OCR RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4751

Introduction to Advanced Mathematics (C1)

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
- Printed answer book 4751
- MEI Examination Formulae and Tables (MF2)

Other materials required:
None

Wednesday 18 May 2011
Morning

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES
These instructions are the same on the printed answer book and the question paper.

- The question paper will be found in the centre of the printed answer book.
- Write your name, centre number and candidate number in the spaces provided on the printed answer book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the printed answer book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are **not** permitted to use a calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES
This information is the same on the printed answer book and the question paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the question paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The printed answer book consists of **12** pages. The question paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this question paper for marking; it should be retained in the centre or destroyed.

No calculator can be used for this paper

Section A (36 marks)

1 Solve the inequality $6(x + 3) > 2x + 5$. **[3]**

2 A line has gradient 3 and passes through the point $(1, -5)$. The point $(5, k)$ is on this line. Find the value of k. **[2]**

3 **(i)** Evaluate $\left(\frac{9}{16}\right)^{-\frac{1}{2}}$. **[2]**

(ii) Simplify $\dfrac{(2ac^2)^3 \times 9a^2c}{36a^4c^{12}}$. **[3]**

4 The point P (5, 4) is on the curve $y = \mathrm{f}(x)$. State the coordinates of the image of P when the graph of $y = \mathrm{f}(x)$ is transformed to the graph of

(i) $y = \mathrm{f}(x - 5)$, **[2]**

(ii) $y = \mathrm{f}(x) + 7$. **[2]**

5 Find the coefficient of x^4 in the binomial expansion of $(5 + 2x)^6$. **[4]**

6 Expand $(2x + 5)(x - 1)(x + 3)$, simplifying your answer. **[3]**

7 Find the discriminant of $3x^2 + 5x + 2$. Hence state the number of distinct real roots of the equation $3x^2 + 5x + 2 = 0$. **[3]**

8 Make x the subject of the formula $y = \dfrac{1 - 2x}{x + 3}$. **[4]**

9 A line L is parallel to the line $x + 2y = 6$ and passes through the point $(10, 1)$. Find the area of the region bounded by the line L and the axes. **[5]**

10 Factorise $n^3 + 3n^2 + 2n$. Hence prove that, when n is a positive integer, $n^3 + 3n^2 + 2n$ is always divisible by 6. **[3]**

Section B (36 marks)

11 **(i)** Find algebraically the coordinates of the points of intersection of the curve $y = 4x^2 + 24x + 31$ and the line $x + y = 10$. **[5]**

(ii) Express $4x^2 + 24x + 31$ in the form $a(x + b)^2 + c$. **[4]**

(iii) For the curve $y = 4x^2 + 24x + 31$,

(A) write down the equation of the line of symmetry, **[1]**

(B) write down the minimum y-value on the curve. **[1]**

12

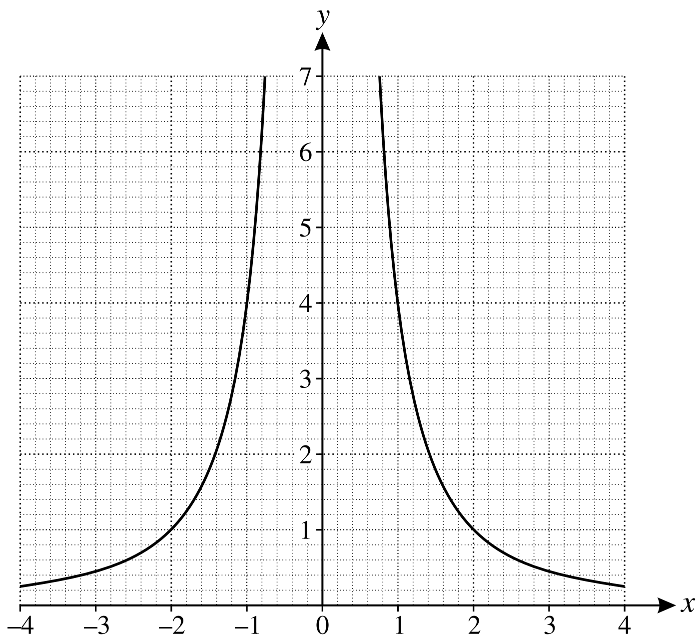

Fig. 12

Fig. 12 shows the graph of $y = \dfrac{4}{x^2}$.

(i) On the copy of Fig. 12, draw accurately the line $y = 2x + 5$ and hence find graphically the three roots of the equation $\dfrac{4}{x^2} = 2x + 5$. **[3]**

(ii) Show that the equation you have solved in part **(i)** may be written as $2x^3 + 5x^2 - 4 = 0$. Verify that $x = -2$ is a root of this equation and hence find, in exact form, the other two roots. **[6]**

(iii) By drawing a suitable line on the copy of Fig. 12, find the number of real roots of the equation $x^3 + 2x^2 - 4 = 0$. **[3]**

[Question 13 is printed overleaf.]

