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Surname	Other na	mes
Pearson Edexcel GCE	Centre Number	Candidate Number
Core Mat	hematic	s C1 殿 🗋
	lary	
Wednesday 17 May 2017 Time: 1 hour 30 minute	7 – Morning	Paper Reference 6663/01

Calculators may NOT be used in this examination.

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.

Information

- The total mark for this paper is 75.
- The marks for each question are shown in brackets
 use this as a guide as to how much time to spend on each 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.

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Past Paper Leave blank 1. Find $\int \left(2x^5 - \frac{1}{4x^3} - 5\right) \mathrm{d}x$ giving each term in its simplest form. (4) 2 P 4 8 7 6 0 A 0 2 2 8

Question Number	Scheme	Marks
1.	$\int \left(2x^5 - \frac{1}{4}x^{-3} - 5 \right) dx$	
	Ignore any spurious integral signs throughout	
	$x^{n} \rightarrow x^{n+1}$ Raises any of their powers by 1. E.g. $x^{5} \rightarrow x^{6}$ or $x^{-3} \rightarrow x^{-2}$ or $k \rightarrow kx$ or $x^{\text{their}n} \rightarrow x^{\text{their}n+1}$. Allow the powers to be un-simplified e.g. $x^{5} \rightarrow x^{5+1}$ or $x^{-3} \rightarrow x^{-3+1}$ or $kx^{0} \rightarrow kx^{0+1}$	M1
	$2 \times \frac{x^{5+1}}{6}$ or $-\frac{1}{4} \times \frac{x^{-3+1}}{-2}$ Any one of the first two terms correct <u>simplified or un-simplified</u> .	A1
	Two of: $\frac{1}{3}x^6$, $\frac{1}{8}x^{-2}$, $-5x$ Two of: $\frac{1}{3}x^6$, $\frac{1}{8}x^{-2}$, $-5x$ Any two correct <u>simplified</u> terms. Accept $+\frac{1}{8x^2}$ for $+\frac{1}{8}x^{-2}$ but not x^1 for x. Accept 0.125 for $\frac{1}{8}$ but $\frac{1}{3}$ would clearly need to be identified as 0.3 recurring.	A1
	$\frac{1}{3}x^{6} + \frac{1}{8}x^{-2} - 5x + c$ All correct and simplified and including + c all on one line. Accept $+\frac{1}{8x^{2}}$ for $+\frac{1}{8}x^{-2}$ but not x^{1} for x. Apply isw here.	A1
		(4 marks)

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Question Number	Sch	Marks	
2.	$y = \sqrt{x} + \frac{4}{\sqrt{x}} + 4$		
	$x^n ightarrow x^{n-1}$	Decreases any power by 1. Either $x^{\frac{1}{2}} \rightarrow x^{-\frac{1}{2}}$ or $x^{-\frac{1}{2}} \rightarrow x^{-\frac{3}{2}}$ or $4 \rightarrow 0$ or $x^{\text{their }n} \rightarrow x^{\text{their }n-1}$ for fractional n .	M1
	$\left(\frac{dy}{dx}\right) = \frac{1}{2}x^{-\frac{1}{2}} + 4 \times -\frac{1}{2}x^{-\frac{3}{2}}$ $\left(=\frac{1}{2}x^{-\frac{1}{2}} - 2x^{-\frac{3}{2}}\right)$	Correct derivative, simplified or un- simplified including indices. E.g. allow $\frac{1}{2}-1$ for $-\frac{1}{2}$ and allow $-\frac{1}{2}-1$ for $-\frac{3}{2}$	A1
	$x = 8 \Longrightarrow \frac{dy}{dx} = \frac{1}{2}8^{-\frac{1}{2}} + 4 \times -\frac{1}{2}8^{-\frac{3}{2}}$	Attempts to substitute $x = 8$ into their 'changed' (even integrated) expression that is clearly not y. If they attempt algebraic manipulation of their dy/dx before substitution, this mark is still available.	M1
	$=\frac{1}{2\sqrt{8}}-\frac{2}{\left(\sqrt{8}\right)^3}=\frac{1}{2\sqrt{8}}-\frac{2}{8\sqrt{8}}=\frac{1}{8\sqrt{2}}=\frac{1}{16}\sqrt{2}$	B1: $\sqrt{8} = 2\sqrt{2}$ seen or implied anywhere, including from substituting $x = 8$ into y. May be seen explicitly or implied from e.g. $8^{\frac{3}{2}} = 16\sqrt{2}$ or $8^{\frac{5}{2}} = 128\sqrt{2}$ or $4\sqrt{8} = 8\sqrt{2}$ A1: $\cos \frac{1}{16}\sqrt{2}$ or $\frac{\sqrt{2}}{16}$ and allow rational equivalents for $\frac{1}{16}$ e.g. $\frac{32}{512}$ Apply isw so award this mark as soon as a correct answer is seen.	- B1A1
		·	(5 marks)

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3. A sequence a_1, a_2, a_3, \dots is defined by

$$a_1 = 1$$
$$a_{n+1} = \frac{k(a_n + 1)}{a_n}, \qquad n \ge 1$$

where k is a positive constant.

