{3}$	M1: Sets $y = 0$ and attempts to find x. Accept as evidence $3x+5=0 \Rightarrow x=$ or $awrt-1.7$ A1: $x = -\frac{5}{3}$ or exact equivalent including 1.6 recurring (i.e. a clear dot over the 6)	M1A1
				(3)
	(b)	Gradient $l_2 = -\frac{1}{\frac{3}{2}} = -\frac{2}{3}$	Uses $m_2 = -\frac{1}{m_1}$ to find the gradient of l_2 (may be implied by their line equation). Allow an attempt to find m_2 from $m_1 \times m_2 = -1$.	M1
		Point <i>B</i> has <i>y</i> coordinate of 4	This may be embedded within the equation of the line but must be seen in part (b).	B1
		e.g. $y - '4' = '-\frac{2}{3}'(x-1)$ or $\frac{y - '4'}{x-1} = '-\frac{2}{3}'$	A correct straight line method with a changed gradient and their point (1, '4'). There must have been attempt to find the y coordinate of <i>B</i> . If using $y = mx + c$, must reach as far as finding a value for <i>c</i> .	M1
		e.g. $y-4 = -\frac{2}{3}(x-1)$ or $\frac{y-4}{x-1} = -\frac{2}{3}$	A correct un-simplified equation	A1
		2x + 3y - 14 = 0	Accept $A(2x+3y-14) = 0$ where A is an integer. Terms can be in any order but must have '= 0'.	A1 (5)
			1	
	Alt (b)	Gradient $l_2 = -\frac{1}{\frac{3}{2}} = -\frac{2}{3}$	Uses $m_2 = -\frac{1}{m_1}$ to find the gradient of l_2 as before	M1
		$\frac{3}{2}x + \frac{5}{2} = -\frac{2}{3}x + c$	A correct statement for $l_1 = l_2$	B1
		$x = 1 \Longrightarrow c = \frac{14}{3}$	Substitutes $x = 1$ to find a value for c	M1
		$y = -\frac{2}{3}x + \frac{14}{3}$	Correct equation	A1
		2x + 3y - 14 = 0	Accept $A(2x+3y-14) = 0$ where A is an integer.	A1

Winter 2017	www.myst	udybro.com N	lathematics C12
Past Paper (Mark :	Scheme) This resource was created a $y = 0 \Longrightarrow 2x - 14 = 0 \Longrightarrow x = 7$	Attempts to find C using $y = 0$ in the equation obtained in part (b)	M1 WMA01
	Attempts Area of triangle us	$ \lim_{x \to 0} \frac{1}{2} \times AC \times (y \text{ coord of } B) $	
	$=\frac{1}{2}\times\left(\frac{7}{2}\right)$	$(\frac{3}{3}) \times (4)$	
	Attempts Area of tria	ngle using 2 triangles	M1
	$\frac{1}{2} \times \left(1 + \left(\frac{3}{3}\right)'\right) \times \left(y \text{ coord of } B\right)$	$+\frac{1}{2} \times (7^{\prime}-1) \times (y \text{ coord of } B)$	
	If they make a second/different atten still allow	this mark.	1
	$=\frac{52}{3}$	Area = $\frac{32}{3}$ or exact equivalent e.g 17 $\frac{1}{3}$ or 17.3 recurring (i.e. a clean	A1
		dot over the 3)	(3)
			(11 marks)
	$y = 0 \Longrightarrow 2x - 14 = 0 \Longrightarrow x = 7$	Attempts to find <i>C</i> using $y = 0$ in the equation obtained in part (b)	M1
Way 2	Attempts area of triangle using A complete method for the area include	$\frac{1}{2}AB \times BC = \frac{1}{2} \times \sqrt{\frac{208}{9}} \times \sqrt{52}$ ding correct attempts at finding AB	M1
6(c)	and BC using their values.	50	
	$=\frac{52}{3}$	Area = $\frac{32}{3}$ or exact equivalent e.g 17 $\frac{1}{3}$ or 17.3 recurring (i.e. a clea	r A1
			(3)
	$y = 0 \Longrightarrow 2x - 14 = 0 \Longrightarrow x = 7$	Attempts to find C using $y = 0$ in the equation obtained in part (b)	M1
Way 3	$ \begin{vmatrix} \frac{1}{2} \begin{vmatrix} 1 & 7 & -\frac{5}{3} & 1 \\ 4 & 0 & 0 & 4 \end{vmatrix} = \frac{1}{2} \begin{vmatrix} -\frac{20}{3} - 28 \end{vmatrix} $	Uses shoelace method. Must see a correct method including ¹ / ₂ .	M1
6(c)	$=\frac{52}{3}$	Area = $\frac{52}{3}$ or exact equivalent e.g 17 $\frac{1}{3}$ or 17.3 recurring (i.e. a clea	r A1
		dot over the 3)	
			(3)

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Past Paper (Mark S Way 4 6(c)	$\begin{array}{c} \text{cheme}) & \text{This resource was created and owned} \\ y = 0 \Longrightarrow 2x - 14 = 0 \Longrightarrow x = 7 \\ \text{equation} \end{array}$	by Pearson Edexcel is to find C using $y = 0$ in the n obtained in part (b)	M1 WMA01
	$\int_{-\frac{5}{3}}^{1} \left(\frac{3x}{2} + \frac{5}{2}\right) dx + \int_{1}^{7} \left(-\frac{2x}{3}\right) dx $	$+\frac{14}{3}dx$	
	$= \left[\frac{3x^2}{4} + \frac{5}{2}x\right]_{-\frac{5}{3}}^{1} + \left[-\frac{2x^2}{6}\right]_{-\frac{5}{3}}^{1} + \left[-\frac{2x^2}{6}\right]_{-\frac$	$\left[+\frac{14}{3}x\right]_{1}^{7}$	M1
	$= \left(\frac{3}{4} + \frac{5}{2}\right) - \left(\frac{75}{36} - \frac{25}{6}\right) + \left(-\frac{49}{3} + \frac{9}{2}\right)$	$\frac{18}{3} - \left(-\frac{1}{3} + \frac{14}{3}\right)$	
	A complete method using their values with c	orrect integration on l_1 and	
	their l_2 : Finds the area under the given line b	etween their -5/3 and 1 and	
	adds the area under their l_2 betwee	en 1 and their 7.	
	52 Area =	$\frac{52}{3}$ or exact equivalent e.g.	A 1
	$=\frac{1}{3}$ 17 $\frac{1}{3}$ or	17.3 recurring (i.e. a clear	AI
	dot ove	r the 3)	
	· · · · · ·		(3)

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7. (i) Find

$$\int \frac{2+4x^3}{x^2} \mathrm{d}x$$

giving each term in its simplest form.