Turn over

13

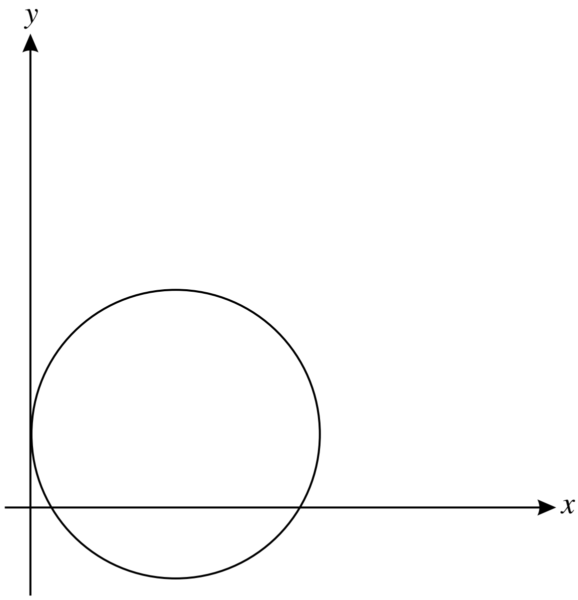

Fig. 13

Fig. 13 shows the circle with equation $(x-4)^2 + (y-2)^2 = 16$.

(i) Write down the radius of the circle and the coordinates of its centre. **[2]**

(ii) Find the x-coordinates of the points where the circle crosses the x-axis. Give your answers in surd form. **[4]**

(iii) Show that the point A $\left(4 + 2\sqrt{2},\ 2 + 2\sqrt{2}\right)$ lies on the circle and mark point A on the copy of Fig. 13.

Sketch the tangent to the circle at A and the other tangent that is parallel to it.

Find the equations of both these tangents. **[7]**

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4751

Introduction to Advanced Mathematics (C1)

PRINTED ANSWER BOOK

Candidates answer on this printed answer book.

OCR supplied materials:
- Question paper 4751 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other materials required:
None

Wednesday 18 May 2011
Morning

Duration: 1 hour 30 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

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No calculator can be used for this paper

Section A (36 marks)

1	
2	
3 (i)	

3 (ii)	
4 (i)	
4 (ii)	
5	

Turn over

6

7

8

9	
10	

Section B (36 marks)

11 (i)	

11 (ii)	
11(iii)(A)	
11(iii)(B)	

12 (i)

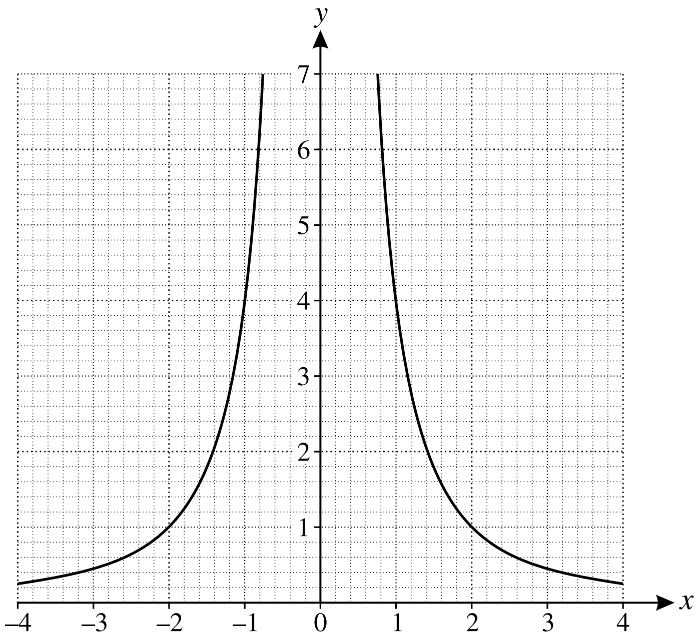

Fig. 12

12 (ii)

12 (iii)

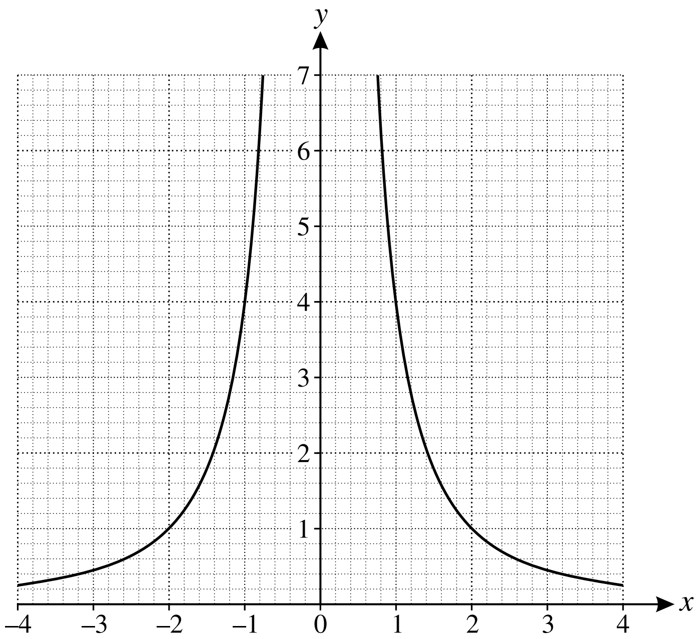

Fig. 12

13 (i)	
13 (ii)	