(a) Write down expressions for a_2 and a_3 in terms of k, giving your answers in their simplest form.

Given that $\sum_{r=1}^{3} a_r = 10$

(b) find an exact value for *k*.

(3)

(3)

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Question Number	Sch	Marks	
3. (a)	$(a_2 =)2k$	2k only	B1
	$(a_3 =) \frac{k("2k"+1)}{"2k"}$	For substituting their a_2 into $a_3 = \frac{k(a_2 + 1)}{a_2}$ to find a_3 in terms of just k	M1
	$\left(a_{3}=\right)\frac{2k+1}{2}$	$(a_3 =) \frac{2k+1}{2}$ or exact simplified equivalent such as $(a_3 =)k + \frac{1}{2}$ or $\frac{1}{2}(2k+1)$ but not $k + \frac{k}{2k}$ Must be seen in (a) but isw once a correct simplified answer is seen.	A1
			(3)
	Note that there are <u>no</u> marks in formula unless their term	(b) for using an AP (or GP) sum is do form an AP (or GP).	
(b)	$\sum_{r=1}^{3} a_{r} = 10 \Longrightarrow 1 + "2k" + "\frac{2k+1}{2}" = 10$	Writes 1 + their a_2 + their $a_3 = 10$. E.g. 1+2k + $\frac{2k^2 + k}{2k} = 10$. Must be a correct follow through equation in terms of k only.	M1
	$\Rightarrow 2+4k+2k+1=20 \Rightarrow k=$ or e.g. $\Rightarrow 6k^2 - 17k = 0 \Rightarrow k =$	Solves their equation in k which has come from the sum of 3 terms = 10, and reaches $k =$ Condone poor algebra but if a quadratic is obtained then the usual rules apply for solving – see General Principles. (Note that it does not need to be a 3- term quadratic in this case)	M1
	$(k=)\frac{17}{6}$	$k = \frac{17}{6}$ or exact equivalent e.g. $2\frac{5}{6}$ Do not allow $k = \frac{8.5}{3}$ or $k = \frac{17/2}{3}$ Ignore any reference to $k = 0$. Allow 2.83 recurring as long as the recurring is clearly indicated e.g. a dot over the 3.	A1
			(3)
			(6 marks)

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blank 4. A company, which is making 140 bicycles each week, plans to increase its production. The number of bicycles produced is to be increased by d each week, starting from 140 in week 1, to 140 + d in week 2, to 140 + 2d in week 3 and so on, until the company is producing 206 in week 12. (a) Find the value of d. (2) After week 12 the company plans to continue making 206 bicycles each week. (b) Find the total number of bicycles that would be made in the first 52 weeks starting from and including week 1. (5) 8 P 4 8 7 6 0 A 0 8 2 8

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Question Number	Sch	eme	Marks
4. (a)	$206 = 140 + (12 - 1) \times d \Longrightarrow d = \dots$	Uses $206 = 140 + (12-1) \times d$ and proceeds as far as $d = \dots$	M1
	(d=)6	Correct answer only can score both marks.	A1
			(2)
(b)		Attempts $S_n = \frac{n}{2}(a+l)$ or	
	12	$S_n = \frac{n}{2} (2a + (n-1)d)$ with $n = 12$,	
	$S_{12} = \frac{12}{2} (140 + 206)$ or	a = 140, l = 206, d = '6' WAY 1	
	12	Or	
	$S_{12} = \frac{12}{2} (2 \times 140 + (12 - 1) \times "6")$ or	Attempts $S_n = \frac{n}{2}(a+l)$ or	M1
	$S_{11} = \frac{11}{2} (140 + 206 - "6")$ or	$S_n = \frac{n}{2} (2a + (n-1)d)$ with $n = 11$,	
	$S_{11} = \frac{11}{2} (2 \times 140 + (11 - 1) \times "6")$	a = 140, l = 206 - 6', d = 6' WAY2	
	2	If they are using	
		$S_n = \frac{n}{2} (2a + (n-1)d), \text{ the } n \text{ must}$	
		be used consistently.	
	$S = 2076 \operatorname{WAY1}$	~	
	or	Correct sum (may be implied)	Al
	S = 18/0 WAY 2	Attempts to find (52, 12), 20(or	
	$(52 - 12) \times 206 =$	Attempts to find $(52-12) \times 206$ of	
	$(52 - 12) \times 200 = \dots$	$(52-11) \times 206$. Does not have to be	M1
	$01(52 - 11) \times 200 =$	first Method mark	
		Attempts to find the total by adding	
	T-4-1 "2076" "2240"	the sum to 12 terms with $(52 - 12)$	
	10tal = 20/6 + 8240 =	lots of 206 or attempts to find the	
	(WATT) or	total by adding the sum to 11 terms	ddM1
	Total = "1870" + "8446" =	with (52 - 11) lots of 206. I.e.	~~~
	(WAY 2)	consistency is now required for this	
		mark. Dependent on both previous	
	10316	cao	A1
		1	(5)
			(7 marks)