(ii) Given that k is a constant and

 $\int_{2}^{4} \left(\frac{4}{\sqrt{x}} + k\right) \mathrm{d}x = 30$

find the exact value of k.

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Question Number	Sche	eme	Marks
7 (i)		Attempts to split the fraction. This can be awarded for $\frac{2}{x^2}$ or $\frac{4x^3}{x^2}$ or may be implied by the sight of one	
	$\frac{2+4x^3}{x^2} = \frac{2}{x^2} + 4x = 2x^{-2} + 4x$	correct index e.g px^{-2} or qx providing one of these terms is obtained correctly. So for	M1
		example $\frac{2+4x^3}{x^2} = 2+4x^3+x^{-2}$ would be M0 as the x^{-2} has been	
	· · · · · · · · · · · · · · · · · · ·	obtained incorrectly.dM1: $x^n \rightarrow x^{n+1}$ on any term. Dependent on the first M.A1: At least one term correct,	
	$\int 2x^{-2} + 4x dx = 2 \times \frac{x}{-1} + 4 \times \frac{x}{2} (+c)$	simplified or un-simplified. Allow powers and coefficients to be un- simplified e.g. $2 \times \frac{x^{-2+1}}{-1}$, $+4 \times \frac{x^{1+1}}{2}$	dM1A1
	$= -\frac{2}{x} + 2x^2 + c$	All correct and simplified including the + c. Accept equivalents such as $-2x^{-1} + 2x^2 + c$	A1
			(4)
	There are no marks in (ii) for use of the trapezium rule – must use integration		
(ii)	$\int \left(\frac{4}{\sqrt{x}} + k\right) dx$	M1: Integrates to obtain either $\alpha x^{0.5}$ or kx	
	$= \int (4x^{-0.5} + k) dx = 4 \frac{x^{0.5}}{0.5} + kx(+c)$	Al. conflict integration (simplified or un-simplified). Allow powers and coefficients to be un-simplified e.g. $4\frac{x^{-0.5+1}}{0.5}$. There is no need for $+c$	M1A1
	$\left[4\frac{x^{0.5}}{0.5} + kx\right]_{2}^{4} = 30 \Rightarrow \left(8\sqrt{4} + 4k\right) - \left(8\sqrt{2} + 2k\right) = 30$ Substitutes both $x = 4$ and $x = 2$ into changed expression involving k		M1
	subtracts either way rou Condone poor use or omission	and sets equal to 30 of brackets when subtracting.	
		dd M1: Attempts to solve for <i>k</i> from a linear equation in <i>k</i> . Dependent upon both M's and need to have	
	$2k + 16 - 8\sqrt{2} = 30 \implies k = 7 + 4\sqrt{2}$	seen $\int k dx \to kx$. A1: 7+4 $\sqrt{2}$ or exact equivalent e.g.	ddM1A1
		$7+2^{2.5}$, $7+4\times2^{0.5}$	
			(5)
			(9 marks)

/inter 2017 ast Paper	www.mystudybro.com This resource was created and owned by Pearson Edexcel	Mathematic	S C12
0	$f(x) = 2x^3 - 5x^2 - 23x - 10$		Leave blank
0.	$\Gamma(x) = 2x = 5x = 25x = 10$		
(a) Find the re	remainder when $f(x)$ is divided by $(x - 3)$.	(2)	
(b) Show that	t $(x + 2)$ is a factor of $f(x)$.	(2)	
(c) Hence ful	ly factorise $f(x)$.	(4)	
(d) Hence sol	lve	(+)	
	$2(3^{3t}) - 5(3^{2t}) - 23(3^t) = 10$		
giving you	ur answer to 3 decimal places.	(2)	

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Question Number	Sche	me	Marks
8(a)	$f(3) = 2(3)^{3} - 5(3)^{2} - 23(3) - 10$ or $x - 3\overline{)2x^{3} - 5x^{2} - 23x - 10}$ 	Attempts to calculate $f(\pm 3)$ or divides by $(x-3)$. For long division need to see minimum as shown with a constant remainder.	M1
	(Remainder =) -70	-70	A1
	Malaxa		(2)
(b)	Mark (b) and $(5/2)^2 - 2(-2)^3 - 5(-2)^2 - 22(-2) - 10$	(c) together	
	$f(-2) = 2(-2)^{2} - 5(-2)^{2} - 23(-2) - 10$ Or $\frac{2x^{2} + \dots}{x+2} 2x^{3} - 5x^{2} - 23x - 10$ \dots	Attempts $f(\pm 2)$ or divides by $(x+2)$. For long division need to see minimum as shown with a constant remainder.	M1
	Remainder = 0, hence $x + 2$ is a factor	Obtains a remainder zero and makes a conclusion (not just a tick or e.g. QED). Do not need to refer to the remainder in the conclusion but a zero remainder must have been obtained. (May be seen in a preamble)	A1*
	Note that just $f(-2) = 0$ therefore $(x + 2)$	is a factor scores M0A0 as there must	
	be some evidence	of a calculation	(2)
(c)	$\frac{2x^3 - 5x^2 - 23x - 10}{(x+2)} = ax^2 + bx + c$	Divides $f(x)$ by $(x+2)$ or compares coefficients or uses inspection to obtain a quadratic expression with $2x^2$ as the first term.	M1
	$2x^2 - 9x - 5$	Correct quadratic seen	A1
	f(x) = (x+2)(x+2)(x+2)(x+2)(x+2)(x+2)(x+2)(x+2)	(2x+1)(x-5) $x^{2})$. The usual rules apply here so if (x), this scores M0 unless the factor of 2 later. $(2x+\frac{1}{2})(x-5)$. All factors together on (x). Ignore subsequent attempts to solve.	d M1A1
	SC: This is a hence question but we v candidates in this part who use their g -0.5 and 5 and write down tl	will allow a special case of 1100 for raphical calculators to get roots of -2, he <u>correct</u> factorised form.	