13 (iii)

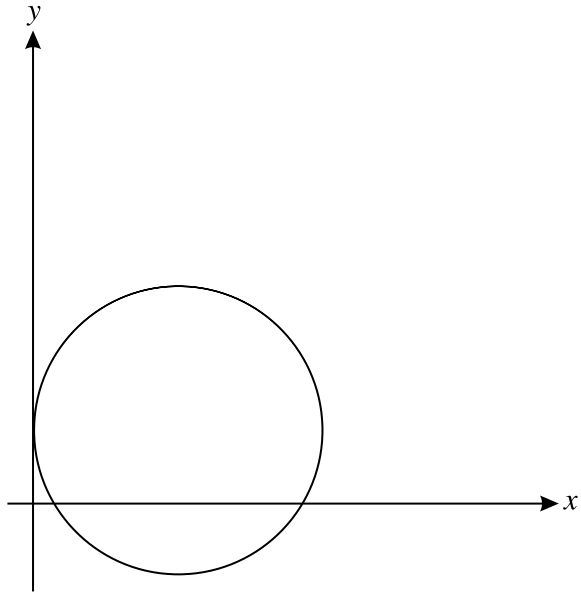

Fig. 13

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RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4751:** Introduction to Advanced Mathematics

Mark Scheme for June 2011

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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SECTION A

1	$x > -13/4$ o.e. isw www	**3**	condone $x > 13/{-4}$ or $13/{-4} < x$; **M2** for $4x > -13$ or **M1** for one side of this correct with correct inequality, and **B1** for final step ft from their $ax > b$ or $c > dx$ for $a \neq 1$and $d \neq 1$; if no working shown, allow **SC1** for $-13/4$ oe with equals sign or wrong inequality	**M1** for $13 > -4x$ (may be followed by $13/{-4} > x$, which earns no further credit); $6x + 3 > 2x + 5$ is an error not an MR; can get **M1** for $4x >$ ... following this, and then a possible **B1**
2	7	**2**	condone $y = 7$ or (5, 7); **M1** for $\frac{k-(-5)}{5-1} = 3$ or other correct use of gradient eg triangle with 4 across, 12 up	condone omission of brackets; or **M1** for correct method for eqn of line and $x = 5$ subst in their eqn and evaluated to find k; or **M1** for both of $y - k = 3(x - 5)$ oe and $y - (-5) = 3(x - 1)$ oe
3	(i) 4/3 isw	**2**	condone $\pm 4/3$; **M1** for numerator or denominator correct or for $\frac{3}{4}$ or $\frac{1}{\left(\frac{3}{4}\right)}$ oe or for $\left(\frac{16}{9}\right)^{\frac{1}{2}}$ soi	**M1** for just $-4/3$; allow **M1** for $\sqrt{16} = 4$ and $\sqrt{9} = 3$ soi; condone missing brackets

3	(ii) $\frac{2a}{c^5}$ or $2ac^{-5}$	**3**	**B1** for each 'term' correct; mark final answer; if B0, then **SC1** for $(2ac^2)^3 = 8a^3c^6$ or $72a^5c^7$ seen	condone a^1; condone multiplication signs but **0** for addition signs
4	(i) (10, 4)	**2**	**0** for (5, 4); otherwise **1** for each coordinate	ignore accompanying working / description of transformation; condone omission of brackets; (Image includes back page for examiners to check that there is no work there)
4	(ii) (5, 11)	**2**	**0** for (5, 4); otherwise **1** for each coordinate	ignore accompanying working / description of transformation; condone omission of brackets
5	6000	**4**	**M3** for $15 \times 5^2 \times 2^4$; or **M2** for two of these elements correct with multiplication or all three elements correct but without multiplication (e.g. in list or with addition signs); or **M1** for 15 soi or for 1 6 15 ... seen in Pascal's triangle; **SC2** for $20000[x^3]$	condone inclusion of x^4 eg $(2x)^4$; condone omission of brackets in $2x^4$ if 16 used; allow **M3** for correct term seen (often all terms written down) but then wrong term evaluated or all evaluated and correct term not identified; $15 \times 5^2 \times (2x)^4$ earns **M3** even if followed by $15 \times 25 \times 2$ calculated; no MR for wrong power evaluated but **SC** for fourth term evaluated

