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Surname	Other	names
Pearson Edexcel nternational Advanced Level	Centre Number	Candidate Number
Core Math	nematio	cs C12
Advanced Subsidia	ry	
Advanced Subsidia	ry	Paper Poferonce
Advanced Subsidia Tuesday 9 January 2018 – I Time: 2 hours 30 minutes	ry Morning	Paper Reference WMA01/01

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- The total mark for this paper is 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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Past Paper WMA01 Leave blank 1. Given that $y = \frac{2x^{\frac{2}{3}} + 3}{6}, \quad x > 0$ find, in the simplest form, (a) $\frac{\mathrm{d}y}{\mathrm{d}x}$ (2) (b) $\int y \, \mathrm{d}x$ (3) 2

Question Number	Scheme	Notes	Marks
1	$y = \frac{2x^{\frac{2}{3}} + 3}{6}$		
(a)	$x^{\frac{2}{3}} \rightarrow x^{-\frac{1}{3}}$	For reducing the power of $x^{\frac{2}{3}}$ by 1 which may be implied by e.g. $x^{\frac{2}{3}} \rightarrow x^{\frac{2}{3}-1}$ and no other powers of x	M1
	Note that some candidates think	$x \frac{2x^{\frac{2}{3}} + 3}{6} = 2x^{\frac{2}{3}} + 3 + 6$ but the M mark can still	
	SC	core for $x^{\overline{3}} \rightarrow x^{\overline{3}}$	
	$\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right) = \frac{2}{9}x^{-\frac{1}{3}}$	Correct expression. Allow equivalent exact, simplified forms e.g. $\frac{2x^{-\frac{1}{3}}}{9}, \frac{2}{9x^{\frac{1}{3}}}, \frac{2}{9\sqrt[3]{x}}$. Allow	A1
		0.222 or 0.2 with a dot over the 2 for $\frac{2}{9}$.	
	Ignore what they use to indicate differentiation and ignore subsequent working following a fully correct answer.		
			(2)
(b)	Must be integrating the given function in (b), not their answer to part (a)		
	$x^{\frac{2}{3}} \rightarrow x^{\frac{5}{3}}$ or $k \rightarrow kx$	increases the power by 1 for one term from $x^{\frac{2}{3}} \rightarrow x^{\frac{5}{3}}$ or $k \rightarrow kx$. May be implied by e.g. $x^{\frac{2}{3}} \rightarrow x^{\frac{2}{3}+1}$. This must come from correct work, so integrating numerator and denominator e.g. $\frac{2x^{\frac{2}{3}}+3}{6} \rightarrow \frac{x^{\frac{5}{3}}+x}{6x}$ is M0	M1
	Note that some candidates think	$x \frac{2x^{\frac{2}{3}} + 3}{6} = 2x^{\frac{2}{3}} + 3 + 6$ but the M mark can still	
	score f	or $x^3 \rightarrow x^3$ or $k \rightarrow kx$	
	$\frac{3}{5} \times \frac{2}{6} x^{\frac{5}{3}}$ or $\frac{3}{6} x$	One correct term which may be un-simplified, including the power. So, $\frac{2}{6} \times \frac{x^{1+\frac{2}{3}}}{1+\frac{2}{3}}$ would be	A1
	$\frac{1}{5}x^{\frac{5}{3}} + \frac{1}{2}x + c$	All correct and simplified including + c all appearing on one line. (c/6 is acceptable for c) Allow $\sqrt[3]{x^5}$ for $x^{\frac{5}{3}}$ but not x^1 for x. Allow 0.2 for $\frac{1}{5}$ and 0.5 for $\frac{1}{2}$	A1
	Ignore any spurious integral signs	and/or dx's and ignore subsequent working following	
	a1	fully correct answer.	(2)
			(3) Total 5
			1 otal 5

Mathematics C12



Question Number	Scheme	Notes	Marks
2	Mark (a) and (b) together		
(a)	$u_2 = -1, u_3 = 5$	As (a) and (b) are marked together, these can score as part of their calculation in (b) if -1 and 5 are clearly the second and third terms.	B1, B1
			(2)
(b)	$u_4 = 2 - 3 \times "5" (= -13)$	Correct attempt at the 4 th term (can score anywhere) and may be implied by their calculation below)	M1
	$\sum_{r=1}^{4} (r - u_r) = \pm \{ (1 - 1) + (2 - " - 1") + (2 - " - 1") \} $	-(3-"5")+(4-"-13")}	
	or		dM1
	$\sum_{r=1}^{4} (r - u_r) = \sum_{r=1}^{4} r - \sum_{r=1}^{4} u_r = \pm \left\{ (1 + 2 + 3 + 2) \right\}$	-4)-(1+"-1"+"5"+"-13")}	
	A correct method for the sum or (– sum). Allo	w minor slips or mis-reads of their	
values but the intention must be clear. Dependent on the first method		ndent on the first method mark.	
	=18	cso	A1
			(3)
			Total 5

Question Number	Scheme	Notes	Marks
3(a)	$\left(3x^{\frac{1}{2}}\right)^4 = 81x^2$	B1: Obtains ax^n , $(a, n \neq 0)$ where $a = 81$ or $n = 2$ B1: $81x^2$	B1B1
	Do not isw so for example $\left(3x^{\frac{1}{2}}\right)$	$\left(\frac{1}{2}\right)^4 = 81x^2 = 9x$ scores B0B0	
			(2)
(b)	$\frac{2y^7 \times (4y)^{-2}}{3y} = \frac{y^4}{24}$	B1: Obtains ay^n , $(a, n \neq 0)$ where $a = \frac{1}{24}$ or $n = 4$ (Allow 0.41666 or 0.416 with a dot over the 6 for $\frac{1}{24}$) B1: $\frac{y^4}{24}$ (Allow $\frac{1y^4}{24}$)	B1B1
	Do not isw – mark t	heir final answer	
			(2)
			Total 4

Mathematics C12

Past Paper WMA01 Leave blank **3.** Simplify fully (a) $\left(3x^{\frac{1}{2}}\right)^2$ (2) (b) $\frac{2y^7 \times (4y)^{-2}}{3y}$ (2) 6 P 5 0 7 1 3 A 0 6 5 2

Question Number	Scheme	Notes	Marks
2	Mark (a) and (b) together		
(a)	$u_2 = -1, u_3 = 5$	As (a) and (b) are marked together, these can score as part of their calculation in (b) if -1 and 5 are clearly the second and third terms.	B1, B1
			(2)
(b)	$u_4 = 2 - 3 \times "5" (= -13)$	Correct attempt at the 4 th term (can score anywhere) and may be implied by their calculation below)	M1
	$\sum_{r=1}^{4} (r - u_r) = \pm \{ (1 - 1) + (2 - " - 1") + (2 - " - 1") \} $	-(3-"5")+(4-"-13")}	
	or		dM1
	$\sum_{r=1}^{4} (r - u_r) = \sum_{r=1}^{4} r - \sum_{r=1}^{4} u_r = \pm \left\{ (1 + 2 + 3 + 2) \right\}$	-4)-(1+"-1"+"5"+"-13")}	
	A correct method for the sum or (– sum). Allo	w minor slips or mis-reads of their	
values but the intention must be clear. Dependent on the first method		ndent on the first method mark.	
	=18	cso	A1
			(3)
			Total 5

Question Number	Scheme	Notes	Marks
3(a)	$\left(3x^{\frac{1}{2}}\right)^4 = 81x^2$	B1: Obtains ax^n , $(a, n \neq 0)$ where $a = 81$ or $n = 2$ B1: $81x^2$	B1B1
	Do not isw so for example $\left(3x^{\frac{1}{2}}\right)$	$\left(\frac{1}{2}\right)^4 = 81x^2 = 9x$ scores B0B0	
			(2)
(b)	$\frac{2y^7 \times (4y)^{-2}}{3y} = \frac{y^4}{24}$	B1: Obtains ay^n , $(a, n \neq 0)$ where $a = \frac{1}{24}$ or $n = 4$ (Allow 0.41666 or 0.416 with a dot over the 6 for $\frac{1}{24}$) B1: $\frac{y^4}{24}$ (Allow $\frac{1y^4}{24}$)	B1B1
	Do not isw – mark t	heir final answer	
			(2)
			Total 4

aper	This resource was created and owned by Pearson Edexcel	W
The equation		L b
The equation		
	$(p-2)x^2 + 8x + (p+4) = 0$, where p is a constant	
has no real root	ts.	
(a) Show that μ	p satisfies $p^2 + 2p - 24 > 0$	
		(3)
(b) Hence find	the set of possible values of <i>p</i> .	(4)