				1		(1-)				
					listing	; in (b)	•		-	
Wee	k	1	2	3	4	5	6	7		
Bicycl	es	140	146	152	158	164	170	176		
Tota		140	286	438	596	760	930	1106		
8	9	10	11	12	13		52	1		
182	188	194	200	206	206		206	1		
1288	1476	1670	1870) 2076	2282		10316	1		
A1: S Then t	= 207	6 or 1	870 870	0 1 1 1 U		100	•			
	S	pecial	case	in (b) -	Treat	s as si	ngle Al	P with <i>i</i>	n = 52	
	$S_n = \frac{52}{2} (2 \times 140 + (52 - 1) \times "6") = 15236$ Scores 11000									
М	1: <i>S</i> _{<i>n</i>}	$=\frac{n}{2}(2$	2a+(r)	(-1)d	with <i>n</i>	= 52,	a = 140), <i>d</i> = "6	A1: 15236	5

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st Paper	This resource was created and owned by Pearson Edexcer	Leav
5.	$f(x) = x^2 - 8x + 19$	blan
(a)	Express $f(x)$ in the form $(x + a)^2 + b$, where a and b are constants.	
(")	(2)	
The poin	e curve C with equation $y = f(x)$ crosses the y-axis at the point P and has a minimum nt at the point Q.	
(b)	Sketch the graph of C showing the coordinates of point P and the coordinates of point Q .	
	(3)	
(c)	Find the distance PQ , writing your answer as a simplified surd. (3)	
10		

Question Number	Scheme	Marks
5.(a)	$f(x) = (x-4)^2 + 3$ $M1: f(x) = (x\pm 4)^2 \pm \alpha, \alpha \neq 0$ (where α is a single number or a numerical expression $\neq 0$) $A1: Allow (x + 4)^2 + 3 and ignored any spurious "= 0"$	ι M1A1 ore
	Allow $a = -4$, $b = 3$ to score both marks	
(b)	B1: U shape anywhere even with axes. Do not allow a "V" shape i with an obvious vertex. B1: <i>P</i> (0, 19). Allow (0, 19) or ju 19 marked in the correct place as long as the curve (or straight line passes through or touches here a allow (19, 0) as long as it is mark in the correct place. Correct coordinates may be seen in the b of the script as long as the curve straight line) passes through or touches here. If there is any ambiguity, the sketch has precedence. (There must be a sketch to score this mark)	(2) 1 no 1.e. B1 st s e) nd ked pody B1 (or
	Sketch to score this mark) $(4, 3)$ <	of ity, v on nd 3 nd
		(3)

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(c)		Correct use of Pythagoras'	
	$PQ^{2} = (0-4)^{2} + (19-3)^{2}$	Theorem on 2 points of the form	M1
		$(0, p)$ and (q, r) where $q \neq 0$ and	
		$p \neq r$ with p , q and r numeric.	
		Correct un-simplified numerical	
		expression for PQ including the	
		square root. This must come from	
	$PQ = \sqrt{4^2 + 16^2}$	a correct <i>P</i> and <i>Q</i>. Allow e.g	A1
		$PQ = \sqrt{(0-4)^2 + (19-3)^2}$.	
		Allow $\pm \sqrt{(0-4)^2 + (19-3)^2}$	
	$PO = 4 \sqrt{17}$	Cao and cso i.e. This must come	A 1
	$PQ = 4\sqrt{17}$	from a correct P and Q.	AI
	Note that it is possible to obtain the	ne correct value for PQ from (-4,3) and	
	(0, 19) and e.g. (0, 13) and (4, -3)	3) but the A marks in (c) can only be	
	awarded for th	ne correct P and Q.	
			(3)
			(8 marks)

