Write your name here

Surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number	Candidate Number

Core Mathematics C1

Advanced Subsidiary

Monday 13 January 2014 – Morning
Time: 1 hour 30 minutes

Paper Reference
6663A/01

You must have:
Mathematical Formulae and Statistical Tables (Pink)

Total Marks

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.

Turn over ▶

PEARSON

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1. Simplify fully

(a) $\left(2\sqrt{x}\right)^2$

(1)

(b) $\dfrac{5+\sqrt{7}}{2+\sqrt{7}}$

(3)

Question Number	Scheme	Marks
1.	(a) $\left(2\sqrt{x}\right)^2 = 4x$	B1
		(1)
	(b) $\dfrac{(5+\sqrt{7})}{(2+\sqrt{7})}\times\dfrac{(2-\sqrt{7})}{(2-\sqrt{7})}$	
	$=\dfrac{10-7+2\sqrt{7}-5\sqrt{7}}{-3}$	M1, A1
	$=-1+\sqrt{7}$	A1
		(3)
		(4 marks)

Notes

(a)	B1	$4x$.Accept alternatives such as $x4$, $4\times x$, $x\times 4$
	M1	For multiplying numerator and denominator by $2-\sqrt{7}$ and attempting to expand the brackets. There is no requirement to get the expanded numerator or denominator correct- seeing the brackets removed is sufficient.
(b)	A1	All four terms correct (unsimplified) on the numerator **OR** the correct denominator of -3
	A1	Correct answer $-1+\sqrt{7}$. Accept $\sqrt{7}-1$, $-1+1\sqrt{7}$ and other fully correct simplified forms

Leave blank

2. $$y = 2x^2 - \frac{4}{\sqrt{x}} + 1, \qquad x > 0$$

(a) Find $\frac{dy}{dx}$, giving each term in its simplest form.

(3)

(b) Find $\frac{d^2y}{dx^2}$, giving each term in its simplest form.

(2)

Question Number	Scheme	Marks
2.	(a) $2x^2-\dfrac{4}{\sqrt{x}}+1=2x^2-4x^{-\frac{1}{2}}+1$	
	$\dfrac{dy}{dx}=2\times 2x-4\times -\dfrac{1}{2}x^{-\frac{3}{2}}(+0)\quad (x^n\to x^{n-1})$	M1
	$\dfrac{dy}{dx}=4x+2x^{-\frac{3}{2}}$ or $4x+\dfrac{2}{x^{\frac{3}{2}}}$ *oe*	A1,A1
		(3)
	(b) $x^n\to x^{n-1}$	M1
	$\dfrac{d^2y}{dx^2}=4-3x^{-\frac{5}{2}}$ or $4-\dfrac{3}{x^{\frac{5}{2}}}$	A1
		(2) **(5 marks)**

Notes

(a)	M1 $x^n\to x^{n-1}$ for any term. The sight of $2x^2\to Ax$ OR $Cx^{-\frac{1}{2}x}\to Dx^{-\frac{3}{2}x}$ OR $1\to 0$ is sufficient Do not follow through on an incorrect index of $\dfrac{4}{\sqrt{x}}$ for this mark. A1 One of the first two terms correct and simplified. Either $4x$ or $2x^{-\frac{3}{2}}$ Accept equivalents such as $4\times x$ and $2\times x^{-\frac{3}{2}}=\dfrac{2}{x^{1.5}}$ Ignore +c for this mark. Do not accept unsimplified terms like $2\times 2x$ A1 A completely correct solution with no +c. That is $4x+2x^{-\frac{3}{2}}$ Accept simplified equivalent expressions such as $4\times x+2\times x^{-\frac{3}{2}}$ or $4x+\dfrac{2}{x^{\frac{3}{2}}}$ There is no requirement to give the lhs ie $\dfrac{dy}{dx}=$. However if the lhs is incorrect withhold the last A1
(b)	M1 For either $4x\to 4$ or $x^n\to x^{n-1}$ for a fractional term. Follow through on incorrect answers in (a). A1 A completely correct solution $4-3x^{-\frac{5}{2}}$ Award for expressions such as $4-3\times x^{-\frac{5}{2}}$ or $4-\dfrac{3}{x^{\frac{5}{2}}}$ or $-3\times x^{-2.5}+4$ There is no requirement to give the lhs ie $\dfrac{d^2y}{dx^2}=....$ However if the lhs is incorrect withhold the last A1