Winter 2018 Past Paper (Mark Scheme)

Question Number	Scheme	Notes	Marks
4(a)	$b^2 - 4ac = 8^2 - 4(p - 2)(p + 4)$	Attempts to use $b^2 - 4ac$ with at least two of a , b or c correct. This could be as part of the quadratic formula or as $b^2 < 4ac$ or as $b^2 > 4ac$ or as $b^2 = 4ac$ or as $\sqrt{b^2 - 4ac}$ etc. If it is part of the quadratic formula only look for use of $b^2 - 4ac$. There must be no x's	M1
	$8^2 - 4(p-2)(p+4) < 0$	For a correct un-simplified inequality in any form that is not the final printed answer or a positive constant multiple of the final printed answer with no incorrect previous statements.	A1
	$64 < 4p^2 + 8p - 32$		
	$p^2 + 2p - 24 > 0*$	Correct solution with intermediate working and no errors with the inequality sign appearing correctly before the final printed answer.	A1*
			(3)
(b)	$p^{2} + 2p - 24 = 0 \Rightarrow p = \dots$ $(p+1)^{2} - 1 - 24 = 0 \Rightarrow p = \dots$ $(p=) \frac{-2 \pm \sqrt{2^{2} - 4 \times 1 \times (-24)}}{2 \times 1}$	For an attempt to solve $p^2 + 2p - 24 = 0$ (not their quadratic) leading to two critical values. See general guidance for solving a 3TQ when awarding this method mark. May be implied by their critical values.	M1
	<i>p</i> = 4, –6	Correct critical values	A1
	<i>p</i> < "-6", <i>p</i> > "4"	Chooses the outside region for their two critical values. Look for $p <$ their -6, p > their 4. This could be scored from 4 or $-6 > p > 4$. Evidence is to be taken from their answers not from a diagram. Allow e.g. $p \le "-6"$, $p \ge "4"$	M1
	$p < -6 \text{or} p > 4$ $p < -6 p > 4$ $p < -6, p > 4$ $p < -6; p > 4$ $p < -6; p > 4$ $(-\infty, -6), (4, \infty)$ $]-\infty, -6[,]4, \infty[$	Correct inequalities e.g. answers as shown. Note that $p < -6$ and $p > 4$ would score M1A0 as would $4 or -6 > p > 4or p < -6 \cap p > 4. Apply isw wherepossible.$	A1
	Allow letter other than <i>p</i> to be used in in term	(b) but the final A mark requires answers as of <i>n</i> only.	
	Correct answer only	v scores full marks in (b)	
			(4) Total 7

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F	(In this quantizer a children have dentirely an analyzed and in the		Leav blan
5.	(In this question, solutions based entirely on graphical or numerical methods are not acceptable.)		
	(i) Solve, for $0 < \theta < \frac{\pi}{2}$		
	$5\sin 3\theta - 7\cos 3\theta = 0$		
	Give each solution, in radians, to 3 significant figures.	(5)	
	(ii) Solve, for $0 < x < 360^{\circ}$		
	$9\cos^2 x + 5\cos x = 3\sin^2 x$		
	Give each solution, in degrees, to one decimal place.	(6)	
		(0)	
10			

Question Number	Scheme	Notes	Marks
5(i)	7	M1: Reaches $\tan \dots = k$ where $k \neq 0$	
	$5\sin 3\theta - 7\cos 3\theta = 0 \Longrightarrow \tan 3\theta = \frac{1}{5}$	A1: $\tan = \frac{7}{5}$	M1A1
	$3\theta = 0.950$)54	dM1
	$3\theta = \tan^{-1}\left(\operatorname{their} \frac{7}{5}\right)$ leading to a value of 3θ . Must be 3θ here but this may be implied if they divide their values by 3 (you may need to check). Dependent on the		
		Awrt 0.317 (Allow awrt 0.101 π) or	
	$\theta = 0.317$ or $\theta = 1.36$	Awrt 1.36 (Allow awrt 0.434π)	Al
	$\theta = 0.317 \mathrm{and} \theta = 1.36 \mathrm{only}$	Awrt 0.317 (Allow awrt 0.101π) or Awrt 1.36 (Allow awrt 0.434π)	A1
	Alternative 1	for (i):	
		M1: Correct method using addition	
	$5\sin 3\theta - 7\cos 3\theta = \sqrt{74}\sin(3\theta - 0.9505)$	formula	M1A1
		A1: $\sqrt{74}\sin(3\theta - 0.9505)$	
	$3\theta - 0.9505 = 0 \pi$	3θ – their $\alpha = \sin^{-1}(0)$. Dependent on	dM1
		the first method mark.	GIVII
	$\theta = 0.317$ or $\theta = 1.36$	Awrt 0.317 (Allow awrt 0.101π) or Awrt 1.36 (Allow awrt 0.424π)	A1
		Awrt 0.317 (Allow awrt 0.434π)	
	$\theta = 0.317$ and $\theta = 1.36$ only	Awrt 1.36 (Allow awrt 0.434π)	Al
	Special case: If both answers are given in degrees allow A1A0 but needs to be awrt 18 2 and awrt 78 2)		
Alternative 2 for (i)			
	$\frac{1}{5\sin 3\theta - 7\cos 3\theta} \rightarrow 25\sin^2 = -49\cos^2$		
	or		
	$5\sin 3\theta - 7\cos 3\theta = 0 \Longrightarrow 25\sin^2 \dots - 49\cos^2 \dots = 0$		M1
	M1: Obtains $p \sin^2 = q \cos^2$ or $p \sin^2 q \cos^2 = 0$ $p, q > 0$		
	$\sin = (\pm) \frac{1}{\sqrt{74}}$ or $\cos = (\pm) \frac{1}{\sqrt{74}}$	Correct value for sin or cos	A1
	$\pm(awrt0.8)$ $\pm(awrt0.6)$		
	$3\theta = 0.950$)54	dM1
	$3\theta = \sin^{-1}\left(\text{their}\frac{7}{\sqrt{74}}\right)$ or $3\theta = \cos^{-1}\left(\text{their}\frac{5}{\sqrt{74}}\right)$ leading to a value of 3θ .		
	N/4/ Dependent on t	N/+/ he first M	
Awrt 0.317 (Allow aw		Awrt 0.317 (Allow awrt 0.101 π) or	A 1
	$\theta = 0.31$ / or $\theta = 1.36$	Awrt 1.36 (Allow awrt 0.434π)	AI
	$\theta = 0.317 \text{ and } \theta = 1.36 \text{ only}$	Awrt 0.317 (Allow awrt 0.101π) or Awrt 1.36 (Allow awrt 0.434π)	A1
	Special case: If both answers are given in degrees allow A1A0 but needs to be awrt		
	18.2 and awrt 78.2). If they give answers in d	legrees and radians, the radians answers	
	take precedence. For an otherwise fully correct solution, the final mark can be withheld for extra answers in range. Ignore extra answers outside the range		
	Answers <u>only</u> scor	es no marks.	
			(5)

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5(ii)	$9\cos^2 x + 5\cos x$	$x = 3\sin^2 x$	
	$9\cos^2 x + 5\cos x = 3(1-\cos^2 x)$	Uses $\sin^2 x = \pm 1 \pm \cos^2 x$	M1
	$12\cos^2 x + 5\cos x - 3 = 0$	Correct 3 term quadratic equation. Allow equivalent equations with terms collected e.g. $12\cos^2 x + 5\cos x = 3$	A1
	$(3\cos x - 1)(4\cos x + 3) = 0$ $\Rightarrow (\cos x) = \dots$	Solves their 3TQ in cos <i>x</i> to obtain at least one value. See general guidance for solving a 3TQ when awarding this method mark. Dependent on the first method mark.	dM1
	$\cos x = \frac{1}{3}, -\frac{3}{4}$	Correct values for cos <i>x</i>	A1
	x = 70.5, 289.5, 138.6, 221.4	A1: Any 2 correct solutions (awrt) A1: All 4 answers (awrt)	A1A1
	Special case: If all answers are given in radians allow A1A0 but needs to be awrt 1.2,		
	5.1, 2.4,	3.9	
	For an otherwise fully correct solution, the	e linal mark can be witnneid for extra	
	Answers only scores no marks.		
			(6)
			Total 11

(5)

(4)

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6.