6	$2x^3 + 9x^2 + 4x - 15$	**3**	as final answer; ignore '= 0'; **B2** for 3 correct terms of answer seen or for an 8-term or 6 term expansion with at most one error: or **M1** for correct quadratic expansion of one pair of brackets; or **SC1** for a quadratic expansion with one error then a good attempt to multiply by the remaining bracket	correct 8-term expansion: $2x^3 + 6x^2 - 2x^2 + 5x^2 - 6x + 15x - 5x - 15$ correct 6-term expansions: $2x^3 + 4x^2 + 5x^2 - 6x + 10x - 15$ $2x^3 + 6x^2 + 3x^2 + 9x - 5x - 15$ $2x^3 + 11x^2 - 2x^2 + 15x - 11x - 15$ for **M1**, need not be simplified; ie **SC1** for knowing what to do and making a reasonable attempt, even if an error at an early stage means more marks not available
7	$b^2 - 4ac$ soi	**M1**		allow seen in formula; need not have numbers substituted but discriminant part must be correct;
	1 www	**A1**	or **B2**	clearly found as discriminant, or stated as $b^2 - 4ac$, not just seen in formula eg **M1A0** for $\sqrt{b^2 - 4ac} = \sqrt{1} = 1$;
	2 [distinct real roots]	**B1**	**B0** for finding the roots but not saying how many there are	condone discriminant not used; ignore incorrect roots found

8	$yx + 3y = 1 - 2x$ oe or ft	**M1**	for multiplying to eliminate denominator <u>and</u> for expanding brackets, or for correct division by y <u>and</u> writing as separate fractions: $x+3=\frac{1}{y}-\frac{2x}{y}$;	each mark is for carrying out the operation correctly; ft earlier errors for equivalent steps if error does not simplify problem; some common errors:
	$yx + 2x = 1 - 3y$ oe or ft	**M1**	for collecting terms; dep on having an ax term and an xy term, oe after division by y,	$y(x + 3) = 1 - 2x$ $yx + 3x = 1 - 2x$ **M0** $yx + 5x = 1$ **M1** ft $x(y + 5) = 1$ **M1** ft $x=\frac{1}{y+5}$ **M1** ft $yx + 3 = 1 - 2x$ **M0** $yx + 2x = -2$ **M1** ft $x(y + 2) = -2$ **M1** ft $x=\frac{-2}{y+2}$ **M1** ft
	$x(y + 2) = 1 - 3y$ oe or ft	**M1**	for taking out x factor; dep on having an ax term and an xy term, oe after division by y,	
	$[x=]\frac{1-3y}{y+2}$ oe or ft as final answer	**M1**	for division with no wrong work after; dep on dividing by a two-term expression; last M not earned for triple-decker fraction as final answer	for **M4**, must be completely correct;

9	$x + 2y = k$ ($k \neq 6$) or $y = -\frac{1}{2}x + c$ ($c \neq 3$)	**M1**	for attempt to use gradients of parallel lines the same; **M0** if just given line used;	eg following an error in manipulation, getting original line as $y = \frac{1}{2}x + 3$ then using $y = \frac{1}{2}x + c$ earns **M1** and can then go on to get **A0** for $y = \frac{1}{2}x - 4$, **M1** for (0, −4) **M1** for (8, 0) and **A0** for area of 16;
	$x + 2y = 12$ or [$y =$]$-\frac{1}{2}x + 6$ oe	**A1**	or **B2**; must be simplified; or evidence of correct 'stepping' using (10, 1) eg may be on diagram;	allow bod **B2** for a candidate who goes straight to $y = -\frac{1}{2}x + 6$ from $2y = -x + 6$; NB the equation of the line is not required; correct intercepts obtained will imply this **A1;**
	(12, 0) or ft	**M1**	or 'when $y = 0$, $x = 12$' etc or using 12 or ft as a limit of integration; intersections must ft from their line or 'stepping' diagram using their gradient	NB for intersections with axes, if both Ms are not gained, it must be clear which coord is being found eg **M0** for intn with x axis = 6 from correct eqn;; if the intersections are not explicit, they may be implied by the area calculation eg use of ht = 6 or the correct ft area found;
	(0, 6)or ft	**M1**	or integrating to give $-\frac{1}{4}x^2 + 6x$ or ft their line	allow ft from the given line as well as others for both these intersection Ms;
	36 [sq units] cao	**A1**	or **B3** www	NB **A0** if 36 is incorrectly obtained eg after intersection $x = -12$ seen (which earns **M0** from correct line);

10	$n(n + 1)(n + 2)$ argument from general consecutive numbers leading to: at least one must be even [exactly] one must be multiple of 3	**M1** **A1** **A1**	condone division by n and then $(n + 1)(n + 2)$ seen, or separate factors shown after factor theorem used; or divisible by 2; if M0: allow **SC1** for showing given expression always even	ignore ' = 0'; an induction approach using the factors may also be used eg by those doing paper FP1 as well; **A0** for just substituting numbers for n and stating results; allow **SC2** for a correct induction approach using the original cubic (**SC1** for each of showing even and showing divisible by 3)