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Mathematics C12

ast	Paper (Mark S Question	cheme) This resource was created and owned by Pearson Edexcel Scheme	WMA01 Marks
	Number	But note that if all that is seen is $(x+2)(x+\frac{1}{2})(x-5)$ this scores 1000	
			(4)

(d)	$3^t = 5' \Longrightarrow t \log 3 = \log 5'$	Solves $3^t = k$ where $k > 0$ and follows from their (c) to obtain $t \log 3 = \log k$. Accept sight of $t = \log_3 k$ where $k > 0$ and follows from their (c)	M1
	$\Rightarrow t = awrt 1.465$ only	t = awrt 1.465 and no other solutions	A1
			(2)
			(10 marks)

Question Number	Scheme	Marks	
9(a)	f (x) = $8x^{-1} + \frac{1}{2}x - 5$ \Rightarrow f'(x) = $-8x^{-2} + \frac{1}{2}$ (may be up since the set of th	$\frac{\frac{1}{2}}{\text{ect f}'(x) = -8x^{-2} + \frac{1}{2}}$ M1A1	
	Sets $-8x^{-2} + \frac{1}{2} = 0 \Rightarrow x = 4$ M1: Sets their "changed" fun by their work) x. A1: $x = 4$ (All	f'(x) = 0 i.e. a ction (may be implied and proceeds to find $low x = \pm 4$)	
	(4,-1) Correct coordi (allow $x = 4, y$) Ignore their (-4)	nates = -1). A1 4,)	
			(5)
(b)(i)	(x=)2, 8 $x=2$ and $x=$ accept as coord	= 8 only. Do not dinates here. B1	
(b)(ii)	(4, 1) $(4, 1)$	w through on their Accept $(x, y+2)$ y). With no other B1ft	
(b)(iii)	$(x=)2, \frac{1}{2}$ Both answers a $(2, 0), (\frac{1}{2}, 0)$ reference to th point.	are needed and accept here. Ignore any e image of the turning	
			(3)
		(8 marks)	

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Past Paper

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Mathematics C12

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Mathematics C12

ast	Paper (Mark S Question	cheme) This resource was created and owned by Pearson Edexcel Scheme	WMA01 Marks
	Number	But note that if all that is seen is $(x+2)(x+\frac{1}{2})(x-5)$ this scores 1000	
			(4)

(d)	$3^t = 5' \Longrightarrow t \log 3 = \log 5'$	Solves $3^t = k$ where $k > 0$ and follows from their (c) to obtain $t \log 3 = \log k$. Accept sight of $t = \log_3 k$ where $k > 0$ and follows from their (c)	M1
	$\Rightarrow t = awrt 1.465$ only	t = awrt 1.465 and no other solutions	A1
			(2)
			(10 marks)

Question Number	Scheme	Marks	
9(a)	f (x) = $8x^{-1} + \frac{1}{2}x - 5$ \Rightarrow f'(x) = $-8x^{-2} + \frac{1}{2}$ (may be up since the set of th	$\frac{\frac{1}{2}}{\text{ect f}'(x) = -8x^{-2} + \frac{1}{2}}$ M1A1	
	Sets $-8x^{-2} + \frac{1}{2} = 0 \Rightarrow x = 4$ x = 4 x = 4	f'(x) = 0 i.e. a ction (may be implied and proceeds to find $low x = \pm 4$)	
	(4,-1) Correct coordi (allow $x = 4, y$) Ignore their (-4)	nates = -1). A1 4,)	
			(5)
(b)(i)	(x=)2, 8 $x=2$ and $x=$ accept as coord	= 8 only. Do not dinates here. B1	
(b)(ii)	(4, 1) $(4, 1) or follow solution in (a). from their (x, y) points.$	w through on their Accept $(x, y+2)$ y). With no other B1ft	
(b)(iii)	$(x=)2, \frac{1}{2}$ Both answers a $(2, 0), (\frac{1}{2}, 0)$ reference to th point.	are needed and accept here. Ignore any e image of the turning	
			(3)
		(8 marks)	

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nter 2017	www.mystudybro.com	Mathematics C
Гареі	This resource was created and owned by rearson Edexcer	Leav
10. The first 3 te given by	erms, in ascending powers of x , in the binomial expansion of (1 +	$(-ax)^{20}$ are
	$1 + 4x + px^2$	
where a and p	<i>p</i> are constants.	
(a) Find the v	value of <i>a</i> .	
		(2)
(b) Find the v	value of <i>p</i> .	(2)
One of the ter	rms in the hinomial expansion of $(1 + ar)^{20}$ is ar^4 , where a is a con-	nstant
(a) $\sum_{i=1}^{n} d_i d_{i-1}$	$\frac{1}{1} = \frac{1}{2} $	istant.
(c) Find the v	value of q.	(2)