m mer Paper	2017	This resourc	www.mystudybro.com was created and owned by Pearson Edexcel	Mathema	tics C1 6663
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6. (a	a) Given $y =$	2^x , show that			
			$2^{2x+1} - 17(2^x) + 8 = 0$		
	can be wr	itten in the form			
			$2x^2 + 17x + 9 = 0$		
			$2y^2 - 1/y + 8 = 0$	(2)	
(1	b) Hence sol	ve			
× ×	,		2^{2x+1} $17(2x) + 9 = 0$		
			$2^{-m} = 1/(2^{m}) + 8 = 0$	(4)	

P 4 8 7 6 0 A 0 1 2 2 8

Question Number	Sche	Marks		
6.(a)	Replaces 2^{2x+1} with $2^{2x} \times 2$ or states $2^{2x+1} = 2^{2x} \times 2$ or states $(2^x)^2 = 2^{2x}$	Uses the addition or power law of indices on 2^{2x} or 2^{2x+1} . E.g. $2^{x} \times 2^{x} = 2^{2x}$ or $(2^{x})^{2} = 2^{2x}$ or $2^{2x+1} = 2 \times 2^{2x}$ or $2^{x+0.5} = 2^{x} \times \sqrt{2}$ or $2^{2x+1} = (2^{x+0.5})^{2}$.	M1	
	$2^{2x+1} - 17 \times 2^{x} + 8 = 0$ $\Rightarrow 2y^{2} - 17y + 8 = 0*$	Cso. Complete proof that includes explicit statements for the addition and power law of indices on 2^{2x+1} with no errors. The equation needs to be as printed including the "= 0". If they work backwards, they do not need to write down the printed answer first but must end with the version in 2^x including '= 0'.	A1*	
	The following are example	les of acceptable proofs.		
	$2^{2x+1} = \left(2^{x+0.5}\right)^2 = \left(2^x + \frac{1}{2}\right)^2$	$\sqrt{2}\right)^2 = \left(y\sqrt{2}\right)^2 = 2y^2$		
	$\Longrightarrow 2^{2x+1} - 17(2^x) + 8 =$	$2y^2 - 17y + 8 = 0$		
	$2y^{2} = 2 \times 2^{x} \times 2^{x} = 2^{2x+1}$ $\Rightarrow 2^{2x+1} - 17(2^{x}) + 8 = 2y^{2} - 17y + 8 = 0$			
	$2y^2 - 17y + 8 = 0 \Longrightarrow 2(2)$	$(2^{x})^{2} - 17(2^{x}) + 8 = 0$		
	$\Rightarrow 2 \times 2^{2x} - 17(2^x) + 8 = 0$	$\Rightarrow 2^{2x+1} - 17(2^x) + 8 = 0$		
	$2^{2x+1} = 2 \times 2^{2x} \Longrightarrow 2 \times$	$2^{2x} - 17(2^x) + 8 = 0$		
	$\Rightarrow 2y^2 - 17y$	+8 = 0		
	Scores M1A0 as $2^{2x} = (2^x)^2 1$			
	Special $2^{2x+1} - 2^1 \times (2^x)^2 \propto$			
	$2^{-x} = 2 \times (2^{-x}) \text{ or } 2^{-x} = (2^{-x}) \times 2^{-x}$ With or without the multiplication signs and with no subsequent explicit evidence of the power law scores M1A0 Example of insufficient working: $2^{2x+1} = 2(2^{x})^{2} = 2y^{2}$			
	scores no marks as neither ru	le has been shown explicitly.	(2)	
			(2)	

(b)	$2y^2 - 17y + 8 = 0 \Longrightarrow (2y - 1)(y - 8)(= 0) \Longrightarrow y = \dots$		
)r	
	$2\left(2^{x}\right)^{2}-17\left(2^{x}\right)+8=0 \Longrightarrow \left(2\left(2^{x}\right)^{2}\right)$	$(2^{x})-1)((2^{x})-8)(=0) \Longrightarrow 2^{x}=$	
	Solves the given quadratic either in terms of y or in terms of 2^x See General Principles for solving a 3 term quadratic Note that completing the square on e.g. $y^2 - \frac{17}{2}y + 4 = 0$ requires		M1
	$\left(y \pm \frac{17}{4}\right)^2 \pm q \pm 4 = 0 \Longrightarrow y = \dots$		
	$(y=)\frac{1}{2}, 8 \text{ or } (2^{x}=)\frac{1}{2}, 8$	Correct values	A1
	$\Rightarrow 2^{x} = \frac{1}{2}, 8 \Rightarrow x = -1, 3$	M1: Either finds one correct value of x for their 2^x or obtains a correct numerical expression in terms of logs e.g. for $k > 0$ $2^x = k \Longrightarrow x = \log_2 k$ or $\frac{\log k}{\log 2}$	M1 A1
		A1. $x = -1, 3$ only. Must be values of x.	(4)
			(4) (6 marks)
			(U IIIal KS)