SECTION B

11	(i) $x + 4x^2 + 24x + 31 = 10$ oe $4x^2 + 25x + 21$ [= 0] $(4x + 21)(x + 1)$ $x = -1$ or $-21/4$ oe isw $y = 11$ or $61/4$ oe isw	M1 M1 M1 A1 A1	for subst of x or y or subtraction to eliminate variable; condone one error; for collection of terms and rearrangement to zero; condone one error; for factors giving at least two terms of their quadratic correct or for subst into formula with no more than two errors [dependent on attempt to rearrange to zero]; or **A1** for (−1, 11) and **A1** for (−21/4, 61/4) oe	or $4y^2 - 105y + 671$ [= 0]; eg condone spurious $y = 4x^2 + 25x + 21$ as one error (and then count as eligible for 3rd **M1**); or $(y - 11)(4y - 61)$; [for full use of completing square with no more than two errors allow 2nd and 3rd **M1**s simultaneously]; from formula: accept $x = -1$ or $-42/8$ oe isw
11	(ii) $4(x + 3)^2 - 5$ isw	4	**B1** for $a = 4$, **B1** for $b = 3$, **B2** for $c = -5$ or **M1** for $31 - 4 \times$ their b^2 soi or for $-5/4$ or for $31/4 -$ their b^2 soi	eg an answer of $(x + 3)^2 - {}^5/_4$ earns **B0 B1 M1**; $1(2x + 6)^2 - 5$ earns **B0 B0 B2**; 4(earns first **B1**; condone omission of square symbol
11	(iii)(*A*) $x = -3$ or ft (–their b) from (ii)	1		**0** for just –3 or ft; **0** for $x = -3$, $y = -5$ or ft
11	(iii)(*B*) −5 or ft their c from (ii)	1	allow $y = -5$ or ft	**0** for just (−3, −5); bod **1** for $x = -3$ stated then $y = -5$ or ft

12	(i) $y = 2x + 5$ drawn -2, -1.4 to -1.2, 0.7 to 0.85	**M1** **A2**	 **A1** for two of these correct	condone unruled and some doubling; tolerance: must pass within/touch at least two circles on overlay; the line must be drawn long enough to intersect curve at least twice; condone coordinates or factors
12	(ii) $4 = 2x^3 + 5x^2$ or $2x+5-\frac{4}{x^2}=0$ and completion to given answer $f(-2) = -16 + 20 - 4 = 0$ use of $x + 2$ as factor in long division of given cubic as far as $2x^3 + 4x^2$ in working $2x^2 + x - 2$ obtained $[x =]\frac{-1\pm\sqrt{1^2-4\times 2\times -2}}{2\times 2}$ oe $\frac{-1\pm\sqrt{17}}{4}$ oe isw	**B1** **B1** **M1** **A1** **M1** **A1**	 or correct division / inspection showing that $x + 2$ is factor; or inspection or equating coefficients, with at least two terms correct; dep on previous M1 earned; for attempt at formula or full attempt at completing square, using their other factor	condone omission of final '= 0'; may be set out in grid format condone omission of + sign (eg in grid format) not more than two errors in formula / substitution / completing square; allow even if their 'factor' has a remainder shown in working; **M0** for just an attempt to factorise

12	(iii) $\frac{4}{x^2} = x + 2$ or $y = x + 2$ soi $y = x + 2$ drawn 1 real root	**M1** **A1** **A1**	eg is earned by correct line drawn	condone intent for line; allow slightly out of tolerance; condone unruled; need drawn for $-1.5 \le x \le 1.2$; to pass through/touch relevant circle(s) on overlay
13	(i) [radius =] 4 [centre] (4, 2)	**B1** **B1**	**B0** for ± 4	 condone omission of brackets

13	(ii) $(x-4)^2 + (-2)^2 = 16$ oe	**M1**	for subst $y = 0$ in circle eqn;	NB candidates may expand and rearrange eqn first, making errors – they can still earn this **M1** when they subst $y = 0$ in their circle eqn; condone omission of $(-2)^2$ for this first **M1** only; not for second and third **M1**s; do not allow substitution of $x = 0$ for any Ms in this part
	$(x-4)^2 = 12$ or $x^2 - 8x + 4$ [= 0]	**M1**	putting in form ready to solve by comp sq, or for rearrangement to zero; condone one error;	eg allow **M1** for $x^2 + 4 = 0$ [but this two-term quadratic is not eligible for 3rd **M1**];
	$x - 4 = \pm\sqrt{12}$ or $[x =]\dfrac{8 \pm \sqrt{8^2 - 4\times1\times4}}{2\times1}$	**M1**	for attempt at comp square or formula; dep on previous M2 earned and on three-term quadratic;	not more than two errors in formula / substitution; allow **M1** for $x - 4 = \sqrt{12}$; **M0** for just an attempt to factorise
	$[x =]4 \pm \sqrt{12}$ or $4 \pm 2\sqrt{3}$ or $\dfrac{8 \pm \sqrt{48}}{2}$ oe isw	**A1**		
	or	**or**		
	sketch showing centre (4, 2) and triangle with hyp 4 and ht 2	**M1**		
	$4^2 - 2^2 = 12$	**M1**	or the square root of this; implies previous M1 if no sketch seen;	
	$[x =]4 \pm \sqrt{12}$ oe	**A2**	**A1** for one solution	