 $f(x) = ax^3 - 8x^2 + bx + 6$

where *a* and *b* are constants.

When f(x) is divided by (x + 1) there is no remainder.

When f(x) is divided by (x - 2) the remainder is -12

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

(b) Factorise f(x) completely.

P 5 0 7 1 3 A 0 1 4 5 2

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Question Number	Scheme	Notes	Marks
6(a)	$f(\pm 1) =$ or $f(\pm 2) =$	Attempts $f(\pm 1)$ or $f(\pm 2)$	M1
	$a(-1)^{3}-8(-1)^{2}+b(-1)+6=0$	Allow un-simplified but do not condone missing brackets unless later work implies a correct expression.	A1
	$a(2)^{3}-8(2)^{2}+b(2)+6=-12$	Allow un-simplified	A1
	a+b=-2, 4a+b=7 $\Rightarrow a=3, b=-5$	M1: Solves two linear equations in <i>a</i> and <i>b</i> simultaneously to obtain values for <i>a</i> and <i>b</i> . A1: Correct values	M1A1
	Alternative by le	ong division:	
	$(ax^3 - 8x^2 + bx + 6) \div (x + 1)$) \rightarrow remainder $f(a,b)$	
	or) 5(7)	
	$\left(ax^3 - 8x^2 + bx + 6\right) \div \left(x - 2x^2\right)$	2) \rightarrow remainder $g(a,b)$	M1
	Attempts long division by either expression	to obtain a remainder in terms of a and b	
	-a-b-2=0	Allow un-simplified but do not condone missing brackets unless later work implies a correct expression.	A1
	8a + 2b - 26 = -12	Allow un-simplified	A1
	a+b=-2, 4a+b=7	M1: Solves simultaneously	
	$\Rightarrow a = 3, b = -5$	A1: Correct values	MIAI
			(5)
(b)	$(x+1)(ax^2+kx+)$	Uses $(x + 1)$ as a factor and obtains at least the first 2 terms of a quadratic with an ax^2 term and an x term. This might be by inspection or by long division.	M1
	$(x+1)(3x^2-11x+6)$	Correct quadratic factor	A1
	$3x^2 - 11x + 6 = (3x - 2)(x - 3)$	Attempt to factorise their 3 term quadratic according to the general guidance, even if there was a remainder and $(x + 1)$ must have been used as a factor.	M1
	Note that $3x^2 - 11x + 6 = (x - 1)x + (x - 1)x +$	$\left(\frac{2}{3}\right)(x-3)$ scores M0 here	
	but $3x^2 - 11x + 6 = 3(x - \frac{2}{3})$	(x-3) is fine for M1	
	(f(x) =)(x+1)(3x-2)(x-3) or $(f(x) =)3(x+1)(x-\frac{2}{3})(x-3)$	Fully correct factorisation. The factors need to appear together all on one line and no commas in between.	A1
	Answers with no v	working in (b):	
	$f(x) = 3x^3 - 8x^2 - 5x + 6 = (x+1)(x+1)(x+1)(x+1) + 6 = (x+1)(x+1)(x+1) + 6 = (x+1)(x+1)(x+1)(x+1) + 6 = (x+1)(x+1)(x+1)(x+1)(x+1)(x+1)(x+1)(x+1)$	3x-2(x-3) scores full marks	
	$f(x) = 3x^3 - 8x^2 - 5x + 6 = (x+1)(x-\frac{2}{3})(x-\frac{2}$	(-3) scores a special case M1A1M0A0	
	Just writing down roots of th	ne cubic scores no marks.	
	Ignore any "= 0" and also ignore any subsection factorised for	quent attempts to solve $f(x) = 0$ once the m is seen.	
			(4)
			Total 9

Mathematics C12



Question Number	Scheme	Note	S	Mar	ks
7(a)	(V=)x(25-2x)(15-2x)	Correct method for the ve be a correct statement for	olume. It must r the volume.	M1	
	$(V) = x(375 - 80x + 4x^2)$	$=4x^3-80x^2+375x^*$		A1*	
	Allow the terms of $4x^3 - 80$.	$x^{2} + 375x$ to be in any order	er.		
	Completes correctly to printed answer w	h no errors including bra	cketing errors		
	E.g. $V = 25x - 2x^2(15 - 2x) = 4$	$x^{3} - 80x^{2} + 375x$ scores M	.1A0		
	$V = 0^{\circ} \text{ or e.g. } V \text{olume} = 0^{\circ}$	nust appear at some point	[. C 1:)		
	$V = x(25 - 2x)(15 - 2x) = 4x^{2} - 80x^{2} + 10x^{2}$	3/5x scores M1AU (lack)	of working)		
	$V = x(25-2x)(15-2x) = (25x-2x^2)(15-2x) = (25x-2x)(15-2x) = (25x-2x)(15-2x)(15-2x) = (25x-2x)(15-2x) = (25$	$(-2x) = 4x^3 - 80x^2 + 375x$	c scores M1A1		
	Mark (b) (c) and (d) together so that a	tinued were with $u=2$	02 in (a) and		(2)
	(d) can be taken as evidence that the c	numbed work with $x = 3$ ndidate has chosen this	\mathbf{v} value in (b).		
	dv = dV	$d^2 v \qquad d^2 V$	varue in (b).		
	Allow e.g. $\frac{dy}{dx}$ for $\frac{dy}{dx}$	and/or $\frac{d^2 y}{dx^2}$ for $\frac{d^2 y}{dx^2}$			
(b)	$\left(\frac{\mathrm{d}V}{\mathrm{d}x}\right) = 12x^2 - 160x + 375$	M1: $x^n \rightarrow x^{n-1}$ seen a A1: Correct derivativ	it least once	M1A1	
	(u)				
	$4V_{-160} + \sqrt{7600}$	Puts $\frac{dx}{dx} = 0$ (may be	implied) and		
	$\frac{dV}{dt} = 0 \Longrightarrow x = \frac{160 \pm \sqrt{7600}}{24}$	attempts to solve a 3	term quadratic	M 1	
	d <i>x</i> 24	to find x. May be imp	plied by correct		
	$r = 3.03 \cdot 10.3$	Values.	only as the		
	but $0 < x < 7.5$ so $x = 3.03$	required value.	my as the	A1	
					(4)
(c)		Attempts the second deri	vative		
	$\left(\frac{\mathrm{d}^2 V}{2}\right) = 24x - 160 = 24(3.03) - 160$ $\left(x^n \rightarrow x^{n-1}\right)$ and substitutes at least on		tes at least one	M1	
	$\left(dx^2 \right)^{-111}$	positive value of <i>x</i> from	their $\frac{\mathrm{d}V}{\mathrm{d}x} = 0$		
	$\frac{d^2V}{d^2V} = 24(3.03) = 160 \implies \frac{d^2V}{d^2V} \le 0$: maximum				
	$\frac{1}{dx^2} = 24(3.03) - 160 \implies \frac{1}{dx^2} < 0^{\circ} \text{ maximum}$				
	Fully correct proof for the maximum using a correct second derivative and using $x = ayrt 2$ only. There must be a substitution and there must be a reference to the sign			Δ1	
	x = awrt 3 only. There must be a substitution and there must be a reference to the sign of the second derivative. A value for the second derivative is not needed and if the				
	evaluation is incorrect, provided all the o	her conditions are met, th	is mark can be		
	awarded. Accept statements such a	"negative so x is the max	ximum"		
	Allow alternatives e.g. considers values of V at, and either side of "3.03" or values of dV/dr either side of "3.03"				
	values of avia el				(2)
(d)		Substitutes a (positiv	ve) x from their		
	$V = 4(3.03)^3 - 80(3.03)^2 + 375(3.03)$	$\frac{\mathrm{d}V}{\mathrm{d}t} = 0$ into t	he given V or a	M1	
		dx	6 ·····		
	V - 512	$\frac{\text{Version} \text{ of } V.}{\text{A wrt 512}}$		Λ1	
	V = 515	AWILJIJ Ronhu goorog MILA 1		лі	
	$\frac{1}{1}$ Note that $v = a wrt 5$.				(2)
				Tota	10

Past Paper

8.