Leave blank

3. Solve the simultaneous equations

$$x - 2y - 1 = 0$$

$$x^2 + 4y^2 - 10x + 9 = 0$$

(7)

Question Number	Scheme		Marks
3.	$x=2y+1$	$2y=x-1$	
	$(2y+1)^2+4y^2-10(2y+1)+9=0$	$x^2+(x-1)^2-10x+9=0$	M1
	$8y^2-16y=0$	$2x^2-12x+10=0$	M1,A1
	$8y(y-2)=0$ Alt $y(8y-16)=0$	$2(x-1)(x-5)=0$ Alt $(2x-2)(x-5)=0$	M1
	$y=0, y=2$	$x=1, x=5$	
	$y=0$ in $x=2y+1 \Rightarrow x=1$	$x=1$ in $y=\dfrac{x-1}{2}=0$	M1
	$y=2$ in $x=2y+1 \Rightarrow x=5$	$x=5$ in $y=\dfrac{x-1}{2}=2$	
	x=1,y=0 and x=5,y=2	x=1,y=0 and x=5,y=2	A1,A1
			(7 marks)

Notes

M1 Rearrange $x-2y-1=0$ into $x=..$, or $y=..$, or $2y=..$ **and** attempt to fully substitute into 2nd equation.
It does not need to be correct but a clear attempt must be made.
Condone missing brackets $(2y+1)^2+4y^2-10\times2y+1+9=0$

M1 Collect like terms to produce a quadratic equation in x (or y) =0

A1 Correct quadratic equation in x (or y)=0. Either $A(y^2-2y)=0$ or $B(x^2-6x+5)=0$

M1 Attempt to solve, with usual rules. Check the first and last terms only for factorisation. See appendix for completing the square and use of formula. Condone a solution from cancelling in a case like $A(y^2-2y)=0$. They must proceed to find at least one solution $x=..$ or $y=..$

M1 Substitute at least one value of their x to find y or vice versa. This may be implied by their solution- you will need to check!

A1 Both x's or both y's correct **or** a correct matching pair. Accept as a coordinate.
Do not accept correct answers that are obtained from incorrect equations.

A1 Both 'pairs' correct. Accept as coordinates $(1,0)\ (5,2)$

Special Cases where candidates write down answers with little or no working as can be awarded above.
One correct solution – B2.
Two correct solutions – B2, B2
To score all 7 marks candidates must prove that there are **only** two solutions. This could be justified by a sketch.

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4.

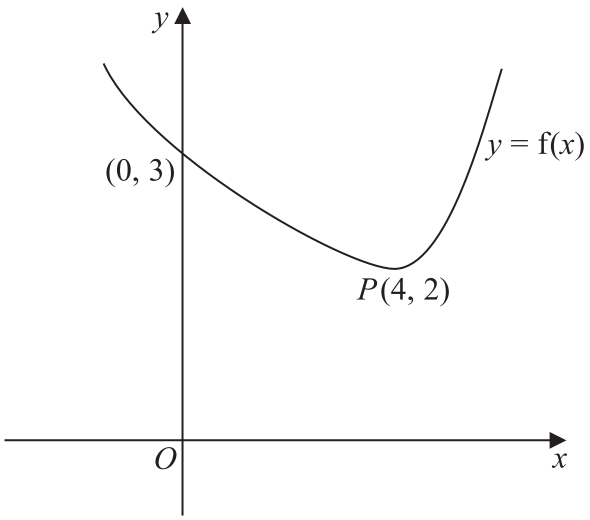


Figure 1

Figure 1 shows a sketch of a curve with equation $y = \mathrm{f}(x)$.

The curve crosses the y-axis at (0, 3) and has a minimum at P (4, 2).