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P 4 8 3 2 4 A 0 3 0 5 2

WMA01

Question Number	Sch	eme	Marks
	Mark (a) and	l (b) together	
10(a)	$(1+ax)^{20} = 1^{20} + {}^{20}C_1 1^{10}$	$^{19}(ax)^{1} + {}^{20}C_{2}1^{18}(ax)^{2}.$	
	Note that the notation $\begin{pmatrix} 20\\1 \end{pmatrix}$) may be seen for ${}^{20}C_1$ etc.	
	${}^{20}C_1 1^{19} (ax)^1 = 4x \Longrightarrow 20a = 4 \Longrightarrow a = 0.2$	M1: Uses either ${}^{20}C_1(1^{19})(ax)^1 = 4x^1$ or $20a = 4$ to obtain a value for a. A1: $a = 0.2$ or equivalent	M1A1
			(2)
(b)	$^{20}C_2 1^{18} (ax)^2 = px^2$ $\Rightarrow \frac{20 \times 19}{2} \times ('0.2')^2 = p$ $\Rightarrow p = \dots$	Uses ${}^{20}C_2(1^{18})(ax)^2 = px^2$ and their value of <i>a</i> to find a value for <i>p</i> . Condone the use of <i>a</i> rather than a^2 in finding <i>p</i> . Maybe implied by an attempt to find a value for $190a^2$ or $190a$. Note: ${}^{20}C_{18}$ can be used for ${}^{20}C_2$	M1
	<i>p</i> = 7.6	Accept equivalents such as $\frac{38}{5}, \frac{190}{25}$	A1
			(2)
(c)	Term is ${}^{20}C_4 1^{16} (ax)^4 \Rightarrow q =$	Identifies the correct term and uses their value of <i>a</i> to find a value for <i>q</i> . Condone the use of <i>a</i> rather than a^4 . Must be an attempt to calculate ${}^{20}C_4a^4$ or ${}^{20}C_4a$ or ${}^{20}C_{16}a^4$ or ${}^{20}C_{16}a$	M1
	$q = {}^{20}C_4 \times 0.2^4 = \frac{969}{125} = (7.752)$	$q = \frac{969}{125} \text{ or exact equivalent e.g.}$ 7.752, $7\frac{94}{125}$. $q = \frac{969}{125}x^4 \text{ scores A0 but}$ $qx^4 = \frac{969}{125}x^4 \text{ scores A1.}$	A1
			(6 marks)

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WMA01 Leave blank 11. In this question solutions based entirely on graphical or numerical methods are not acceptable. (i) Solve, for $0 \leq x < 2\pi$, $3\cos^2 x + 1 = 4\sin^2 x$ giving your answers in radians to 2 decimal places. (5) (ii) Solve, for $0 \le \theta < 360^\circ$, $5\sin(\theta + 10^\circ) = \cos(\theta + 10^\circ)$ giving your answers in degrees to one decimal place. (5) 34 P 4 8 3 2 4 A 0 3 4 5 2

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Mathematics C12

Past Paper (Mark S	(Mark Scheme) This resource was created and owned by Pearson Edexcel		WMA01
Number	Sc	heme	Marks
11(i)	$3\cos^{2} x + 1 = 4(1 - \cos^{2} x)$ or $3(1 - \sin^{2} x) + 1 = 4\sin^{2} x$ or $3 + \tan^{2} x + 1 = 4\tan^{2} x$ or $3\frac{\cos 2x + 1}{2} + 1 = 4\frac{1 - \cos 2x}{2}$	Uses $\sin^2 x = 1 - \cos^2 x$ to produce an equation in $\cos^2 x$ or uses $\cos^2 x = 1 - \sin^2 x$ to produce an equation in $\sin^2 x$ or uses $\cos^2 x + \sin^2 x = 1$ and divides by $\cos^2 x$ to produce an equation in $\tan^2 x$ or uses $\sin^2 x$ and $\cos^2 x$ in terms of $\cos 2x$. Condone missing brackets.	M1
	$\Rightarrow \cos^2 x = \frac{3}{7} \text{ or } \sin^2 x = \frac{4}{7} \text{ or}$ $\tan^2 x = \frac{4}{3} \text{ or } \cos 2x = -\frac{1}{7}$	Correct value for $\cos^2 x$ or $\sin^2 x$ or $\tan^2 x$ or $\cos 2x$. This may be implied by $\cos x = \sqrt{\frac{3}{7}}$ or $\sin x = \sqrt{\frac{4}{7}}$ or $\tan x = \sqrt{\frac{4}{3}}$	A1
	$\Rightarrow \cos x = \pm \sqrt{\frac{3}{7}}$ A correct order of operations to c $\cos^2 x = p \Rightarrow \cos x =$ $\sin^2 x = p \Rightarrow \sin x =$ $\tan^2 x = p \Rightarrow \tan x =$ $\cos 2x = p \Rightarrow 2x = 0$ This may be implied by one	$\Rightarrow x = \cos^{-1}\left(\sqrt{\frac{3}{7}}\right)$ betain a correct expression for x. E.g. $= \sqrt{p} \Rightarrow x = \cos^{-1}\sqrt{p} \text{ or}$ $= \sqrt{p} \Rightarrow x = \sin^{-1}\sqrt{p} \text{ or}$ $= \sqrt{p} \Rightarrow x = \tan^{-1}\sqrt{p} \text{ or}$ $\cos^{-1} p \Rightarrow x = \frac{1}{2}\cos^{-1} p$ correct answer for their values.	M1
	$\Rightarrow x = awrt 0.86, 2.28, 4.00, 5.43$	A1: Any two of awrt 0.86, 2.28, 4.00, 5.43 A1: All four of awrt 0.86, 2.28, 4.00, 5.43 with no additional solutions in the range and ignore solutions outside the range.	A2,1,0
	Note that answers in degrees a Allow A1 for awrt two of the For answers given as awrt 0.27π , 0.72 of these but dedu	re: 49.11, 130.89, 229.11, 310.89 ese but deduct the final A mark. 3π , 1.27 π , 1.73 π , allow A1 only for any 2 loct the final A mark.	
			(5)