Mathematics C12

(3)

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Figure 3

Figure 3 shows a sketch of the curve with equation $y = f(x), x \in \mathbb{R}$.

The curve crosses the *y*-axis at the point (0, 5) and crosses the *x*-axis at the point (6, 0).

The curve has a minimum point at (1, 3) and a maximum point at (4, 7).

On separate diagrams, sketch the curve with equation

(a)
$$y = f(-x)$$
 (3)

(b) y = f(2x)

On each diagram, show clearly the coordinates of any points of intersection of the curve with the two coordinate axes and the coordinates of the stationary points.



Question Number	Scheme	Notes	Marks	
8(a)	(-4, 7)	5		
	Reflection in the y-axis. Needs to be a positive minimum in the second quadrant. The cur	/e cubic with one maximum and one rve must at least reach both axes.	B1	
	It should be a curve and not a set of straight lines. Passes through (-6, 0) and (0, 5). Allow - 6 and 5 to be marked in the correct place and allow (0, -6) and (5, 0) as long as they are in the correct places. There must be sketch but this mark can be awarded if the correct coordinates are given in the body the script provided they correspond with the sketch. Ignore any other intercepts. If there is any ambiguity, the sketch takes precedence but if the correct coordinates are seen in the script, allow sign errors when transferring them to			
	 Maximum at (-4, 7) and minimum at (-1, 3) in the second quadrant. Must be seen as correct coordinate pairs or as numbers marked on the axes that clearly indicate the position of the maximum or minimum. There must be a sketch but this mark can be awarded if the correct coordinates are given in the body of the script provided they correspond with the sketch. Ignore any other turning points. If there is any ambiguity, the sketch takes precedence but if the correct coordinates are seen in the script, allow sign errors when transferring them to the sketch 			
			(3)	
(b)	5 (0.5,	(2, 7) 3) 3)		
	A stretch in the <i>x</i> direction. Need to see $(x, y) \rightarrow (k, must be no evidence of a changThe curve must at least reach both axes. It should$	(x, y) where $k \neq 1$ for all points seen. There e in ant y coordinates. be a curve and not a set of straight lines.	B1	
	Passes through (3, 0) and (0, 5). Allow 3 and 5 to 1 (0, 3) and (5, 0) as long as they are in the correct pla can be awarded if the correct coordinates are give correspond with the sketch. Igno If there is any ambiguity, the sk	be marked in the correct places and allow aces. There must be a sketch but this mark n in the body of the script provided they ore any other intercepts. Eacth takes precedence.	B1	
	Minimum at $\left(\frac{1}{2}, 3\right)$ and maximum at (2, 7). in the coordinate pairs or as numbers marked on the axe maximum or minimum. There must be a sketch bu coordinates are given in the body of the script pro- Ignore any other turn	he first quadrant. Must be seen as correct as that clearly indicate the position of the at this mark can be awarded if the correct ovided they correspond with the sketch. hing points.	B1	
	II there is any ambiguity, the sk	leich takes precedence.	(3)	
			Total 6	

st Pape	er This resource was created and owned by Pearson Edexcel		WMA01
			Leave
0	The first term of a geometric series is 20 and the common ratio is 0.9		blank
).	The first term of a geometric series is 20 and the common ratio is 0.7		
	(a) Find the value of the fifth term.		
		(2)	
	(b) Find the sum of the first 8 terms, giving your answer to one decimal place.		
		(2)	
	Given that $S_{\infty} - S_N < 0.04$, where S_N is the sum of the first N terms of this series,		
	(c) show that $0.9^N < 0.0002$		
	(c) show that $0.7 < 0.0002$	(4)	
		()	
	(d) Hence find the smallest possible value of <i>N</i> .		
		(2)	
26			

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Question Number	Scheme	Notes	Marks
9(a)	$t_5 = ar^{n-1} = 20 \times 0.9^{5-1} = 13.122$	M1: Use of a correct formula with a = 20, r = 0.9 and $n = 5$. Can be implied by a correct answer. A1: 13.122 or $\frac{6561}{500}$. Apply isw but just 13.1 is A0.	M1A1
	MR: Some are misreading fifth as the tensor $t_{15} = ar^{n-1} = 20 \times 0.9^{15-1} = 4.57$ or t_{15} Allow M1A0 in the Listing: Need to see a fully correct at e.g. 20, 18, 16.2, 14.58, 13.122 Must reach and not bee see	fifteenth or fiftieth and find = $ar^{n-1} = 20 \times 0.9^{50-1} = 0.114$ hese cases. attempt to find the fifth term wrt 13 and intermediate decimals may en)	
	Just 13.122 with no working	g scores both marks	
(b)	$S_8 = \frac{a(1-r^n)}{1-r} = \frac{20(1-0.9^8)}{1-0.9} = 113.9$	M1: Use of a correct formula with a = 20, r = 0.9 and $n = 8A1: 113.9 only$	(2) M1A1
	Listing: Need to see a ful e.g. 20 + 18 + 16.2 + 14.58 ++ 9.565938 =	ly correct method = 113.9 (May be implied by awrt 114)	
			(2)
(c)	$S_{\infty} = \frac{20}{1 - 0.9} (= 200)$	Correct S_{∞} which can be simplified or un-simplified.	B1
	$200 - \frac{20(1 - 0.9^{N})}{1 - 0.9} < 0.04$	M1: Attempts $S_{\infty} - S_N < 0.04$ (allow <i>n</i> for <i>N</i>) using $a = 20$ and $r = 0.9$ A1: Correct inequality in any form in terms of <i>N</i> or <i>n</i> only.	M1A1
	Note that $\frac{20}{1-0.9} - \frac{20(1-0.9^N)}{1-0.9}$	< 0.04 scores B1M1A1	
	0.9 ^N < 0.0002*	Reaches the printed answer with intermediate working and with <u>no</u> <u>errors or incorrect statements</u>	A1*
		M1. Compatient to find N	(4)
(a)	$(N >) \frac{\log 0.0002}{\log 0.9} \Longrightarrow N = 81$	ignoring what they use for ">" i.e. they could be using < or =. Look for $(N =) \frac{\log 0.0002}{\log 0.9}$ or $(N =) \log_{0.9} 0.0002$ May be implied by awrt 81 A1: 81 only. Accept 81 only or N/n = 81 but not $N/n > 81$	M1A1
	81 <u>only</u> with no working s	scores both marks	
	<u> </u>		(2)
			Total 10