13	(iii) subst $\left(4+2\sqrt{2},\ 2+2\sqrt{2}\right)$ into circle eqn and showing at least one step in correct completion	**B1**	or showing sketch of centre C and A and using Pythag: $\left(2\sqrt{2}\right)^2+\left(2\sqrt{2}\right)^2=8+8=16$;	or subst the value for one coord in circle eqn and correctly working out the other as a possible value;
	Sketch of both tangents	**M1**		need not be ruled; must have negative gradients with tangents intended to be parallel and one touching above and to right of centre; mark intent to touch – allow just missing or just crossing circle twice; condone A not labelled
	grad tgt = −1 or −1/their grad CA	**M1**	allow ft after correct method seen for grad CA = $\dfrac{2+2\sqrt{2}-2}{4+2\sqrt{2}-4}$ oe (may be on/ near sketch);	allow ft from wrong centre found in (i);
	$y-(2+2\sqrt{2}) = \text{their } m(x-(4+2\sqrt{2}))$	**M1**	or y = their mx + c and subst of $\left(4+2\sqrt{2},\ 2+2\sqrt{2}\right)$;	for intent; condone lack of brackets for **M1**; independent of previous Ms; condone grad of CA used;
	$y=-x+6+4\sqrt{2}$ oe isw	**A1**	accept simplified equivs eg $x+y=6+4\sqrt{2}$;	**A0** if obtained as eqn of other tangent instead of the tangent at A (eg after omission of brackets);
	parallel tgt goes through $\left(4-2\sqrt{2},\ 2-2\sqrt{2}\right)$	**M1**	or ft wrong centre; may be shown on diagram; may be implied by correct equation for the tangent (allow ft their gradient);	no bod for just $y-2-2\sqrt{2}=-1(x-4-2\sqrt{2})$ without first seeing correct coordinates;
	eqn is $y=-x+6-4\sqrt{2}$ oe isw	**A1**	accept simplified equivs eg $x+y=6-4\sqrt{2}$	**A0** if this is given as eqn of the tangent at A instead of other tangent (eg after omission of brackets)

Section B Total: 36

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4751: Introduction to Advanced Mathematics (C1)

General Comments

This paper differentiated well across all abilities, with some questions accessible to most candidates, but some to challenge the best candidates. Few candidates scored very low marks. As expected, the questions found most difficult were 10, 12(iii) and 13(iii). Very few gained full marks; where just one or two marks were lost this was most often on question 10.

It is still the case that many candidates do not use brackets when they should. This was seen most clearly in question 5 with $2x^4$ instead of $(2x)^4$ and in question 13(iii) with $y - 2 + \sqrt{2} = -(x - 4 + \sqrt{2})$ for the tangent at A instead of $y - (2 + \sqrt{2}) = -(x - (4 + \sqrt{2}))$, with consequent sign errors when simplifying.

Poor arithmetic was also evident at times from some candidates, particularly in question 5, where many did not manage to obtain the correct answer of 6000 after reaching 15 × 25 × 16, and question 11(i), where one root involved fractions.

There were three quadratic equations to solve, in questions 11(i), 12(ii) and 13(ii). The first was not difficult to factorise, but the formula involved large numbers and knowing the square root of 289. The second came out easily using the formula. In the third, the square was already completed, which made that method very simple. Candidates should be proficient in all three methods and thus able to choose whichever method is easiest in a particular question.

Some candidates possibly ran out of time, having lost time in question 5 (struggling to multiply), in question 10 (futile efforts) and in question 11(i) (having failed to factorise). However, the lack of an attempt at question 13(iii) may simply indicate that they did not know how to tackle this question, which was targeted at the better candidates.

Comments on Individual Questions

Section A

1 Most gained full marks for this question. Those who reached $13 > -4x$ rather than $4x > -13$ often ended up with the wrong inequality.

2 This was generally completed well with most candidates choosing to find the equation of the straight line ($y = 3x - 8$) before substituting to find k, instead of directly using the gradient of a line between two points. A small minority struggled with the negative number arithmetic involved, finding an incorrect y-intercept and hence k value.

3 Many candidates gained full marks on both parts of this question. Some candidates found part (i) of question challenging and did not have a clear idea of the meaning of fractional and negative indices. Candidates appeared to find part (ii) of the question easier than the first part, with a significant majority being able to find at least two of the three terms in the product correctly. Errors tended to be introduced by expanding $(2ac)^3$ as $2ac^6$ or $2a^3c^6$.

4 Many candidates gained all 4 marks, but there were some who translated in the wrong direction. Some candidates failed to read the question correctly and gave a description of the transformation without the coordinates, gaining no marks.