On separate diagrams, sketch the curve with equation

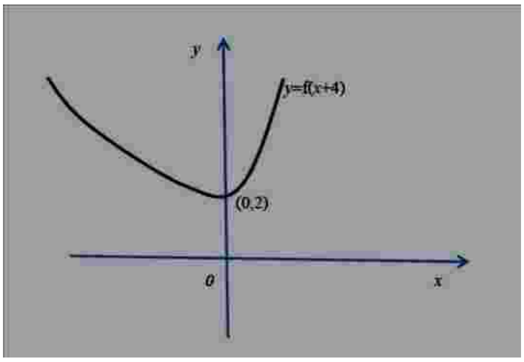
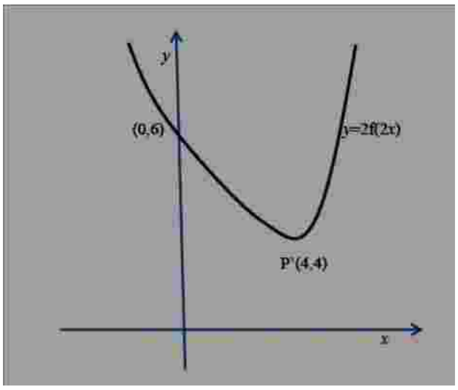
(a) $y = \mathrm{f}(x + 4)$,

(2)

(b) $y = 2\mathrm{f}(x)$.

(2)

On each diagram, show clearly the coordinates of the minimum point and any point of intersection with the y-axis.

Question Number	Scheme		Marks
4.	(a) 	Horizontal translation of ±4	M1
		Minimum point on the y- axis at (0,2)	A1
			(2)
	(b) 	Correct 'shape' with P' adapted	M1
		y intercept (0,6) and P'(4,4)	A1
			(2)
			(4 marks)

Notes

(a)	M1 A horizontal translationof ± 4. The y coordinate of P remains unchanged at 2. Look for $P' = (0,2)$ or $(8,2)$. Condone U shaped curves A1 The shape remains unchanged and has a minimum at (0,2). Condone U shaped curves	
(b)	M1 The curve remains in quadrant 1 and quadrant 2 with the minimum in quadrant 1. The shape must be correct. Condone U shaped curves. P' must have been adapted. The mark cannot be scored for drawing the original curve with P'=(4,2). A1 Correct shape, condoning U shapes with the y intercept at (0, 6) and P'=(4,4) The coordinates of the points may appear in the text or besides the diagram. This is acceptable but if they contradict the diagram, the diagram takes precedence.	

Leave blank

5. Given that for all positive integers n,

$$\sum_{r=1}^{n} a_r = 12 + 4n^2$$

(a) find the value of $\sum_{r=1}^{5} a_r$

(2)

(b) Find the value of a_6

(3)

Question Number	Scheme	Marks
5.	(a) $\sum_{r=1}^{5} a_r = 12 + 4\times 5^2 = ..$	M1
	$= 112$	A1
		(2)
	(b) $\sum_{r=1}^{6} a_r = 12 + 4\times 6^2$	M1
	$a_6 = \sum_{r=1}^{r=6} a_r - (\text{part } a)$	dM1
	$a_6 = 156 - 112 = 44$	A1
		(3) **(5 marks)**

Notes

(a)	M1 Substitutes n=5 into the expression $12+4n^2$ and attempt to find a numerical answer for $\sum_{r=1}^{5} a_r$. Accept as evidence expressions such as $12+4\times 5^2 = ..$, $12+4(5)^2 = ..$, even $12+20^2 = 412$ Accept for this mark solutions which add $12+4\times1^2, 12+4\times2^2, 12+4\times3^2, 12+4\times4^2, 12+4\times5^2$ and as a result 112 appears in a sum. A1 cao 112. Accept this answer with no incorrect working for both marks. If it is consequently summed it will be scored A0
(b)	M1 Substitutes n =6 into the expression $12+4n^2$ Accept as evidence $12+4\times 6^2 = ..$, $12+4(6^2) = ..$ $12+24^2 = ..$ or indeed 156. You **can** accept the appearance of $12+4\times 6^2 = ..$ in a sum of terms. dM1 Attempts to find their answer to $\sum_{r=1}^{6} a_r$ − their answer to part a This is dependent upon the previous M mark. Also accept a restart where they attempt $\sum_{r=1}^{6} a_r - \sum_{r=1}^{5} a_r$ A1 cao 44 Alternative to 5(b) M1 Writes down an expression for $a_n = (12+4n^2) - (12+4(n-1)^2) = 4(n^2-(n-1)^2) = 4(2n-1)$ dM1 Subs $n=6$ into the expression for $a_n = 4(2n-1) = ...$ A1 cao 44

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6.