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Past Paper (Mark S	$\frac{\text{Cheme}}{5 \sin(\theta + 10^\circ)} = \cos(\theta + 10^\circ)$	A downed by Pearson Edexcel M1: Reaches $\tan() = \alpha$ where α is a	WMA01
	$3\sin(\theta + 10) = \cos(\theta + 10)$	constant including zero.	M1A1
	$\Rightarrow \tan(\theta + 10^\circ) = 0.2$	A1: $tan() = 0.2$	
		For the correct order of operations to	
		produce one value for θ .	
	$\Rightarrow \theta = \tan^{-1}(0.2) - 10^{\circ}$	Accept $\theta = \tan^{-1}(\alpha) - 10$, $\alpha \neq 0$ or one	d M1
		Correct answer as evidence.	
		A1: One of awrt $\theta = 1.3, 181.3$	
	$\rightarrow \theta$ - overt 1.3° 181.3°	A1: Both awrt $\theta = 1.3, 181.3$ and no	A 1 A 1
	$\rightarrow 0 - a wit 1.5, 101.5$	other solutions in range and ignore	AIAI
		solutions outside the range.	
	Note that final answers in radians in the earlier marks are as	(11) cannot score the final 2 A marks but vailable (maximum 11100)	
			(5)
			(10 marks)
	Alternative 1 fo	r (ii) by squaring:	
	$5\sin(\ldots) = \cos(\ldots)$		
	$\Rightarrow 25 \sin^2() = \cos^2()$	Squares both sides, replaces	
	$\Rightarrow 25(1 - \cos^2()) = \cos^2()$	$\sin^2()$ by $1-\cos^2()$ or	
		replaces $\cos^2()$ by	M1
	$25 \sin^2($) $1 \sin^2($)	$1 - \sin^2()$ and reaches	
	$25 \sin \left(\dots \right) = 1 - \sin \left(\dots \right)$	$\sin^2() = \text{ or } \cos^2() =$	
	$\sin^2()$ = or $\cos^2()$ =		
		Connectively for $\sin^2(x)$ or	
	1		
	$\sin^2() = \frac{1}{26}$	$\cos^2()$. This may be implied	
	or	by $\sin() = \frac{1}{\sqrt{5}}$ or	A1
	$\cos^2() = \frac{25}{2}$	$\sqrt{26}$	
	26	$\cos() = \sqrt{\frac{25}{26}}$	
	1		
	$\theta = \sin^{-1} \frac{1}{\sqrt{26}} - 10^{\circ}$	For the correct order of operations to produce one value	
	or	for θ as shown or accept one	d M1
	$\theta = \cos^{-1} \frac{5}{-10^{\circ}}$	correct answer as evidence.	
	$\sqrt{26}$	Dependent on the first M.	
		A1: One of awrt $\theta = 1.3, 181.3$	
	$\rightarrow \theta - 1.3^{\circ}$ 181.3°	A1: Both awrt $\theta = 1.3, 181.3$ and	A 1 A 1
		no other solutions in range and ignore solutions outside the	AIAI
		range.	
	Note that final answers in radians in	n (ii) cannot score the final 2 A marks	
	but the earlier marks are a	vailable (maximum 11100)	

	Alternative 2 for (ii) Using	the addition formulae	
Alt (ii)	$5\sin\theta\cos 10 + 5\cos\theta\sin 10 = 0$ Uses the correct addition formulae on bo	M1	
	$\tan\theta = \frac{\cos 10 - 5\sin 10}{5\cos 10 + \sin 10} = (0.0229)$	A1	
	$\tan\theta = 0.0229 \Longrightarrow \theta = \dots$	Uses arctan to produce one value for θ . Dependent on the first M.	d M1
	$\Rightarrow \theta = 1.3^{\circ}, 181.3^{\circ}$ A1: One of awrt $\theta = 1.3, 181.3$ A1: Both awrt $\theta = 1.3, 181.3$ and no other solutions in range and ignore solutions outside the range.		A1A1
	Note that final answers in radians in (ii) cannot score the final 2 A marks but the earlier marks are available (maximum 11100)		
	out the currer marks are available (maximum 11100)		(5)

12.

Past Paper

P(4, 11)

x

Mathematics C12

WMA01









Figure 4 shows a sketch of part of the curve C with equation

1

R

$$y = \frac{3}{4}x^2 - 4\sqrt{x} + 7, \quad x > 0$$

The point P lies on C and has coordinates (4, 11).

Line l is the tangent to C at the point P.

0

y

(a) Use calculus to show that *l* has equation y = 5x - 9

(5)

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Past	Paper (Mark S	cheme) This resource was created and	Jowned by Pearson Edexcel	WMA01
	Number	Sche	eme	Marks
	12(a)	$y = \frac{3}{4}x^2 - 4\sqrt{x} + 7 \Longrightarrow \frac{dy}{dx} = \frac{3}{2}x - 2x^{-0.5}$	M1: Differentiates to obtain at least one correct power for one of the terms in x. (may be un-simplified) e.g. $x^2 \rightarrow x^{2-1}$ or $\sqrt{x} \rightarrow x^{\frac{1}{2}-1}$ A1: Correct derivative. Allow un- simplified e.g. $2 \times \frac{3}{4} x^{2-1}$ or $-4 \times \frac{1}{2} x^{\frac{1}{2}-1}$	M1A1
		At $x = 4 \frac{dy}{dx} = \frac{3}{2}(4) - 2(4)^{-0.5} = \dots$	Substitutes $x = 4$ into a changed function in an attempt to find the gradient.	M1
		y-11 = "5"(x-4) or $y = mx + c \Longrightarrow 11 = "5" \times 4 + c \Longrightarrow c =$	Correct straight line method using $(4, 11)$ correctly placed and their dy/dx at $x = 4$ for the tangent not the normal . If using $y = mx + c$, must reach as far as finding a value for <i>c</i> . Dependent on the previous M .	d M1
		y = 5x - 9	Correct printed equation with no errors seen. Beware of the "5" appearing from wrong working.	A1*
		Important Note:Important Note:Following a correct derivative, if candidate states $x = 4$ so $dy/dx = 5$, this is fine if they then complete correctly – allow full marks. However, following a correct derivative, if the candidate just states $dy/dx = 5$ and then proceeds to obtain the correct straight line equation, the final mark can be withheld. Some evidence is needed that the candidate is considering the gradient at $x = 4$.		
				(5)

For part (b), in all cases, look to apply the appropriate scheme that gives the candidate the best mark