5 The stronger candidates produced a well-organised solution to finding the binomial coefficient, focusing directly on the term asked for. A few candidates calculated the fourth term in the binomial expansion instead of the coefficient of x^4. The expected error of using $2x^4$ instead of $(2x)^4$ was common. In spite of the 15 × 25 × 16 often being seen, many candidates involved themselves in long multiplication of 15 × 25 to work out the answer of 6000 instead of shortcuts of starting with 25 × 4 etc, with arithmetic errors common. Attempts to find the term by multiplying $(2x+5)$ by itself six times were nearly always unsuccessful.

6 This question was done well by most of those candidates who as a first step multiplied out two brackets. Those who attempted to multiply all three brackets at once were often unsuccessful. A few treated the expression as an equation = 0 and divided by 2 at the end, losing a mark.

7 Many candidates did this question well, knowing what a discriminant is, finding it, and knowing that a positive discriminant meant there were two real roots. Some used $\sqrt{b^2 - 4ac}$ as the discriminant and were able to gain two of the three marks. The majority of candidates obtained the mark for the number of real roots, but some thought that a discriminant of 1 meant there was one real root. A minority either did not read the question properly or did not know what a discriminant is, solved the equation by factorising and found the roots; some of these stated the number of roots and obtained 1 mark.

8 Many candidates gave the impression of being well practised in the steps required to change the subject of a formula and the correct answer was seen encouragingly often. Almost all candidates multiplied by $x + 3$ as their first step, but some later attempted to divide through by y and then did not divide every term by y; very few candidates completed successfully after dividing by y.

9 The less familiar form for the equation of the line caused some candidates problems as they were unable to correctly identify the gradient of the original line. Most realised that the area could be found easily by first finding the intercepts of L with the coordinate axes. A few attempted integration, often successfully.

10 The majority of the candidates factorised the given expression completely and correctly and obtained the first mark. However, few obtained more than 1 mark. Many simply showed that numbers divisible by 6 were obtained when several values of n were substituted, with some claiming proof by exhaustion! Some knew that it was not sufficient to try a few values of n and made unsuccessful attempts to use algebra. Some were able to obtain a second mark by a correct argument based on odd and even numbers. Only a small minority argued correctly that with three consecutive numbers, at least one must be a multiple of 2 and one a multiple of 3, making the expression divisible by 2 and by 3 and hence by 6. A few candidates who knew about proof by induction from FP1 attempted to use it but very few did so successfully.

Section B

11 (i) Most candidates knew how to tackle this question and made a good attempt. Many who reached the correct quadratic were unable to factorise it correctly or avoided factorising and resorted to using the formula, which was applied correctly by most. However few recognised that $\sqrt{289} = 17$ and so were unable to gain the correct simplified answers. Some had difficulty finding y from the fractional value of x. Some, presumably thinking that there must be an easier way of doing this, decided to try to eliminate x. However, they soon realised that this was less easy than before. Having correctly substituted for x into the

right hand side of the equation and simplified that quadratic expression, most ignored the y term on the left hand side and treated it as thought the left hand side was zero. As a consequence they were then left with the wrong quadratic equation which was even more difficult to solve.

(ii) The candidates' ability to deal with the method of completing the square seems to be improving and nearly half of the candidates gave fully correct answers. As would be expected, the main reason for some candidates failing to do this correctly was the fact that the x^2 term was a multiple of 4. Many of them successfully started off by taking out the factor of 4 from the $4x^2$, but they were then unable to determine how this affected the coefficients of the other terms, so it was quite common to see $4(x + 6)^2$ .... , or $4(x + 12)^2$ .... . When it came to determining the constant term it was quite common to determine the value of c as 31 – the value of their b^2 rather than $31 - 4 \times$ their b^2 .So common incorrect final answers were $4(x + 3)^2 + 22$ or $4(x + 3)^2 - 113$.

(iii) Some candidates knew how to extract the required information from their completed square form, others clearly had no idea. Some started from scratch, using calculus. In part (*B*), some gave the coordinates of the minimum point rather than the minimum y-value that was requested. There were quite a few "No Responses" in part (iii).

12 (i) This was attempted well. Nearly all candidates were able to draw the line accurately on the diagram and most realised that they were required to read off the x-coordinates of the intersections, although some did not attempt to give roots. A few lost marks due to a loss of accuracy in one or more of the values – some did not realise that −2 was an exact answer, and others misread the x-scale. A very small minority of candidates appear to have attended the examination without a ruler or a sharp pencil and this affected their performance here.

(ii) The majority of candidates were able to derive the cubic and verify that −2 is a root. A range of methods was employed for the factorisation of the cubic and the majority of candidates did this successfully, although many then thought that the quadratic factor could be factorised. The phrasing 'exact form' and their answers to part (i) should have warned them not to expect this – and many of the better candidates did successfully find the other roots.