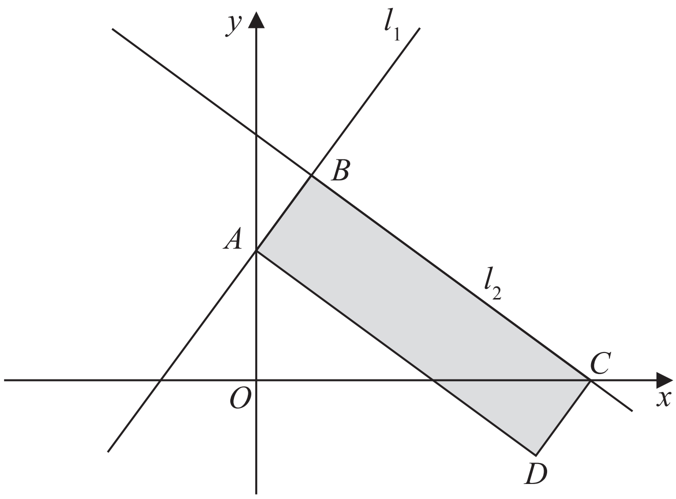

Figure 2

The straight line l_1 has equation $2y = 3x + 7$

The line l_1 crosses the y-axis at the point A as shown in Figure 2.

(a) (i) State the gradient of l_1

(ii) Write down the coordinates of the point A.

(2)

Another straight line l_2 intersects l_1 at the point B (1, 5) and crosses the x-axis at the point C, as shown in Figure 2.

Given that $\angle ABC = 90°$,

(b) find an equation of l_2 in the form $ax + by + c = 0$, where a, b and c are integers.

(4)

The rectangle $ABCD$, shown shaded in Figure 2, has vertices at the points A, B, C and D.

(c) Find the exact area of rectangle $ABCD$.

(5)

Question Number	Scheme	Marks
6.	(a) (i) $\frac{3}{2}$ or equivalents such as 1.5	B1
	(ii) (0, 3.5) Accept y= $3\frac{1}{2}$	B1
		(2)
	(b) Perpendicular gradient $l_2 = = -\frac{2}{3}$	B1ft
	Equation of line is: $y-5=-\frac{2}{3}(x-1)$	M1A1
	$3y+2x-17=0$	A1
		(4)
	(c) Point C: $y=0 \Rightarrow 2x=17 \Rightarrow x=8.5$ oe	M1, A1
	$AB=\sqrt{(1-0)^2+(5-3.5)^2}=\left(\frac{\sqrt{13}}{2}\right)$	M1 (either)
	$BC=\sqrt{(8.5-1)^2+(5-0)^2}=\left(\frac{\sqrt{325}}{2}\right)$	
	Area rectangle = AB×BC= $\frac{\sqrt{13}}{2}\times\frac{\sqrt{325}}{2}=\frac{\sqrt{13}}{2}\times\frac{\sqrt{13}\sqrt{25}}{2}=\frac{5\times13}{4}=16.25$ oe	dM1A1
		(5)
		(11 marks)

Notes

(a)	B1 cao gradient =1.5. Accept equivalences such as $\frac{3}{2}$
	B1 cao intercept =(0,3.5). Accept 3.5, y=3.5 and equivalences such as $\frac{7}{2}$
(b)	B1ft For using the perpendicular gradient rule, $m_1=-\frac{1}{m_2}$ on their '1.5'.
	Accept $-\frac{1}{'1.5'}$ or this as part of their equation for l_2 Eg. $-\frac{1}{'1.5'}=\frac{y-...}{x-...}$
	M1 For an attempt at finding the equation of l_2 using (1,5) and their adapted gradient. Condone for this mark a gradient of $\frac{3}{2}$ going to $\frac{2}{3}$.Eg. Allow for $\frac{y-5}{x-1}=\frac{2}{3}$ If the form $y=mx+c$ is used it must be a full method to find c with (1,5) and an adapted gradient.
	A1 For an a correct unsimplified equation of the line through (1,5) with the correct gradient. Allow $\frac{y-5}{x-1}=-\frac{2}{3}$ and $5=-\frac{2}{3}\times1+c \Rightarrow c=\frac{17}{3}$
	A1 cso $\pm(3y+2x-17)=0$
	An example of B1ftM0A0A0 would be $-\frac{1}{3}=\frac{y-5}{x+1}$ following a gradient of '3' in part (a)
	An example of B1ftM1A0A0 would be $-\frac{1}{3}=\frac{y-5}{x-1}$ following a gradient of '3' in part (a)
	An example of B0ftM1A0A0 would be $\frac{1}{3}=\frac{y-5}{x-1}$ following a gradient of '3' in part (a)