	Finds area under curve between 1 and 4 and subtracts triangle C			
	(see diagram at end)			
(b) Way 1	$\int \frac{3}{4}x^2 - 4\sqrt{x} + 7 \mathrm{d}x = \frac{1}{4}x^3 - \frac{8}{3}x^{1.5} + 7$	Tx(+c)	M1: $x^n \rightarrow x^{n+1}$ on any term. May be un-simplified e.g. $x^2 \rightarrow x^{2+1}, x^{0.5} \rightarrow x^{0.5+1},$ $7 \rightarrow 7x^1$ A1: Correct integration. May be un-simplified e.g. terms such as $\frac{1}{3} \times \frac{3}{4} x^{2+1},$ $-\frac{2}{3} \times 4x^{0.5+1}, 7x^1$ and $+c$ is not required	M1A1
		This m	av be embedded within a	
	Tangent meets x axis at $x = 1.8$	triangle on a dia	e area below or may be seen agram.	B1
	Area of triangle $=\frac{1}{2}$ ×	(4-'1.8'	$) \times 11 = (12.1)$	
	Correct method for the area of a tr This may be implied by the evaluation	iangle - l n of \int_{1}^{4}	book for $\frac{1}{2} \times (4 - 1.8) \times 11$ $5x - 9 dx = \left[5\frac{x^2}{2} - 9x\right]_{1.8}^4$	M1
	Correct method for area = Area $\left(\frac{1}{4}4^3 - \frac{8}{3} \times 4^{1.5} + 7 \times 4\right) - \left(\frac{1}{4}4^3 - \frac{8}{3} \times 4^{1.5} + 7 \times 4\right)$	$\frac{1}{4}A + Are$ $\frac{1}{4}1^3 - \frac{8}{3} \times 1$	a B + Area C - Area C $a^{1.5} + 7 \times 1 - 12.1'$	dd M1
	Correct combination of areas. Depend	ent on b	oth previous method marks.	
	= awrt 5.98	Area of exact as	FR = a wrt 5.98 or allow the nswer of $\frac{359}{60}$ or equivalent.	A1
				(6)
				(11 marks)

	Finds area under curve between 1 and "1.8"		
	"curve – line" between "1		
(b) Way 2	$\int \frac{3}{4}x^2 - 4\sqrt{x} + 7 \mathrm{d}x = \frac{1}{4}x^3 - \frac{8}{3}x^{1.5} + 7x(+c)$	M1: $x^n \rightarrow x^{n+1}$ on any term. May be un-simplified e.g. $x^2 \rightarrow x^{2+1}, x^{0.5} \rightarrow x^{0.5+1},$ $7 \rightarrow 7x^1$ A1: Correct integration. May be un-simplified e.g. terms such as $\frac{1}{3} \times \frac{3}{4} x^{2+1},$ $-\frac{2}{3} \times 4x^{0.5+1}, 7x^1$ and $+c$ is not required.	M1A1
	Tangent meets x axis at $x = 1.8$	This may be seen on a diagram.	B1
	Area between "1.8" ar		
	$\pm \int_{1.8}^{4} \left(\frac{3}{4}x^2 - 4\sqrt{x} + 7\right) - (5x - 9) dx = \pm \left[\frac{1}{4}\right]$ $= \frac{56}{2} - 15.7182 (= 2.9)$	M1	
	Attempts to integrate "curve – line" or "line – "1.8" and 4 and subtr	- curve", substitute the limits acts.	
	Correct method for area = Are	ea A + Area B	
	$\left(\left(\frac{1}{4}"1.8"^{3}-\frac{8}{3}"1.8"^{1.5}+7\times"1.8"\right)-\left(\frac{1}{4}1^{3}-\frac{8}{3}\right)\right)$	dd M1	
	Correct combination of areas. Dependent on b		
	= awrt 5.98	Area of R = awrt 5.98 or allow the exact answer of $\frac{359}{60}$ or equivalent.	A1
			(6)

	Uses "line – curve" or "curve – line"		
	below		
(b) Way 3	$\pm \left(\frac{3}{4}x^2 - 4\sqrt{x} + 7 - 5x + 9\right)$	$= \pm \left(\frac{3}{4}x^2 - 4\sqrt{x} - 5x + 16\right)$	
	$\pm \int \frac{3}{4}x^2 - 4\sqrt{x} - 5x + 16 \mathrm{d}x = 1$	N#1 A 1	
	M1: $x^n \rightarrow x^{n+1}$ on any term. May be un	n-simplified e.g. $x^2 \rightarrow x^{2+1}$,	MIAI
	$x^{0.5} \to x^{0.5+1}, x \to x^{1+1}, 16 \to 16x^1$. If ter	ms are not collected when subtracting	
	then the same condition applies.		
	A1: Correct integration as shown. Ma	y be un-simplified for coefficients and	
	powers and $+c$ is not required.		
		This may be embedded within a	
	Tangent meets x axis at $x = 1.8$	triangle area below or may be seen	B1
	Area of triangle = $\frac{1}{2} \times (1)$	M1	
	Correct method for the area of a trian	IVI I	
	Correct method for area = $Area$	A + Area B + Area D - Area D	
	$\left(\left(\frac{1}{4}4^{3}-\frac{8}{3}4^{1.5}-\frac{5\times4^{2}}{2}+16\times4\right)-\left(\frac{1}{2}+16\times4\right)\right)$	dd M1	
	Correct combination of areas. Depend		
	= awrt 5.98	A1	
		•	(6)



Mathematics C12

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13. (a) On separate axes sketch the graphs of (i) $y = c^2 - x^2$

(ii) $y = x^2(x - 3c)$

where c is a positive constant.

Show clearly the coordinates of the points where each graph crosses or meets the *x*-axis and the *y*-axis.

(5)

(b) Prove that the *x* coordinate of any point of intersection of

 $y = c^2 - x^2$ and $y = x^2(x - 3c)$

where c is a positive constant, is given by a solution of the equation

$$x^3 + (1 - 3c)x^2 - c^2 = 0$$
(2)

Given that the graphs meet when x = 2

(c) find the exact value of *c*, writing your answer as a fully simplified surd.