Question	Scheme	Notes	Marks
Number			14101165
10(i)	Examples: $3\log_8 2 = \log_8 2^3$, $3\log_8 2 = \log_8 8$ $3\log_8 2 = 1$, $\log_8 2 = \frac{1}{3}$, $2 = \log_8 64$	Demonstrates a law or property of logs on either of the constant terms.	B1
	Examples: $\log_{8}(7-x) - \log_{8} x = \log_{8} \frac{(7-x)}{x}$ $\log_{8} 64 + \log_{8} x = \log_{8} 64x$ $\log_{8} 8 + \log_{8} (7-x) = \log_{8} 8(7-x)$	Demonstrates the addition or subtraction law of logs on two terms, at least one of which is in terms of x .	B1
	For the B marks above, look for work possible. If there is some correct as penalise for the i	as described and award the marks where nd some incorrect work, do not look to incorrect statements.	
	$\log_8 8(7-x) = \log_8 64x, \log_8 \frac{(7-x)}{x} = 1, \log_8 \frac{(7-x)}{8x} = 0, \log_8 \frac{8(7-x)}{x} = 2$ Correct processing leading to one of these equations or the equivalent.		M1
	$8(7-x) = 64x, \frac{(7-x)}{x} = 8, \frac{7-x}{8x} = 1, \frac{8(7-x)}{x} = 64$		A1
	$x = \frac{7}{9}$	Accept equivalents but must be exact e.g. $\frac{56}{72}$ or 0.777 or 0.7 with a dot over the 7	A1
(::)	2 ² V	2**1 10	(5)
(II)	$3^{y} \times 3^{y} + 3 \times 3^{y} = 10 \text{ or } 3^{y} (3^{y} + 3) = 10 \text{ or}$ A correct qua	$\frac{-3^{y+1} = 10}{\left(3^{y}\right)^{2} + 3 \times 3^{y} = 10 \text{ or } x = 3^{y} \Longrightarrow x^{2} + 3x = 10}$ advatic in x (or 3 ^y)	B1
	$x^2 + 3x - 10 = 0 \Longrightarrow x = \dots$	Correct attempt to solve a quadratic equation of the form $ax^2 + bx \pm 10 = 0$ (may be a letter other than x or may be 3^y etc.)	M1
	x=2 or x=2 and -5	Correct values.	A1
	$3^y = 2 \Longrightarrow y = \log_3 2 \text{ or } \frac{\log 2}{\log 3}$	Correct use of logs. Need to see $3^{y} = k \Rightarrow y = \log_{3} k \text{ or } \frac{\log k}{\log 3}, k > 0 \text{ which}$ may be implied by awrt 0.63. Allow lg and ln for log.	dM1
	$y = \log_3 2 \text{ or } y = \frac{\log 2}{\log 3}$	Cao (And no incorrect work using " -5 "). Give BOD but penalise very sloppy notation e.g. log3(2) for log ₃ 2 if necessary.	A1
			(5) Total 10
			1 otal 10

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(ii)	$3^{2y} + 3^{y}$	+1 = 10	
Way 2	$3^{2y} + 3^{y+1} = (3^2)^y + 3(9)^{0.5y}$ $\Rightarrow 9^y + 3(9)^{0.5y} = 10$	Correct quadratic in 9 ^{0.5y}	B1
	$x^2 + 3x - 10 = 0 \Longrightarrow x = 2(\text{or} - 5)$	M1: Correct attempt to solve a quadratic equation of the form $ax^2 + bx - 10 = 0$ (may be a letter other than x or may be $9^{0.5y}$ etc.) A1: Correct solution(s)	M1A1
	$9^{0.5y} = 2 \Longrightarrow 0.5y = \log_9 2 \text{ or } \frac{\log 2}{\log 9}$	Correct use of logs. Need to see $9^{0.5y} = k \Longrightarrow 0.5y = \log_9 k \text{ or } \frac{\log k}{\log 9}, k > 0$	dM1
	$y = 2\log_9 2 \text{ or } y = \frac{2\log 2}{\log 9}$	Cao (And no incorrect work using " -5 ")	A1
			(5)

This resource was created and owned by Pearson Edexcel Past Paper WMA01 Leave blank **11.** The circle *C* has equation $x^2 + y^2 - 8x - 10y + 16 = 0$ The centre of C is at the point T. (a) Find (i) the coordinates of the point T, (ii) the radius of the circle C. (4) The point M has coordinates (20, 12). (b) Find the exact length of the line MT. (2) Point P lies on the circle C such that the tangent at P passes through the point M. (c) Find the exact area of triangle MTP, giving your answer as a simplified surd. (3) 34 P 5 0 7 1 3 A 0 3 4 5 2

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Question Number	Scheme	Notes	Marks	
	Mark (a)(i) and (ii) together			
11(a)(i)	$(x\pm 4)^2$ and $(y\pm 5)^2$			
	Attempts to complete the square on x and y or	sight of $(x\pm 4)^2$ and $(y\pm 5)^2$. May be		
	implied by a centre of $(\pm 4, \pm 5)$. Or if consideri	$x^{2} + y^{2} + 2gx + 2fy + c = 0$, centre is		
	$(\pm g, \pm f)$).		
	Centre is (4, 5)	Correct centre	A1	
	Correct answer score	es both marks		
(ii)	$r^{2} = (\pm "4")^{2} + (\pm "5")^{2} -$	-16 (Must be -16)	M1	
	Must read	eh:		
	$r^{2} = \text{their} (\pm 4)^{2} + \text{their} (\pm 5)^{2} - 16 \text{ or } r =$	$=\sqrt{\text{their}(\pm 4)^2 + \text{their}(\pm 5)^2 - 16}$		
	or if using $x^2 + y^2 + 2gx + 2fx + c = 0, r^2$	$=g^{2}+f^{2}-c$ or $r=\sqrt{g^{2}+f^{2}-c}$		
	Must clearly be identifying	the radius or radius ²		
	$\frac{\text{May be implied by a }}{r-5}$	correct radius.	Δ1	
	Correct answer score	es both marks		
			(4)	
(b)	$MT^{2} = (20 - "4")^{2} + (12 - "5")^{2} (= 305)$	Fully correct method using Pythagoras for <i>MT</i> or <i>MT</i> ²	M1	
	Other methods may be see	en for finding <i>MT</i> .		
	E.g. $\tan \theta = \frac{7}{16} \Longrightarrow \theta = 23.6,$	$MT = \frac{7}{\sin \theta} = 17.46$		
	Needs a fully correct r	nethod for <i>MT</i>		
	$MT = \sqrt{305}$	Must be exact	A1	
	Beware incorrect work leading	to a correct answer e.g.		
	$MT^{2} = \sqrt{(20-4)^{2} + \sqrt{(12-5)^{2}}} = \sqrt{256} + \sqrt{49} = \sqrt{305} \text{ scores M0}$			
			(2)	
(c)	$\left(MP^2\right) = MT^2 - "5"^2$	Correct method for MP or MP^2 where MT > "5"	M1	
	Area $MTP = \frac{1}{2} \times "5" \times "\sqrt{280}"$	Correct triangle area method	M1	
	5√70	cao	A1	
			(3)	
	Alternative fo	or (c):		
	$\cos PTM = \frac{"5"}{\sqrt{"305"}} \sin PMT = \frac{"5"}{\sqrt{"305"}}$	PMT (NB $PTM = 73.36, PMT = 16.63)$	M1	
	Area $MTP = \frac{1}{2} \times "5" \times "\sqrt{305}" \times \sqrt{\frac{56}{61}}$	Correct triangle area method. May not work with exact values but needs to be a fully correct method using their values.	M1	
	5√70	Cao. Note that $5\sqrt{70} = 41.83$ which might imply a correct method.	A1	
			Total 9	

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12. The line l_1 has equation $x + 3y - 11 = 0$	
The point A and the point B lie on l_1	
Given that A has coordinates $(-1, p)$ and B has coordinates $(q, 2)$, where p and q are integers,	
(a) find the value of p and the value of q ,	(2)
(b) find the length of AB , giving your answer as a simplified surd.	(2)
The line l_2 is perpendicular to l_1 and passes through the midpoint of AB.	
(c) Find an equation for l_2 giving your answer in the form $y = mx + c$, where <i>m</i> and <i>c</i> are constants to be found	
where <i>m</i> and <i>c</i> are constants to be round.	(5)
38	1