Question Number	Scheme	Marks
	Notes for Question 6 continued	
(c)	M1 An attempt to use their equation found in part b to find the *x* coordinate of *C* They must either use the equation of l_2 and set $y=0 \Rightarrow x=...$ or use its gradient $\frac{17.5}{x}=\frac{3}{2} \Rightarrow x=..$ A1 *C*= (8.5, 0). Allow equivalents such as *x* =8.5 at *C* M1 An attempt to use $\sqrt{(x_1-x_2)^2+(y_1-y_2)^2}$ for *AB* or *BC*. There is no need to 'calculate' these. Evidence of an attempt would be $AB^2=1^2+1.5^2 \Rightarrow AB=..$ dM1 Multiplying together their values of *AB* and *BC* to find area *ABCD* It is dependent upon both M's having been scored. A1 cao16.25 or equivalents such as $\frac{65}{4}$.	

Leave blank

7. Shelim starts his new job on a salary of £14 000. He will receive a rise of £1500 a year for each full year that he works, so that he will have a salary of £15 500 in year 2, a salary of £17 000 in year 3 and so on. When Shelim's salary reaches £26 000, he will receive no more rises. His salary will remain at £26 000.

(a) Show that Shelim will have a salary of £26 000 in year 9.
(2)

(b) Find the total amount that Shelim will earn in his job in the first 9 years.
(2)

Anna starts her new job at the same time as Shelim on a salary of £A. She receives a rise of £1000 a year for each full year that she works, so that she has a salary of £(A + 1000) in year 2, £(A + 2000) in year 3 and so on. The maximum salary for her job, which is reached in year 10, is also £26 000.

(c) Find the difference in the total amount earned by Shelim and Anna in the first 10 years.
(6)

Question Number	Scheme	Marks
7.	(a) 14000+8×1500=14000+12000 =£26000	M1 A1* (2)
	(b) $S_n = \frac{n}{2}(a+l) = \frac{9}{2}\times(14000+26000)$ OR $S_9 = \frac{n}{2}(2a+(n-1)d) = \frac{9}{2}\times(28000+8\times1500)$ =£180000	M1 A1 (2)
	(c) Use $a+(n-1)d$ to find A $A+(10-1)\times1000 = 26000$ $A = 17000$ Use $S_n = \frac{n}{2}(a+l)$ or $S_n = \frac{n}{2}(2a+(n-1)d)$ to find S for Anna $S_{10} = \frac{10}{2}(17000+26000)$ $(=£215000)$ or $S_{10} = \frac{10}{2}(2\times17000+9\times1000)(=£215000)$ Shelim earns 180000+26000 in 10 years =(£206000) Difference= £9000	 M1 A1 M1A1 B1ft A1 (6) **(10 marks)**

Notes

(a)	M1 Uses $S = a+(n-1)d$ with a=14000, d=1500 and n=8, 9 or 10 in an attempt to find salary in year 9 Accept a sequence written out only if all terms up to year 9 are included-Allow no errors. A1* csa 26000. It is acceptable to write a sequence for both the 2 marks FYI the terms are 14000,15500,17000,18500,20000,21500,23000,24500,26000 Alt (a) Alternative working backwards M1 Uses $S = a+(n-1)d$ with a=14000, d=1500 and S =26000 in attempt to find n. It must reach n=.. A1 n=9
(b)	M1 Uses $S_n = \frac{n}{2}(a+l)$ with a=14000, l=26000 and n=8, 9 or 10. Do not allow ft's on incorrect l's . Alternatively uses $S_n = \frac{n}{2}(2a+(n-1)d)$ with a=14000, d=1500 and n=8, 9 or 10. Weaker candidates may list the individual salaries. This is acceptable as long as all terms are included. For example $14000+15500+17000+18500+20000+21500+23000+24500+26000$ A1 Cao (£) 180000.