(4)



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Ouestion	cheme) I his resource was created and owned by Pearson Edexcel	WMA
Number	Scheme	Marks
13(a)(i)	$(0, c^2)$	
	(-c, 0)/ $(c, 0)$	
	\wedge \circ	
	The maximum must be smooth and not form a point and the branches must not	
	clearly turn back in on themselves	
	or	
	A continuous graph passing through or touching at the points $(-c, 0)$, $(c, 0)$ and	B1
	$(0, c^2)$. They can appear on their sketch or within the body of the script but	
	there must be a sketch. Allow these marked as $-c$, c and c^2 in the correct	
	places. Allow $(0, -c)$, $(0, c)$ and $(c^2, 0)$ as long as they are marked in the correct	
	places. If there is any ambiguity, the sketch takes precedence.	
	A fully correct diagram with the curve in the correct position and the	
	intercepts and shape as described above. The maximum must be on the y-axis	
() (**)	and the branches must extend below the <i>x</i> -axis.	
(a)(ii)	There must be a sketch to score any marks in (a) $(2 - \sqrt{2})^{-1}$	
	Snape. A positive cubic with only	
	one maximum and one minimum. The	B1
	at the minimum (not pointed)	
	A smooth curve that touches or meets the	
	x-axis at the origin and $(3c, 0)$ in the	
	correct place and no other intersections	
	The origin does not need to be marked but	
	$\frac{1}{100}$ $\frac{1}$	B1
	(3c, 0) marked in the correct place. May appear on	
	their sketch or within the body of the	
	script. If there is any ambiguity, the sketch	
	takes precedence.	
	Maximum at the origin (allow the	D 1
	maximum to form a point or cusp)	DI
	There must be a sketch to score any marks in (a)	
(b)	Intersect when $x^2(x-3c) = c^2 - x^2 \Longrightarrow x^3 - 3cx^2 = c^2 - x^2$	
	Sets equations equal to each other and attempts to multiply out the bracket or	M1
	vice versa	
	Collects to one side (may be implied),	
	factorises the x^2 terms and obtains printed	
	answer with no errors. There must be an $r^3 + r^2 - 3cr^2 - c^2 = 0$	
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	A1*
	$\Rightarrow x^{3} + (1-3c)x^{2} - c^{2} = 0^{*} \qquad \text{Allow } x^{3} + x^{2}(1-3c) - c^{2} = 0 \text{ or}$	
	$0 = x^3 + (1 - 3c)x^2 - c^2$ or	
	$0 = x^3 + x^2(1 - 3c) - c^2$	

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			(11 marks)
			(4)
	$4\sqrt{3}-6$	$c = 4\sqrt{3} - 6$ or $c = -6 + 4\sqrt{3}$ only	A1
	$c = \frac{-12 \pm \sqrt{12^2 - 4 \times 1 \times (-12)}}{2}$	implied by a correct exact answer for their 3TQ. (May need to check)	MI
	$(c+6)^2 - 36 - 12 = 0 \Longrightarrow c = \dots$ or	Solves their 3TQ by using the formula or completing the square only . This may be	N/1
	$c^2 + 12c - 12 = 0$	Correct 3 term quadratic. Allow any equivalent form with the terms collected (may be implied)	A1
	$8 + 4(1 - 3c) - c^2 = 0$	Substitutes $x = 2$ to give a correct un- simplified form of the equation.	M1
t Paper (Mark S	Scheme) This resource was create	ad and owned by Pearson Edexcel	WMA0 ⁴

(4)

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14. A geometric series has a first term *a* and a common ratio *r*.

(a) Prove that the sum of the first n terms of this series is given by

$$S_n = \frac{a(1-r^n)}{1-r}$$

A liquid is to be stored in a barrel.

Due to evaporation, the volume of the liquid in a barrel at the end of a year is 7% less than the volume at the start of the year.

At the start of the first year, a barrel is filled with 180 litres of the liquid.

(b) Show that the amount of the liquid in this barrel at the end of 5 years is approximately 125.2 litres.

(2)

At the start of each year a new identical barrel is filled with 180 litres of the liquid so that, at the end of 20 years, there are 20 barrels containing varying amounts of the liquid.

(c) Calculate the total amount of the liquid, to the nearest litre, in the 20 barrels at the end of 20 years.

(3)



Vinter 2017	www.mystu	dybro.com	Math	ematics C12
ast P aper (Mark S Question Number	cheme) This resource was created and Sche	I owned by Pearson I me	Edexcel	WMA01 Marks
14 (a)	Allow the use of <i>S</i> or <i>S_n</i> the $S = a + ar + ar^2 + \dots ar^{n-1}$ and There must be a minimum of '3' terms term. Condone for this mark only $rS = ar + ar^2 + ar^3 + \dots ar^{n+1}$ and allow belo	oughout without per $rS = ar + ar^2 + ar$ and must include the $rS = a + ar + ar^2 + ar$ wy commas instead of wy.	enalty. $a^{3} + \dots ar^{n}$ the first and the <i>n</i> th $\dots ar^{n}$ and of +'s but see note	M1
	$S-rS=a-ar^{n}$	Subtracts either w special case allow For this mark, the must be different and rS they are co possible missing t	ray around. As a $v S - rS = a + ar^n$. ir S and their rS but it must be S insidering with erms or slips.	M1
	$\Rightarrow S(1-r) = a(1-r^n) \Rightarrow S = \frac{a(1-r^n)}{(1-r)}$	dM1: Dependent previous M's. It is common factor of S = A1*: Fully correct errors or omission commas instead of $S = \frac{a(r^n - 1)}{(r - 1)}$ with printed answer is	upon both s for taking out a <i>S</i> and achieving t proof with no ons. The use of of +'s is an error. out reaching the A0	d M1A1*
				(4)
(a) Way 2	$S = \frac{(a + ar + ar^{2} + \dots ar^{n-1})(1 - r)}{1 - r}$	Gives a minimum must include the f and multiplies top 1 - r	of '3' terms and first and the <i>n</i> th and bottom by	M1
	$S = \frac{a + ar + ar^{2} + \dots ar^{n-1} - ar - ar^{2} - ar^{2}}{1 - r}$	$\frac{ar^{n}}{ar^{n}} = \begin{bmatrix} Expands \\ minimum \\ each and \\ first and \\ \end{bmatrix}$	the top with a m of '3' terms in l must include the the <i>n</i> th term	M1
	$S = \frac{a(1-r^n)}{(1-r)}$	dM1: Dependent of previous M's. It is common factor of achieving $S =$ A1*: Fully correct errors or omission commas instead of $S = \frac{a(r^n - 1)}{(r - 1)}$ with printed answer is	upon both for taking out a <i>a</i> on top and t proof with no ons. The use of of +'s is an error. out reaching the A0	dM1A1