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Question Number	Scheme	Notes	Marks
12(a)	p = 4 or $q = 5$	One correct value. May be implied by e.g. when $x = -1$, $y = 4$ or when $y = 2$, $x = 5$	B1
	p = 4 and $q = 5$	Both correct values. May be implied by e.g. when $x = -1$, $y = 4$ and when $y = 2$, $x = 5$	B1
			(2)
(b)	$AB^{2} = ("4"-2)^{2} + (-1 - "5")^{2}$ or $AB = \sqrt{("4"-2)^{2} + (-1 - "5")^{2}}$	Correct Pythagoras method using $(-1, "4")$ and $("5", 2)$ to find <i>AB</i> or AB^2	M1
	$(AB) = 2\sqrt{10}$	$2\sqrt{10}$ only	A1
			(2)
(c)	$M = \left(\frac{-1 + 5, -4, -4, -2}{2}\right) = (2, 3)$	Correct midpoint method. May be implied by at least one correct coordinate if no working is shown.	M1
	Gradient of $l_1 = -\frac{1}{3}$	Correct gradient of l_1 . Allow equivalent exact expressions. May be implied by a correct perpendicular gradient.	B1
	Perpendicular gradient = 3	Correct perpendicular gradient rule. This can be awarded for a correct value or a correct method e.g. $m = \frac{-1}{-\frac{1}{3}}$ or $\frac{-1}{3} \times m = -1 \Longrightarrow m =$	M1
	y - "3" = "3"(x - "2") or $y = mx + x \Longrightarrow "3" = "3" \times "2" + c \Longrightarrow c =$	Correct straight line method using their midpoint and a "changed" gradient. If using $y = mx + c$, they must reach as far as a value for <i>c</i> .	M1
	y = 3x - 3	cao	A1
			(5)
	Alternative for last 4	marks of (c):	
	3x - y + c = 0	$ \begin{array}{c} B1: "3x - y"\\ M1: 3x - y + c = 0 \end{array} $	B1M1
	$3(2)-3+c=0 \Longrightarrow c=-3$	Correct method to find <i>c</i> using their values	M1
	y = 3x - 3	сао	A1
			Total 9

Mathematics C12





Question Number	Scheme	Notes	Marks
13(a)	$(APN =) 360^{\circ} - 314^{\circ} = 46^{\circ}$ $(APB =) 46^{\circ} + 52^{\circ} = 98^{\circ}$ or $(Reflex APB) = 314^{\circ} - 52^{\circ} = 262^{\circ}$ $(APB =) 360^{\circ} - 262^{\circ} = 98^{\circ}$ or Shows on a sketch the 314 and 46 And states $46^{\circ} + 52^{\circ} = 98^{\circ}$	Correct explanation that explains why APN is 46° (e.g. 360° – 314°) and adds that to 52° or shows/states that reflex APB = 262° and so APB = 360° - 262° = 98°. Do not be overly concerned how they use the letters to reference angles as long as the correct calculations are seen. Do not allow the use of $AB = 9.8$ from (b).	B1
			(1)
(b)	$(AB^2 =) 8.7^2 + 3.5^2 - 2 \times 8.7 \times 3.5 \cos 98^\circ$	Correct use of cosine rule. You can ignore the lhs for this mark so just look for $8.7^2 + 3.5^2 - 2 \times 8.7 \times 3.5 \cos 98^\circ$	M1
	$AB = 9.8 (\mathrm{km})$	Awrt 9.8 km (you can ignore their intermediate value for AB^2 provided awrt 9.8 is obtained for AB)	A1
			(2)
(c) Way 1	$\frac{"9.8"}{\sin 98^{\circ}} = \frac{3.5}{\sin PAB}$ or $3.5^{2} = 8.7^{2} + "9.8"^{2} - 2 \times 8.7 \times "9.8" \cos PAB$ $\implies PAB = \dots$	Correct sine or cosine rule method to obtain angle <i>PAB</i> . May be implied by awrt 21°	M1
	<i>PAB</i> = 20.66°	Allow awrt 21°. May be implied by a correct bearing.	A1
	Bearing is $180^{\circ} - 20.66^{\circ} - 46^{\circ}$	Fully correct method	M1
	$= 113^{\circ} \text{ or } 114^{\circ}$	Awrt 113° or awrt 114°	A1
(c) Way 2	$\frac{"9.8"}{\sin 98^{\circ}} = \frac{8.7}{\sin PBA}$ or $8.7^{2} = 3.5^{2} + "9.8"^{2} - 2 \times 3.5 \times "9.8" \cos PBA$ $\implies PBA =$	Correct sine or cosine rule method to obtain angle <i>PBA</i> . May be implied by awrt 61° or 62°	M1
	$PBA = 61.33^{\circ}$	Allow awrt 61° or awrt 62°. May be implied by a correct bearing.	A1
	Bearing is 52° + "61.33°"	Fully correct method	M1
	= 113° or 114°	Awrt 113° or awrt 114°	A1
			(4)
(c) Way 3	Let α = Bearing – 90°		
	$\tan \alpha = \frac{BC}{AC} = \frac{8.7 \cos 46^\circ - 3.5 \cos 52^\circ}{8.7 \sin 46^\circ + 3.5 \sin 52^\circ}$	Correct method for a	M1
	$\alpha = 23.33^{\circ}$	Allow awrt 23°. May be implied by a correct bearing.	A1
	Bearing is 90° + "23.33°"	Fully correct method	M1
	= 113° or 114°	Awrt 113° or awrt 114°	A1
			(4)
			Total 7

Diagram for Q13



14.

l

Past Paper

Mathematics C12





Figure 5 shows a sketch of part of the line *l* with equation y = 8 - x and part of the curve C with equation $y = 14 + 3x - 2x^2$

0

The line l and the curve C intersect at the point A and the point B as shown.

(a) Use algebra to find the coordinates of A and the coordinates of B.

The region R, shown shaded in Figure 5, is bounded by the coordinate axes, the line *l*, and the curve *C*.

(b) Use algebraic integration to calculate the exact area of *R*.



Question Number	Scheme	Notes	Marks
14	$y = 8 - x, \ y = 1$	$14 + 3x - 2x^2$	
(a)	$8-x = 14+3x-2x^{2}$ or $y = 14+3(8-y)-2(8-y)^{2}$	Uses the given line and curve to obtain an equation in one variable.	M1
	$2x^{2}-4x-6=0 \Longrightarrow x = \dots$ or $2y^{2}-28y+90=0 \Longrightarrow y = \dots$	Solves their 3TQ as far as $x =$ or $y =$ Dependent on the first method mark.	dM1
	x = -1, x = 3 or y = 5, y = 9	Correct <i>x</i> values or correct <i>y</i> values	A1
	(-1, 9) (3, 5)	ddM1: Solves for y or x using at least one value of x or y.Dependent on both previous method marks.A1: Correct coordinates which do	ddM1A1
	Special case: Fully correct answers only y	not need to be paired so just look for correct values.	
			(5)

(b)			H E G F	
WAY 1	Adds area	s E a	nd F	
	$x=0 \Rightarrow y=8 \text{ or } \int (8-x) dx = 8x - \frac{x^2}{2}$	-	Correct y intercept which may be seen on the diagram or correct integration of $8 - x$	B1
	$14 + 3x - 2x^2 = 0 \Longrightarrow x = 3.5$		Correct value - may be seen on the diagram.	B1
	$\int (14+3x-2x^2) dx = 14x + \frac{3x^2}{2} - \frac{2x^3}{3} (+$	-c)	M1: $x^n \rightarrow x^{n+1}$ on at least two terms for the curve <i>C</i> A1: Correct integration	M1A1
	$\left[\dots\right]_{3^{"}}^{"3.5"} = \left(49 + \frac{147}{8} - \frac{343}{12}\right) - \left(42 + \frac{27}{2} - 1\right) \\ \left(=\frac{31}{24}\right)$	18)	Correct use of their limits "3" and "3.5" either way round on their integrated curve <i>C</i> . Must be a "changed" function.	M1
	Trapezium: $\frac{1}{2} \times "3"("8"+"5")\left(=\frac{39}{2}\right)$ or $\left[8x - \frac{x^2}{2}\right]_0^{"3"} = 8(3) - \frac{(3)^2}{2}(-0)$		Correct method for the area of the trapezium between $x = 0$ and $x = 3$ using their values. If using the integration, the integration must be correct and used correctly.	M1
	Area $R = \frac{39}{2} + \frac{31}{24} = \frac{499}{24}$	dM1 integ prev A1:	: Adds their trapezium area and grated area (dependent on <u>all</u> ious method marks) Allow exact equivalents e.g. $20\frac{19}{24}$	dM1A1

Winter 2018 Past Paper (Mark Scheme)