Question Number	Scheme	Marks
	Notes for Question 7 continued	
(c)	M1 Use $l = a+(n-1)d$ to find *A*. It must be a full method with *d*=1000, *l*=26000*a*=*A* and *n*=9, 10 or 11 leading to a value for *A* A1 *A*=17000. Accept *A*=17000 written down for 2 marks as long as no incorrect work seen in its calculation. M1 Use $S_n = \frac{n}{2}(a+l)$ to find *S* for Anna. Follow through on their *A*, but *l*=26000 and *n*=9, 10 or 11 Alternatively uses $S_n = \frac{n}{2}(2a+(n-1)d)$ with their numerical value of *A*, *d*=1000 and *n*=9, 10 or 11 Accept a series of terms with their value of A, rising in £1000's up to a maximum of £26000. A1 Anna earns $S_{10} = \frac{10}{2}(17000+26000)$ OR $S_{10} = \frac{10}{2}(2\times17000+9\times1000)$ in 10 years This is an intermediate answer. There is no requirement to state the value £215 000 B1ft Shelim earns (b)+26000 in 10 years. This may be scored at the start of part c. A1 CAO and CSO Difference =£9000	

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8. The equation $2x^2 + 2kx + (k + 2) = 0$, where k is a constant, has two distinct real roots.

(a) Show that k satisfies

$$k^2 - 2k - 4 > 0$$

(3)

(b) Find the set of possible values of k.

(4)

Question Number	Scheme	Marks
8.	(a) $b^2-4ac=(2k)^2-4\times 2\times(k+2)$	M1A1
	$b^2-4ac>0 \Rightarrow 4k^2-4\times 2\times(k+2)>0 \Rightarrow k^2-2k-4>0$	A1*
		(3)
	(b) $k^2-2k-4=0 \Rightarrow (k-1)^2=5$	M1
	$k=1\pm\sqrt{5}$ oe	A1
	$k>1+\sqrt{5}$, $k<1-\sqrt{5}$	dM1A1
		(4)
		(7 marks)
	Alt (a) $b^2>4ac \Rightarrow (2k)^2>4\times 2\times(k+2)$	M1A1
	$\Rightarrow k^2-2k-4>0$	A1*
		(3)

Notes

(a)	M1 For attempting to use b^2-4ac with the values of *a*, *b* and *c* from the given equation. Condone invisible brackets. $2k^2-4\times 2\times k+2$ could be evidence	
	A1 Fully correct (unsimplified) expression for $b^2-4ac=(2k)^2-4\times 2\times(k+2)$ The bracketing must be correct. You can accept with or without any inequality signs. Accept $a=2, b=2k, c=k+2 \Rightarrow b^2-4ac=(2k)^2-4\times 2\times(k+2)$	
	A1* Full proof, no errors, this is a given answer. It must be stated or implied that $b^2-4ac>0$ Do not accept recovery from poor or incorrect bracketing or incorrect inequalities. Do not accept the answer written down without seeing an intermediate line such as $4k^2-4\times 2\times(k+2)>0 \Rightarrow k^2-2k-4>0$ Or $4k^2-8k-8>0 \Rightarrow k^2-2k-4>0$ The inequality must have been seen at least once before the final line for this mark to have been awarded. Eg accept $D=4k^2-8k-8 \Rightarrow 4k^2-8k-8>0 \Rightarrow k^2-2k-2>0$	
(b)	M1 Attempt to solve the given 3 term quadratic (=0) by formula or completing the square. **Do NOT accept an attempt to factorise in this question**. If the formula is given it must be correct. It can be implied by seeing either $\frac{-(-2)\pm\sqrt{(-2)^2-4\times 1\times -4}}{2\times 1}$ or $\frac{--2\pm\sqrt{-2^2-4\times 1\times -4}}{2\times 1}$ If completing the square is used it can be implied by $(k-1)^2\pm 1-4=0 \Rightarrow k=...$	
	A1 Obtains critical values of $1\pm\sqrt{5}$. Accept $\frac{2\pm\sqrt{20}}{2}$	
	dM1 Outsides of their values chosen. It is dependent upon the previous M mark having been awarded. States $k>$ their largest value, $k<$ their smallest value Do not award simply for a diagram or a table- they must have chosen their 'outside regions'	
	A1 Correct answer only. Accept $k>1+\sqrt{5}$ or $k<1-\sqrt{5}$, $k>1+\sqrt{5}$ $k<1-\sqrt{5}$, $(-\infty, 1-\sqrt{5})\cup(1+\sqrt{5},\infty)$ but not $k>1+\sqrt{5}$ and $k<1-\sqrt{5}$, $1+\sqrt{5}<k<1-\sqrt{5}$	