Winter 2017		www.mystu	dybro.com Ma	athematics C12
Past Pa	$U = 180 \times 0.93^{n} \text{ with } n = 4 \text{ or } 5$ Attempts $U = 180 \times 0.93^{n} \text{ with } n = 3 \text{ or } 5$ Attempts $U = 180 \times 0.93^{n} \text{ with } n = 3 \text{ or } 5$ Attempts $U = 167.4 \times 0.93^{n} \text{ with } n = 3 \text{ or } 5$ Allow 93% for 0.93		Attempts $U = 180 \times 0.93^n$ with n = 4 or 5. Accept $U = 167.4 \times 0.93^n$ with $n = 3 \text{ or } 4$ Allow 93% for 0.93	M1
		$U_{5} = 180 \times (0.93)^{5} = 125.2$ (litres)	Cso. Awrt 125.2	A1*
		Allow 93% or 1	- 7% for 0.93	
	(c)	Attempts $S_n = \frac{a(1-r^n)}{(1-r)}$ n = 20/21 $a = 180Allow 93%$	tempts $S_n = \frac{a(1-r^n)}{(1-r)}$ with any combination of: n = 20/21 $a = 180/167.4$ and $r = 0.93Allow 93% for 0.93$	
		$S = \frac{167.4(1-0.93^{20})}{(1-0.93)} \text{ or } S$	$S = 180 \times \frac{0.93(1 - 0.93^{20})}{(1 - 0.93)}$ r $\frac{0.93^{21}}{93} - 180$ e sum (may be implied by awrt 1831) 7% for 0.03) A1
		1831 (litres)	1831 only (Ignore units). Do not isw here, so 1831 followed by $1831 \times 20 = \dots$ scores A0.	A1
				(3) (9 marks)

<u>Listing:</u>

(b)	Sight of awrt 180, 167, 156, 145, 135, 125	Starts with 180 and multiplies by 0.93 either 4 or 5 times showing each result at least to the nearest litre and chooses the 5 th or 6 th term	M1
	$U_{5} = 125.2$ (litres)	Must see all values accurate to 1dp: e.g. awrt 180, 167.4, 155.7, 144.8, (134.6 or 134.7), 125.2	A1*
			(2)
(c)	Total = $180 \times 0.93 + 180 \times 0.93^2 + \dots + 180 \times 0.93^{19} + 180 \times 0.93^{20} = \dots$ Finds an expression for the sum of 20 or 21 terms		M1
	All sums accurate to awrt 1dp 167.4+155.7+144.8+134.6+125.2+42.2 A correct numerical expression for the sum (may be implied by awrt 1831)		A1
	1831 (litres)	1831 only (Ignore units). Do not isw here, so 1831 followed by $1831 \times 20 = \dots$ scores A0.	A1
			(3)

Mathematics C12

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Figure 5

Figure 5 shows the design for a logo.

The logo is in the shape of an equilateral triangle ABC of side length 2r cm, where r is a constant.

The points L, M and N are the midpoints of sides AC, AB and BC respectively.

The shaded section R, of the logo, is bounded by three curves MN, NL and LM.

The curve MN is the arc of a circle centre L, radius r cm.

The curve NL is the arc of a circle centre M, radius r cm.

The curve LM is the arc of a circle centre N, radius r cm.

Find, in cm², the area of R. Give your answer in the form kr^2 , where k is an exact constant to be determined.

(5)

Winter 2017	www.mystudybro.com Mat	hematics C12
Number	Scheme	Marks
15	Area of triangle = $\frac{1}{2} \times (2r)^2 \sin\left(\frac{\pi}{3} \text{ or } 60\right)$ or $\frac{1}{2} \times (r)^2 \sin\left(\frac{\pi}{3} \text{ or } 60\right)$ Correct method for the area of either triangle. Ignore any reference to which triangle they are finding the area of.	M1
	Area of sector = $\frac{1}{2} \times r^2 \times \frac{\pi}{3}$ Use of the sector formula $\frac{1}{2}r^2\theta$ with $\theta = \frac{\pi}{3}$ which may be embedded within a segment	M1
	Area R = Sector + 2 Segments = $\frac{1}{2}r^2 \times \frac{\pi}{3} + 2 \times \left(\frac{1}{2}r^2 \times \frac{\pi}{3} - \frac{1}{2}r^2 \times \frac{\sqrt{3}}{2}\right)$ Area R = Triangle + 3 Segments = $\frac{1}{2}r^2 \times \frac{\sqrt{3}}{2} + 3 \times \left(\frac{1}{2}r^2 \times \frac{\pi}{3} - \frac{1}{2}r^2 \times \frac{\sqrt{3}}{2}\right)$ Area R = 3 Sectors - 2 Triangles = $3 \times \frac{1}{2}r^2 \times \frac{\pi}{3} - 2 \times \left(\frac{1}{2}r^2 \times \frac{\sqrt{3}}{2}\right)$ Area R = Big triangle - 3 White bits = $\frac{1}{2} \times (2r)^2 \frac{\sqrt{3}}{2} - 3 \times \left(\frac{1}{2}r^2 \times \frac{\sqrt{3}}{2} - \left(\frac{1}{2}r^2 \times \frac{\pi}{3} - \frac{1}{2}r^2 \times \frac{\sqrt{3}}{2}\right)\right)$ M1: A fully correct method (may be implied by a final answer of awrt $0.705r^2$) A1: Correct exact expression - for this to be scored $\sin \frac{\pi}{3} = \frac{\sqrt{3}}{2}$ must be seen	M1A1
	$=\frac{1}{2}\pi r^2 - \frac{\sqrt{3}}{2}r^2 = r^2 \left(\frac{1}{2}\pi - \frac{\sqrt{3}}{2}\right)$ Cso (Allow $\frac{r^2}{2}(\pi - \sqrt{3})$ or any exac equivalent with r^2 taken out as a common factor)	A1
		(5 marks)