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Past Paper The curve *C* has equation y = f(x), x > 0, where 7. $f'(x) = 30 + \frac{6 - 5x^2}{\sqrt{x}}$ Given that the point P(4, -8) lies on C, (a) find the equation of the tangent to C at P, giving your answer in the form y = mx + c, where *m* and *c* are constants. (4) (b) Find f(x), giving each term in its simplest form. (5)

Question Number	Scheme		Marks
7.(a)	$f'(4) = 30 + \frac{6 - 5 \times 4^2}{\sqrt{4}}$	Attempts to substitutes $x = 4$ into $f'(x) = 30 + \frac{6-5x^2}{\sqrt{x}}$ or their algebraically manipulated $f'(x)$	M1
	f'(4) = -7	Gradient = -7	A1
	$y - (-8) = "-7" \times (x - 4)$ or $y = "-7" x + c \Longrightarrow -8 = "-7" \times 4 + c$ $\Longrightarrow c = \dots$	Attempts an equation of a tangent using their numeric f '(4) which has come from substituting $x = 4$ into the given f '(x) or their algebraically manipulated f '(x) and $(4, -8)$ with the 4 and -8 correctly placed. If using $y = mx + c$, must reach as far as $c =$	M1
	y = -7x + 20	Cao. Allow $y = 20 - 7x$ and allow the "y =" to become "detached" but it must be present at some stage. E.g. $y =$ = -7x + 20	A1
(b)	Allow the marks in (b) to see in	(a); a mark (a) and (b) tagether	(4)
(6)	Thow the marks in (b) to score in	M1: 30 \rightarrow 30x or $\frac{6}{2}$ $\rightarrow \alpha x^{\frac{1}{2}}$ or	
	$\Rightarrow f(x) = 30x + 6\frac{x^{\frac{1}{2}}}{0.5} - 5\frac{x^{\frac{5}{2}}}{2.5}(+c)$	\sqrt{x} $-\frac{5x^2}{\sqrt{x}} \rightarrow \beta x^{\frac{5}{2}} \text{ (these cases only)}$ A1: Any 2 correct terms which can be simplified or un-simplified. This includes the powers – so allow $-\frac{1}{2} + 1 \text{ for } \frac{1}{2} \text{ and allow } \frac{3}{2} + 1 \text{ for } \frac{5}{2}$ (With or without + c) A1: All 3 terms correct which can be simplified or un-simplified. (With or without + c)	M1A1A1
	Ignore any spuri		
	$x = 4, f(x) = -8 \Longrightarrow$ $-8 = 120 + 24 - 64 + c \Longrightarrow c = \dots$	Substitutes $x = 4$, $f(x) = -8$ into their $f(x)$ (not $f'(x)$) i.e. a changed f'(x) containing $+c$ and rearranges to obtain a value or numerical expression for c .	M1
	$\Rightarrow (f(x) =) 30x + 12x^{\frac{1}{2}} - 2x^{\frac{5}{2}} - 88$	Cao and cso (Allow \sqrt{x} for $x^{\frac{1}{2}}$ and e.g. $\sqrt{x^5}$ or $x^2\sqrt{x}$ for $x^{\frac{5}{2}}$). Isw here so as soon as you see the correct answer, award this mark. Note that the "f(x) =" is not needed.	A1 (5)
			(9 marks)