$\frac{\pm(\operatorname{curve-line}) = \pm(14+3x-2x^2-(8-x))}{14+3x-2x^2=0 \Rightarrow x=3.5}$ Correct value - may be seen on the diagram. B1 $\int (14+3x-2x^2) dx = 14x + \frac{3x^2}{2} - \frac{2x^3}{3}(+c)$ or $\int \pm(\operatorname{curve-line}) dx = \pm \left("6x+2x^2-\frac{2x^3}{3}" \right)(+c)$ A1: Correct integration but allow correct ft integration but allow correct ft integration for slips on their $\pm(\operatorname{curve-line})(\operatorname{ignore} + c)$ Correct use of their upper limit $\left[\dots \right]_{0}^{"3.5"} = \left(49 + \frac{147}{8} - \frac{343}{12} \right) - (0) \left(= \frac{931}{24} \right)$ Correct use of their upper limit $\left[6x+2x^2-\frac{2x^3}{3} \right]_{0}^{"3"} = 6(3)+2(3)^2-\frac{2(3)^3}{3}(-0)$ M1 Correct use of their "3" and 0 (which may be implied) either way round on their integrated $\pm(\operatorname{curve-line})$. M1 $\left[\operatorname{Correct} use of their "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of their "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of their "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of their "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of \operatorname{Their} "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of \operatorname{Their} "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of \operatorname{Their} "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of \operatorname{Their} "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of \operatorname{Their} "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of \operatorname{Their} "3" and 0 (which may be implied) either way round on their integrated \pm(\operatorname{curve-line}). M1 \left[\operatorname{Correct} use of \operatorname{Their} "3" and 0 (which may be implied) either way round on their integrated \pm(cur$	WAY 2	Adds areas E, F and H and subtracts area H			
$\frac{14+3x-2x^{2}=0 \Rightarrow x=3.5}{\int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{2} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{2} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{2} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{2} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{2} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{2} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{2} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{2} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{3} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{3} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{3} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{3} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{3} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{3} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = 14x + \frac{3x^{2}}{3} - \frac{2x^{3}}{3}(+c)}{or} = \int (14+3x-2x^{2}) dx = \frac{14x^{2}}{3} - \frac{2x^{3}}{3}(-c)}{or} = \int (14+3x-2x^{2}) dx = \frac{14x^{2}}{3} - 14x^{$		\pm (curve-line) = \pm (14+3x-2x ² -(8-x))			
$\int (14+3x-2x^2) dx = 14x + \frac{3x^2}{2} - \frac{2x^3}{3}(+c)$ or $\int \pm (\text{curve}-\text{line}) dx = \pm \left((6x+2x^2 - \frac{2x^3}{3}) (+c) \right)$ $A1: \text{ Correct integration but allow correct fi integration for slips on their \pm (\text{curve}-\text{line})(\text{ignore}+c) I:]_{0}^{*3.5''} = \left(49 + \frac{147}{8} - \frac{343}{12} \right) - (0) \left(= \frac{931}{24} \right) Correct use of their upper limit (3.5'' and 0 (which may be implied)) either way round on their integrated curve C. Must be a "changed" function. I:Correct use of their (3'') and 0 (which may be implied) either way round on their integrated \pm (\text{curve} - \text{line}). M11 Correct use of their (3'') and 0 (which may be implied) either way round on their integrated \pm (\text{curve} - \text{line}). M12 Area R = \frac{931}{2} - 18 = \frac{499}{2} Area R = \frac{931}{2} - 18 = \frac{499}{2}$		$14 + 3x - 2x^2 = 0 \Longrightarrow x = 3.5$		Correct value - may be seen on the diagram.	B1
$\int \pm (\operatorname{curve-line}) dx = \pm \left(\left(\left(6x + 2x^2 - \frac{2x^3}{3} \right) \right) (+c) \right) $ $A1: \operatorname{Correct integration but allow correct ft integration for slips on their \pm (\operatorname{curve-line}) (\operatorname{ignore} + c) \left[\dots \right]_0^{*3.5"} = \left(49 + \frac{147}{8} - \frac{343}{12} \right) - (0) \left(= \frac{931}{24} \right) Correct use of their upper limit (*3.5" and 0 (which may be implied) either way round on their integrated curve C. Must be a "changed" function. \left[6x + 2x^2 - \frac{2x^3}{3} \right]_0^{*3"} = 6(3) + 2(3)^2 - \frac{2(3)^3}{3}(-0) M1 Correct use of their (*3" and 0 (which may be implied) either way round on their integrated \pm (\operatorname{curve-line}). Must be a "changed" function. dM1: \operatorname{Subtracts} (\operatorname{curve-line}) \operatorname{area} from \operatorname{curve} area (dependent on all previous method marks) dM1 \wedge 1 = 0$		$\int (14+3x-2x^2) dx = 14x + \frac{3x^2}{2} - \frac{2x^3}{3} (+6x^2) dx = 14x + \frac{3x^2}{2} - \frac{2x^3}{3} (+6x^2) dx = 14x + \frac{3x^2}{2} - \frac{3x^2}{3} (+6x^2) dx = 14x + \frac{3x^2}{2} (-5x^2) $	c)	M1: $x^n \rightarrow x^{n+1}$ on at least two terms for the curve <i>C</i> or their \pm (curve-line)	M1 A 1
$\begin{bmatrix} \dots \end{bmatrix}_{0}^{3.5"} = \left(49 + \frac{147}{8} - \frac{343}{12}\right) - (0)\left(=\frac{931}{24}\right) \qquad \begin{bmatrix} \text{Correct use of their upper limit} \\ \text{``3.5'' and 0 (which may be implied)} \\ \text{either way round on their integrated} \\ \text{curve } C. \text{ Must be a ``changed''} \\ \text{function.} \end{bmatrix} M1$ $\begin{bmatrix} 6x + 2x^2 - \frac{2x^3}{3} \\ \end{bmatrix}_{0}^{3"} = 6(3) + 2(3)^2 - \frac{2(3)^3}{3}(-0) \qquad M1$ $\begin{bmatrix} \text{Correct use of their ``3'' and 0 (which may be implied) either way round on their integrated \pm(\text{curve} - \text{line}). \text{ Must be a ``changed''' function.} \end{bmatrix}$ $\begin{bmatrix} \text{M1} \\ \text{M2} \\ \text{M2} \\ \text{M3} \\ \text{M3} \\ \text{M4} $		$\int \pm (\text{curve} - \text{line}) dx = \pm \left((6x + 2x^2 - \frac{2x^3}{3}) \right) (-1)^{1/2}$	+c)	A1: Correct integration but allow correct ft integration for slips on their \pm (curve-line)(ignore + c)	MIAI
$\begin{bmatrix} 6x + 2x^2 - \frac{2x^3}{3} \end{bmatrix}_0^{\pi_{3^{\prime\prime}}} = 6(3) + 2(3)^2 - \frac{2(3)^3}{3}(-0) \qquad M1$ Correct use of their "3" and 0 (which may be implied) either way round on their integrated ±(curve - line). Must be a "changed" function. $\frac{dM1: \text{ Subtracts (curve - line) area from}}{\text{ curve area (dependent on all previous}} \qquad dM1 \wedge 1$		$\left[\dots\right]_{0}^{"3.5"} = \left(49 + \frac{147}{8} - \frac{343}{12}\right) - \left(0\right)\left(=\frac{931}{24}\right)$		Correct use of their upper limit "3.5" and 0 (which may be implied) either way round on their integrated curve <i>C</i> . Must be a "changed" function.	M1
Correct use of their "3" and 0 (which may be implied) either way round on their integrated \pm (curve – line). Must be a "changed" function.dM1: Subtracts (curve – line) area from curve area (dependent on <u>all</u> previous method marks)dM1 A 1		$\left[6x+2x^2-\frac{2x^3}{3}\right]_0^{"3"}=6(3)+2(3)^2-\frac{2(3)^3}{3}(-0)$			
$\Delta rea R = \frac{931}{-18} = \frac{499}{-18}$ $dM1: Subtracts (curve - line) area fromcurve area (dependent on all previousmethod marks) dM1A1$		Correct use of their "3" and 0 (which may be implied) either way round on their integrated +(curve – line). Must be a "changed" function			
Alt: Allow exact equivalents e.g. $20\frac{19}{24}$		Area $R = \frac{931}{24} - 18 = \frac{499}{24}$ Area $R = \frac{931}{24} - 18 = \frac{499}{24}$ Area $R = \frac{931}{24} - 18 = \frac{499}{24}$ Al: Allow exact equivalents e.g. 2		Subtracts (curve – line) area from e area (dependent on <u>all</u> previous od marks) Allow exact equivalents e.g. $20\frac{19}{24}$	d M1A1