Question Number	Scheme	Marks
	Notes for Question 8 continued	
	Also accept exact alternatives as a simplified form is not explicitly asked for in the question Accept versions such as $k > \frac{2+\sqrt{20}}{2}$ or $k < \frac{2-\sqrt{20}}{2}$	

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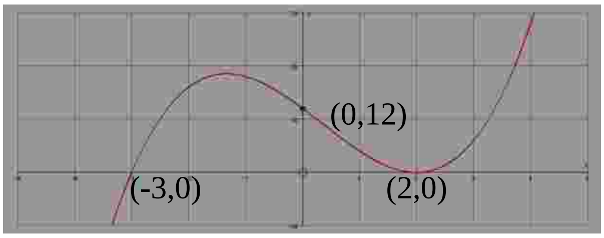
9. A curve with equation $y = f(x)$ passes through the point (3, 6). Given that

$$f'(x) = (x - 2)(3x + 4)$$

(a) use integration to find $f(x)$. Give your answer as a polynomial in its simplest form. **(5)**

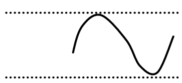
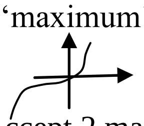
(b) Show that $f(x) \equiv (x - 2)^2(x + p)$, where p is a positive constant. State the value of p. **(3)**

(c) Sketch the graph of $y = f(x)$, showing the coordinates of any points where the curve touches or crosses the coordinate axes. **(4)**

Question Number	Scheme	Marks
9.	(a) $f'(x)=(x-2)(3x+4)$	
	$=3x^2-2x-8$	B1
	$y=\int 3x^2-2x-8\,dx=3\times\frac{x^3}{3}-2\times\frac{x^2}{2}-8x+c$	M1A1
	$x=3, y=6\Rightarrow 6=27-9-24+c$	
	$c=..$	M1
	$f(x)=x^3-x^2-8x+12$ cso	A1
		(5)
	(b) $f(x)=(x-2)^2(x+p)\quad p=3$	B1
	$f(x)=(x^2-4x+4)(x+3)$	
	$f(x)=x^3-4x^2+3x^2+4x-12x+12$	
	$f(x)=x^3-x^2-8x+12$ cso	M1A1
		(3)
	(c)	
	 	
	Shape	B1
	Min at (2,0)	B1
	Crosses x- axis at (-3,0)	B1ft
	Crosses y- axis at (0,12)	B1
		(4)
		(12 marks)

Notes

(a)	B1	Writes $(x-2)(3x+4)$ as $3x^2-2x-8$
	M1	$x^n\to x^{n+1}$ in any one term. For this M to be scored there must have been an attempt to expand the brackets and obtain a quadratic expression
	A1	Correct (unsimplified) expression for $f(x)$, no need for +c. Accept $3\frac{x^3}{3}-2\frac{x^2}{2}-8x$
	M1	Substitutes x=3 and y=6 into their f(x) containing a constant 'c' and proceed to find its value.
	A1	Cso $f(x)=x^3-x^2-8x+12$. Allow y =.. **Do not accept an answer produced from part (b)**
(b)	B1	States $p=3$ This may be obtained from subbing (3,6) into $f(x)=(x-2)^2(x+p)$
	M1	Multiplies out a pair of brackets first, usually $(x-2)^2$ and then attempts to multiply by the third.The minimum criteria should be the first multiplication is a 3T quadratic with correct first and last terms and the second is a 4T cubic with correct first and last terms. Accept an expression involving p for M1 $(x-2)^2(x+p)=(x^2+..x+4)(x+p)=x^3+..x^2+..x+4p$
	A1	cso $f(x)=x^3-x^2-8x+12$, which must be the same as their answer for part (a)