8 7 6 0 A 0 1 6 A

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Question Number	Scheme		Marks
8.(a)	Gradient of $l_1 = \frac{4}{5}$ oe	States or implies that the gradient of $l_1 = \frac{4}{5}$. E.g. may be implied by a perpendicular gradient of $-\frac{5}{4}$. Do not award this mark for just rearranging to $y = \frac{4}{5}x +$ unless they then state e.g. $\frac{dy}{dx} = \frac{4}{5}$	B1
	Point <i>P</i> = (5, 6)	States or implies that P has coordinates (5, 6). $y = 6$ is sufficient. May be seen on the diagram.	B1
	$-\frac{5}{4} = \frac{y - 6''}{x - 5}$ or $y - 6'' = -\frac{5}{4}(x - 5)$ or $-\frac{5}{4}(5) + c \Rightarrow c = \dots$	Correct straight line method using P(5, "6") and gradient of $-\frac{1}{\text{grad }l_1}$. Unless $-\frac{5}{4}$ or $-\frac{1}{4}$ is being used as the gradient here, the gradient of l_1 clearly needs to have been identified and its negative reciprocal attempted to score this mark.	M1
	5x + 4y - 49 = 0	Accept any integer multiple of this equation including "= 0"	A1
			(4)

			(4)
	fortuitously resulte	d in a correct area.	
	Note that the final mark is cso so	o beware of any errors that have	
	= 36.9	36.9 cso oe e.g $\frac{505}{10}$, $36\frac{5}{10}$, $\frac{750}{20}$ but not e.g. $\frac{73.8}{2}$	A1
	$\frac{1}{2} \times ('2.5') \times '2' + \frac{1}{2} (''2'' + ''6'') \times 5 + \frac{1}{2} \times (''9.8'' - 5') \times '6' = \dots$		
	$\frac{\text{Method 5:}}{1}$ Trapezium + 2 triangles		
	determinar	nt method)	
	(must see a correct calculation i	e. the middle expression for this	
	$\begin{vmatrix} \frac{1}{2} \begin{vmatrix} 5 & 9.8 & -2.5 & 5 \\ 6 & 0 & 0 & 6 \end{vmatrix} = \frac{1}{2} (0+0-1) ^2$	$(5) - (58.8 + 0 + 0) = \frac{1}{2} - 73.8 = \dots$	
	<u>Method 4:</u> Sh	oelace method	
	$\frac{1}{2} \times (5 + 2.5') \times 6' + \frac{1}{2}$		
	Method 3:		
	any of the calculations, the met	thod mark can still be awarded	
	$\left(= \frac{1}{2} \times \frac{3\sqrt{41}}{2} \right)$ Note that if the method is correct h	dd M1	
	$\frac{1}{2} \times \sqrt{(5 - (-2.5))^2 + ((-6))^2} \times \sqrt{((-9.8)^2 - 5)^2 + ((-6))^2} = \dots$		
	<u>Method 2:</u>	$\frac{1}{2}SP \times PT$	
	$\frac{1}{2} \times (9.8$	1 ap pm	
		$\frac{1}{2}$ Si x 0	
	Attempts to use integration sho	$1_{ST \sim C }$	
	with vertices at points of the form (:	5, "6"), $(p, 0)$ and $(q, 0)$ where $p \neq q$	
	(Note that at $T, x = 9$	9.8 and at S, $x = -2.5$)	
		diagram.	
	and $y=0 \Rightarrow 5(0)=4x+10 \Rightarrow x=$	find a value for x. This may be	MI
	$y = 0 \Longrightarrow 5x + 4(0) - 49 = 0 \Longrightarrow x = \dots$	a value for x and substitutes $y = 0$ into l_1 or their rearrangement of l_1 to	
		Substitutes $y = 0$ into their l_2 to find	
	$y = 0 \Longrightarrow 5(0) = 4x + 10 \Longrightarrow x = \dots$	implied by a correct value on the	
	\mathbf{Or}	find a value for <i>x</i> . This may be	M1
	$y = 0 \Longrightarrow 5x + 4(0) - 49 = 0 \Longrightarrow x = \dots$	a value for x or substitutes $y = 0$ into <i>k</i> or their rearrangement of <i>k</i> to	
8(b)		Substitutes $y = 0$ into their l_2 to find	

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- 9. (a) On separate axes sketch the graphs of
 - (i) y = -3x + c, where *c* is a positive constant,
 - (ii) $y = \frac{1}{x} + 5$

On each sketch show the coordinates of any point at which the graph crosses the *y*-axis and the equation of any horizontal asymptote.

(4)

Given that y = -3x + c, where c is a positive constant, meets the curve $y = \frac{1}{x} + 5$ at two distinct points,

- (b) show that $(5-c)^2 > 12$
- (c) Hence find the range of possible values for c.