WAY 3	Adds areas E, F and G and subtracts area G			
	$x = 0 \Longrightarrow y = 8$ or +(line - curve) = +(8 - r - (14 + 3r - 7))	$(2r^2)$	Correct y intercept - may be	
	or $\int (8-x) dx = 8x - \frac{x^2}{2}$	2,))	\pm (curve-line) or correct integration of 8 – x	B1
	$14 + 3x - 2x^2 = 0 \Longrightarrow x = 3.5$	Correct diagram	value - may be seen on the n.	B1
	$\int \pm (\text{line} - \text{curve}) dx = \pm \left(\frac{2x^3}{3} - 6x - 2x^2\right) (+c)$	M1: x^n their \pm (A1: Conft integr	$\rightarrow x^{n+1}$ on at least two terms for (curve-line) rect integration but allow correct ration for slips on their	M1A1
		\pm (curve	e-line)(ignore + c)	
	$\left[\left[\left[\frac{2x^{3}}{3}-6x-2x^{2}\right]\right]_{x_{3}}^{x_{3},x_{3}}=\frac{2\left(\left[3.5\right]\right)^{3}}{3}-6\left(\left[3.5\right]\right)^{2}\right]$)-2("3.5	$(")^{2} - \left(\frac{2("3")^{3}}{3} - 6("3") - 2("3")^{2}\right)$	M1
	Correct use of their "3" and "3.5" either wa Must be a "char	y round onged" fur	on their integrated \pm (curve – line).	
	Trapezium: $\frac{1}{2} \times "3.5" ("8"+"4.5") \left(= \frac{175}{8} \right)$ or $\left[8x - \frac{x^2}{2} \right]_{0}^{"3.5"} = 8(3.5) - \frac{(3.5)^2}{2}(-0)$	Correct trapeziu using th integrat correct	method for the area of the im between $x = 0$ and $x = "3.5"$ heir values. If using the ion, the integration must be and used correctly.	M1
	Area $R = \frac{175}{8} - \frac{13}{12} = \frac{499}{24}$	dM1: St trapeziu previou	ubtracts (line – curve) area from um area (dependent on <u>all</u> s method marks)	d M1A1
		A1: All	ow exact equivalents e.g. $20\frac{15}{24}$	
				(8)
				Total 13

Q14(b) COMBINED SCHEME

B1 $x = 0 \rightarrow y = 8$ (May be seen on the diagram)

OR: Correct integration of 8 - x, giving $8x - \frac{x^2}{2}$

OR: $\pm (curve - line) = \pm (14 + 3x - 2x^2 - (8 - x))$

- B1 $14 + 3x 2x^2 = 0 \rightarrow x = 3.5$ (May be seen on the diagram).
- M1 Integration of the curve quadratic or their $\pm(curve line)$ quadratic expression with $x^n \rightarrow x^{n+1}$ for at least two terms.
- A1 Completely correct integration of the quadratic expression, even if mistakes have been made in 'simplifying' their quadratic expression. Ignore "+ c". (So the M1A1 is essentially given for correct integration).

N.B. "integrated curve" = "
$$\left(14x + \frac{3x^2}{2} - \frac{2x^3}{3}\right)$$
"

"integrated (curve – line)" = " $(6x + 2x^2 - \frac{2x^3}{3})$ "

Next two M marks for any one of the following three variations, with correct use of their limits on their integrated function (must be a "changed" function) or correct method for the appropriate trapezium using their values:

M1 1(i) ["integrated curve"]
$$"3.5"_{3"} = \cdots$$
 $(\frac{31}{24})$

M1 1(ii)
$$\left[8x - \frac{x^2}{2}\right]_{0}^{"3"} = \cdots \text{ or } \frac{1}{2} \times "3" \times ("8 + "5")$$
 $\left(\frac{39}{2}\right)$

M1
 2(i)
 ["integrated curve"]
$${}^{"}3.5"_{0} = \cdots$$
 $\left(\frac{931}{24}\right)$

 M1
 2(ii)
 ["integrated $\pm (curve - line)"] {}^{"}0_{0} = \cdots$
 (18)

 M1
 3(i)
 ["integrated $\pm (line - curve)"] {}^{"}3.5"_{"}3" = \cdots$
 $\left(\frac{13}{12}\right)$

 M1
 3(ii)
 $\left[8x - \frac{x^2}{2}\right] {}^{"}3.5"_{0} = \cdots$
 or
 $\frac{1}{2} \times "3.5" \times ("8 + "4.5")$
 $\left(\frac{175}{8}\right)$

- dM1 (Dependent on all previous method marks). Attempts the correct combination, which must be either 1(i) + 1(ii), or 2(i) 2(ii), or 3(ii) 3(i).
- A1 $\frac{499}{24}$ or exact equivalent, e.g. $20\frac{19}{24}$

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15.	The binomial expansion, in ascending powers of x, of $(1 + kx)^n$ is	bla
	$1 + 36x + 126kx^2 + \dots$	
,	where k is a non-zero constant and n is a positive integer.	
1	(a) Show that $nk(n-1) = 252$	
		(2)
((b) Find the value of k and the value of n .	
		(5)
((c) Using the values of k and n, find the coefficient of x^3 in the binomial	
	expansion of $(1 + kx)^n$	(3)

P 5 0 7 1 3 A 0 5 0 5 2

Question Number	Scheme	Notes	Marks	
15	$(1+kx)^n = 1+nkx + \frac{n(n-1)}{2}k^2x^2$			
(a)	(a) $\frac{n(n-1)}{2}k^2 = 126k$ or $\frac{n(n-1)}{2}k = 126k$ or ${}^nC_2k^2 = 126k$ or ${}^nC_2k = 126k$ Compares r^2 terms using one of these forms, with or without the r^2			
	$kn(n-1) = 1$ Obtains the printed equation from $\frac{n(n-1)}{2}$	252* $k^{2} = 126k \text{ or } \frac{n(n-1)}{2}k^{2}x^{2} = 126kx^{2}$	A1*	
	Note that these are acc	ceptable proofs:		
	$\frac{n(n-1)}{2}k^2x^2 \text{ followed by } \frac{n(n-1)}{2}$	$\int k = 126 \Longrightarrow nk(n-1) = 252$		
	$\frac{1}{2}k^2x^2$ followed by $n(n-1)k$	$k^2 = 252k \Longrightarrow nk(n-1) = 252$		
			(2)	
(b)	<i>nk</i> = 36	Correct equation (oe).	B1	
	36(n-1) = 252 or $36(\frac{36}{k}-1) = 252$	Uses a valid method with their nk = 36 and the given equation to obtain an equation in <i>n</i> or <i>k</i> only. It must be a correct algebraic method allowing for sign and/or arithmetic slips only.	M1	
	$36n - 36 = 252 \Longrightarrow n = 8$	dM1: Solves, using a correct method,		
	Or 36 1 7 1 4 5	to obtain a value for <i>n</i> or k	dM1A1	
	$\frac{30}{k} - 1 = 7 \Longrightarrow k = 4.5$			
	$n=8 \Longrightarrow k=4.5$ or $k=4.5 \Longrightarrow n=8$	Correct values for <i>n</i> and <i>k</i>	A1	
	Special Case: Some candidates have a second term of nx which gives $n = 36$ and then solve $kn(n-1) = 252$ to give $k = 0.2$. This scores a special case of B1.			
	Generally, to score the method marks, candidates must be solving 2 equations			
	in <i>n</i> and	<i>K</i> .	(5)	
(c)	$\frac{n(n-1)(n-2)}{3!}k^{3}(x^{3})$	Correct coefficient. May be implied by $56k^3$ or "8" C_3 " k " ³ with or without x^3 . If no working is shown, you may need to check their values.	B1ft	
	$=\frac{8(8-1)(8-2)}{3!}4.5^{3}=\dots$	Substitutes their values correctly including integer $n, n > 3$, to obtain a value for the coefficient of x^3 . Must be a correct calculation for the x^3 coefficient for their values.	M1	
	$=5103$ Allow $5103x^3$			
	Answer only of 5103 s	scores B1M1A1	(3)	
			Total 10	