	Notes for Question 9 continued
	Candidates who have experienced Core 2 could take their answer to (a) and factorise. The mark scheme can be applied with M1 for division by $(x-2)$ and further factorisation of the quotient $\begin{array}{r} x^2 \\ x-2\overline{\smash{)}x^3+\ldots\ldots\ldots} \end{array}$ Alternatively the candidate could divide by (x^2-4x+4) to obtain $(x+..)$ $\begin{array}{r} x+.. \\ x^2-4x+4\overline{\smash{)}x^3+\ldots\ldots\ldots} \end{array}$ The A1 is scored for $\mathrm{f}(x)=(x-2)^2(x+3)$ The B1 is awarded for a statement of $p=3$ and not just $(x-2)^2(x+3)$
(c)	B1 Shape $+x^3$ graph with one maximum and one minimum. Its position is not important for this mark. It must appear to tend to + infinity at the rhs and – infinity at the lhs. The curve must extend beyond its 'maximum' point and minimum points.   Eg. These are NOT acceptable. B1 There is a turning point at (2, 0). Accept 2 marked as a maximum or minimum on the x- axis. B1ft Graph crosses the x- axis at (-3, 0). Accept -3 marked at the point where the curve crosses the x-axis. You may follow through on their values of '$-p$' as long as $p<2$ B1 Graph crosses the y-axis at (0, 12). Accept 12 marked on the y- axis.

Leave blank

10. The curve C has equation $y = x^3 - 2x^2 - x + 3$

The point P, which lies on C, has coordinates $(2, 1)$.

(a) Show that an equation of the tangent to C at the point P is $y = 3x - 5$

(5)

The point Q also lies on C.

Given that the tangent to C at Q is parallel to the tangent to C at P,

(b) find the coordinates of the point Q.

(5)

Question Number	Scheme	Marks
10.	(a) $x^n \to x^{n-1}$ $\frac{dy}{dx} = 3x^2 - 2\times 2x - 1$	M1A1
	Sub x=2 $\frac{dy}{dx} = 3\times 2^2 - 2\times 4 - 1 = (3)$	M1
	$3 = \frac{y-1}{x-2}$	dM1
	$y = 3x - 5$ cso	A1*
		(5)
	(b) At Q $\frac{dy}{dx} = 3x^2 - 4x - 1 = 3$	
	$3x^2 - 4x - 4 = 0$	M1
	$(3x+2)(x-2) = 0$	dM1
	$x = -\frac{2}{3}$	A1
	Sub $x = -\frac{2}{3}$ into $y = x^3 - 2x^2 - x + 3$	dM1
	$y = \frac{67}{27}$	A1
		(5)
		(10 marks)

Notes

(a)	M1 $x^n \to x^{n-1}$ for any term including 3→0. A1 $\left(\frac{dy}{dx}\right) = 3x^2 - 2\times 2x - 1$ There is no need to see any simplification M1 Sub x=2 into their f '(x) dM1 Uses their numerical gradient with (2, 1) to find an equation of a tangent to y = f(x). It is dependent upon both M's. Accept their $\left.\frac{dy}{dx}\right\|_{x=2} = \frac{y-1}{x-2}$. Both signs must be correct If $y = mx + c$ is used then it must be a full attempt to find a numerical 'c' A1* Cso $y = 3x - 5$. This is a given answer and all steps must be correct. Look for gradient =3 having been achieved by differentiation.
(b)	M1 Sets their $\frac{dy}{dx} = 3$ and proceeds to a 3TQ=0. Condone errors on $\left(\frac{dy}{dx}\right)$ dM1 Factorises their 3TQ (usual rules) leading to a solution x=… . It is dependent upon the previous M. Award also for use of formula/ completion of square as long as the previous M has been awarded. A1 $x = -\frac{2}{3}$ d M1 Sub their $x = -\frac{2}{3}$ into $y = x^3 - 2x^2 - x + 3$. It is dependent only upon the first M in (b) having been scored A1 Correct y coordinate $y = \frac{67}{27}$ or equivalent