(4)

(3)

DO NOT WRITE IN THIS AREA



Question Number	Scheme		Marks
9.(a)(i)		B1: Straight line with negative gradient anywhere even with no axes.	B1
	(0, c)	B1: Straight line with an intercept at $(0, c)$ or just <i>c</i> marked on the positive <i>y</i> -axis provided the line passes through the positive <i>y</i> -axis. Allow $(c, 0)$ as long as it is marked in the correct place. Allow $(0, c)$ in the body of the script but in any ambiguity, the sketch has precedence. Ignore any intercepts with the <i>x</i> -axis.	B1
(a)(ii)	y = 5	Either: For the shape of a $y = \frac{1}{x}$ curve in any position. It must have two branches and be asymptotic horizontally and vertically with no obvious "overlap" with the asymptotes, but otherwise be generous. The curve may bend away from the asymptote a little at the end. Sufficient curve must be seen to suggest the asymptotic behaviour, both vertically and horizontally and the branches must approach the same asymptote Or the equation $y = 5$ seen independently i.e. whether the sketch has an asymptote here or not. Do not allow $y \neq 5$ or $x = 5$.	B1
		B1: Fully correct graph and with a horizontal asymptote on the positive <i>y</i> -axis. The asymptote does not have to be drawn but the equation $y = 5$ must be seen. The shape needs to be reasonably accurate with the "ends" not bending away significantly from the asymptotes and the branches must approach the same asymptote. Ignore $x = 0$ given as an asymptote.	B1
	Allow sketches to be	e on the same axes.	(4)
			(4)

(7.)			
(b)	$\frac{1}{x} + 5 = -3x + c \Longrightarrow 1 + 5x = -3x^2 + cx$ $\Longrightarrow 3x^2 + 5x - cx + 1 = 0$	Sets $\frac{1}{x} + 5 = -3x + c$, attempts to multiply by <i>x</i> and collects terms (to one side). Allow e.g. ">" or "<" for "=". At least 3 of the terms must be multiplied by <i>x</i> , e.g. allow one slip. The ' = 0' may be implied by subsequent work and provided correct work follows, full marks are still possible in (b).	M1
	$b^2 - 4ac = (5 - c)^2 - 4 \times 1 \times 3$	Attempts to use $b^2 - 4ac$ with their a , b and c from their equation where $a = \pm 3$, $b = \pm 5 \pm c$ and $c = \pm 1$. This could be as part of the quadratic formula 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
	$(5-c)^2 > 12*$	Completes proof with no errors or incorrect statements and with the ">" appearing correctly before the final answer, which could be from $b^2 - 4ac > 0$. Note that the statement $3x^2 + 5x - cx + 1 > 0$ or starting with e.g. $\frac{1}{x} + 5 > -3x + c$ would be an error.	A1*
	Note: A minimum	for (b) could be,	
	$\frac{1}{x} + 5 = -3x + c \Longrightarrow 3x^2 + 3x^2$	-5x - cx + 1(=0) (M1)	
	$b^2 > 4ac \Longrightarrow (5-c)^2 > 12 (\text{M1A1})$		
	If $b^2 > 4ac$ is not seen then 4×3	3×1 needs to be seen explicitly.	
			(3)

Summer 2017

Past Paper (Mark Scheme)

(a)	M1. Attempts to find at least one	
(C)	$(5-c)^{2} = 12 \Rightarrow (c=)5\pm\sqrt{12}$ or $(5-c)^{2} = 12 \Rightarrow c^{2}-10c+13=0$ $=10 \pm \sqrt{(-10)^{2}} \pm 122$ (See General Principles) (the "= 0" may be implied)	M1A1
	$\Rightarrow (c=) \frac{-10 \pm \sqrt{(-10)} - 4 \times 13}{2}$ All contect critical values in any form. Note that $\sqrt{12}$ may be seen a $2\sqrt{3}$.	s
	$c < "5 - \sqrt{12}", \ c > "5 + \sqrt{12}"$ Chooses outside region. The '0 <' can be ignored for this mark. So look for $c <$ their $5 - \sqrt{12}$ $c >$ their $5 + \sqrt{12}$. This could be scored from $5 + \sqrt{12} < c < 5 - \sqrt{12}$ or $5 - \sqrt{12} > c > 5 + \sqrt{12}$. Evidence is to be taken from their answers not from a diagram.	, M1 Dr
	$0 < c < 5 - \sqrt{12}, \ c > 5 + \sqrt{12}$ $Correct ranges including the `0 <' e.g. answer as shown or each region written separately or e.g. (0,5 - \sqrt{12}), (5 + \sqrt{12}, \infty). The critical values may be un-simplified but must be at least \frac{10 + \sqrt{48}}{2}, \frac{10 - \sqrt{48}}{2}. \text{ Note that} 0 < c < 5 - \sqrt{12} \text{ and } c > 5 + \sqrt{12} would score M1A0.$	^d A1 2
	Allow the use of x rather than c in (c) but the final answer must be in	L
	terms of <i>c</i> .	
		(4)
		(11 marks)

Past Paper

Mathematics C1



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Figure 2 shows a sketch of part of the curve $y = f(x), x \in \mathbb{R}$, where

 $f(x) = (2x - 5)^2(x + 3)$

(a) Given that

- (i) the curve with equation y = f(x) k, $x \in \mathbb{R}$, passes through the origin, find the value of the constant k,
- (ii) the curve with equation $y = f(x + c), x \in \mathbb{R}$, has a minimum point at the origin, find the value of the constant *c*.