(iii) This was one of the least well done parts of any question on the paper. Most students did not know what to do, despite the similarity to part (i). Some drew curves, others did long calculations, attempting to find roots or to calculate a discriminant from the cubic equation.

13 (i) Nearly all candidates stated the centre and radius correctly.

(ii) There were a good number of fully correct solutions. A reasonable number realised that the equation could easily be rewritten in the completed square form and produced an efficient solution using this method. Those who multiplied out and used the quadratic formula were more prone to errors, but many did reach the correct answer. A few used $x = 0$ instead of $y = 0$; this gave the simple solution of $y = 2$ and so did not earn credit. Solutions using a geometric method were rare.

(iii) This was a challenging question, but there were many good attempts, although some struggled with manipulating the surds. A good number gained the mark for showing that A was on the circle, although some, having substituted the coordinates, did not simplify and attempted to square the unsimplified expression. Finding the gradient of the tangent caused some problems – most realised that they needed to start by finding the gradient of the radius at A, but were often unable to do so correctly. Some arrived straight at the correct tangent gradient by reasoning geometrically. Very many candidates failed to use brackets in their attempt at the equation of the tangent, resulting in sign errors.

GCE Mathematics (MEI)

			Max Mark	a	b	c	d	e	u
4751/01	(C1) MEI Introduction to Advanced Mathematics	Raw	72	55	49	43	37	32	0
		UMS	100	80	70	60	50	40	0
4752/01	(C2) MEI Concepts for Advanced Mathematics	Raw	72	53	46	39	33	27	0
		UMS	100	80	70	60	50	40	0
4753/01	(C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	54	48	42	36	29	0
4753/02	(C3) MEI Methods for Advanced Mathematics with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4753/82	(C3) MEI Methods for Advanced Mathematics with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
4753	(C3) MEI Methods for Advanced Mathematics with Coursework	UMS	100	80	70	60	50	40	0
4754/01	(C4) MEI Applications of Advanced Mathematics	Raw	90	63	56	50	44	38	0
		UMS	100	80	70	60	50	40	0
4755/01	(FP1) MEI Further Concepts for Advanced Mathematics	Raw	72	59	52	45	39	33	0
		UMS	100	80	70	60	50	40	0
4756/01	(FP2) MEI Further Methods for Advanced Mathematics	Raw	72	55	48	41	34	27	0
		UMS	100	80	70	60	50	40	0
4757/01	(FP3) MEI Further Applications of Advanced Mathematics	Raw	72	55	48	42	36	30	0
		UMS	100	80	70	60	50	40	0
4758/01	(DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	63	57	51	45	39	0
4758/02	(DE) MEI Differential Equations with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4758/82	(DE) MEI Differential Equations with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
4758	(DE) MEI Differential Equations with Coursework	UMS	100	80	70	60	50	40	0
4761/01	(M1) MEI Mechanics 1	Raw	72	60	52	44	36	28	0
		UMS	100	80	70	60	50	40	0
4762/01	(M2) MEI Mechanics 2	Raw	72	64	57	51	45	39	0
		UMS	100	80	70	60	50	40	0
4763/01	(M3) MEI Mechanics 3	Raw	72	59	51	43	35	27	0
		UMS	100	80	70	60	50	40	0
4764/01	(M4) MEI Mechanics 4	Raw	72	54	47	40	33	26	0
		UMS	100	80	70	60	50	40	0
4766/01	(S1) MEI Statistics 1	Raw	72	53	45	38	31	24	0
		UMS	100	80	70	60	50	40	0
4767/01	(S2) MEI Statistics 2	Raw	72	60	53	46	39	33	0
		UMS	100	80	70	60	50	40	0
4768/01	(S3) MEI Statistics 3	Raw	72	56	49	42	35	28	0
		UMS	100	80	70	60	50	40	0
4769/01	(S4) MEI Statistics 4	Raw	72	56	49	42	35	28	0
		UMS	100	80	70	60	50	40	0
4771/01	(D1) MEI Decision Mathematics 1	Raw	72	51	45	39	33	27	0
		UMS	100	80	70	60	50	40	0
4772/01	(D2) MEI Decision Mathematics 2	Raw	72	58	53	48	43	39	0
		UMS	100	80	70	60	50	40	0
4773/01	(DC) MEI Decision Mathematics Computation	Raw	72	46	40	34	29	24	0
		UMS	100	80	70	60	50	40	0
4776/01	(NM) MEI Numerical Methods with Coursework: Written Paper	Raw	72	62	55	49	43	36	0
4776/02	(NM) MEI Numerical Methods with Coursework: Coursework	Raw	18	14	12	10	8	7	0
4776/82	(NM) MEI Numerical Methods with Coursework: Carried Forward Coursework Mark	Raw	18	14	12	10	8	7	0
4776	(NM) MEI Numerical Methods with Coursework	UMS	100	80	70	60	50	40	0
4777/01	(NC) MEI Numerical Computation	Raw	72	55	47	39	32	25	0
		UMS	100	80	70	60	50	40	0