(b) Show that $f'(x) = 12x^2 - 16x - 35$

Points *A* and *B* are distinct points that lie on the curve y = f(x).

The gradient of the curve at A is equal to the gradient of the curve at B.

Given that point A has x coordinate 3

(c) find the *x* coordinate of point *B*.

(5)

(3)

(3)



Question Number	Scheme		Marks
10.(a)(i)	$k = \left(-5\right)^2 \times 3 = 75$	M1: Attempts to find the 'y' intercept. Accept as evidence $(-5)^2 \times 3$ with or without the bracket. If they expand f(x) to polynomial form here then they must then select their constant to score this mark . May be implied by sight of 75 on the diagram. A1: $k = 75$.Must clearly be identified as k. Allow this mark even from an incorrect or incomplete expansion as long as the constant $k = 75$ is obtained. Do not isw e.g. if 75 is seen followed by $k = -75$ score M1A0.	M1A1
(ii)	$c = \frac{5}{2}$ only	$c = \frac{5}{2}$ oe (and no other values). Do not award just from the diagram – must be stated as the value of <i>c</i> .	B1
			(3)
(b)	f $(x) = (2x-5)^2(x+3) = (4x^2-20x+25)(x+3) = 4x^3-8x^2-35x+75$ Attempts f(x) as a cubic polynomial by attempting to square the first bracket and multiply by the linear bracket or expands $(2x-5)(x+3)$ and then multiplies by $2x-5$ Must be seen or used in (b) but may be done in part (a). Allow poor squaring e.g. $(2x-5)^2 = 4x^2 \pm 25$		M1
	$(f'(x) =)12x^2 - 16x - 35*$	M1: Reduces powers by 1 in all terms including any constant $\rightarrow 0$ A1: Correct proof. Withhold this mark if there have been any errors including missing brackets earlier e.g. $(2x-5)^2(x+3) = 4x^2 - 20x + 25(x+3) =$	M1A1*

		•	
		Substitutes $x = 3$ into their f '(x) or	
(c)	$f'(3) = 12 \times 3^2 - 16 \times 3 - 35$	the given $f'(x)$. Must be a changed	M1
		function i.e. not into $f(x)$.	
		Sets their $f'(x)$ or the given $f'(x) =$	
	$12r^2 - 16r - 35 - 1251$	their f '(3) with a consistent f '.	dM1
	12x - 10x - 35 - 25	Dependent on the previous method	ulvii
		mark.	
		$12x^2 - 16x - 60 = 0 \text{ or equivalent } 3$	
		term quadratic e.g. $12x^2 - 16x = 60$.	
	$12x^2 - 16x - 60 = 0$	(A correct quadratic equation may be	A1 cso
	12x 10x 00 = 0	implied by later work). This is cso so	111 050
		must come from correct work – i.e.	
		they must be using the given $f'(x)$.	
		Solves 3 term quadratic by suitable	
	$(x-3)(12x+20) = 0 \Longrightarrow x = \dots$	method – see General Principles.	dd M1
		Dependent on both previous	
		method marks.	
		$x = -\frac{5}{3}$ oe clearly identified. If $x = 3$	
		is also given and not rejected, this	
	5	mark is withheld.	
	$x = -\frac{3}{2}$	(allow -1.6 recurring as long as it is	A1 cso
	5	clear i.e. a dot above the 6). This is	
		cso and must come from correct	
		work – i.e. they must be using the	
		given $f'(x)$.	(-)
			(5)
			(11 marks)
Alt (b)	f (x) = $(2x-5)^2(x+3) \Rightarrow$ f'(x) = $(2x-5)^2 \times 1 + (x+3) \times 4(2x-5)$ M1: Attempts product rule to give an expression of the form $p(2x-5)^2 + q(x+3)(2x-5)$ M1: Multiplies out and collects terms		
Product			M1
rule.			M1A1*
	A1: $f'(x) = 12x^2 - 16x - 35*$		