# Monday 19 May 2014 – Morning

## AS GCE MATHEMATICS (MEI)

**4751/01** Introduction to Advanced Mathematics (C1)

**QUESTION PAPER**

Candidates answer on the Printed Answer Book.

**OCR supplied materials:**
- Printed Answer Book 4751/01
- MEI Examination Formulae and Tables (MF2)

**Other materials required:**
None

**Duration:** 1 hour 30 minutes

*3187042054*

**INSTRUCTIONS TO CANDIDATES**

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside 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. HB 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 **8** 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 recycled. Please contact OCR Copyright should you wish to re-use this document.

**No calculator can be used for this paper**

**Section A** (36 marks)

**1** **(i)** Evaluate $\left(\frac{1}{27}\right)^{\frac{2}{3}}$. **[2]**

**(ii)** Simplify $\frac{(4a^2c)^3}{32a^4c^7}$. **[3]**

**2** A is the point (1, 5) and B is the point (6, −1). M is the midpoint of AB. Determine whether the line with equation $y = 2x - 5$ passes through M. **[3]**

**3**

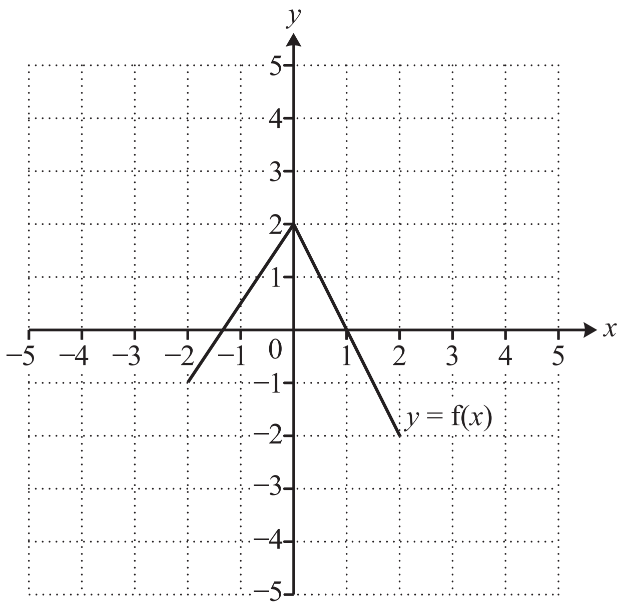


**Fig. 3**

Fig. 3 shows the graph of $y = \mathrm{f}(x)$. Draw the graphs of the following.

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

**(ii)** $y = \mathrm{f}(x - 3)$ **[2]**

**4** **(i)** Expand and simplify $(7 - 2\sqrt{3})^2$. **[3]**

**(ii)** Express $\frac{20\sqrt{6}}{\sqrt{50}}$ in the form $a\sqrt{b}$, where $a$ and $b$ are integers and $b$ is as small as possible. **[2]**

**5** Make $a$ the subject of $3(a+4) = ac + 5f$. **[4]**

**6** Solve the inequality $3x^2 + 10x + 3 > 0$. **[3]**

**7** Find the coefficient of $x^4$ in the binomial expansion of $(5+2x)^7$. **[4]**

**8** You are given that $f(x) = 4x^3 + kx + 6$, where $k$ is a constant. When $f(x)$ is divided by $(x-2)$, the remainder is 42. Use the remainder theorem to find the value of $k$. Hence find a root of $f(x) = 0$. **[4]**

**9** You are given that $n$, $n + 1$ and $n + 2$ are three consecutive integers.

**(i)** Expand and simplify $n^2 + (n+1)^2 + (n+2)^2$. **[2]**

**(ii)** For what values of $n$ will the sum of the squares of these three consecutive integers be an even number? Give a reason for your answer. **[2]**

## Section B (36 marks)

**10** Fig. 10 shows a sketch of a circle with centre C (4, 2). The circle intersects the $x$-axis at A (1, 0) and at B.

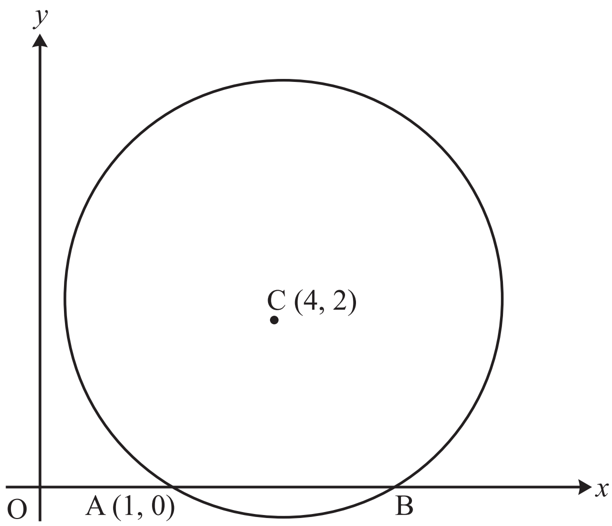


**Fig. 10**

**(i)** Write down the coordinates of B. **[1]**

**(ii)** Find the radius of the circle and hence write down the equation of the circle. **[4]**

**(iii)** AD is a diameter of the circle. Find the coordinates of D. **[2]**

**(iv)** Find the equation of the tangent to the circle at D. Give your answer in the form $y = ax + b$. **[4]**

**11**

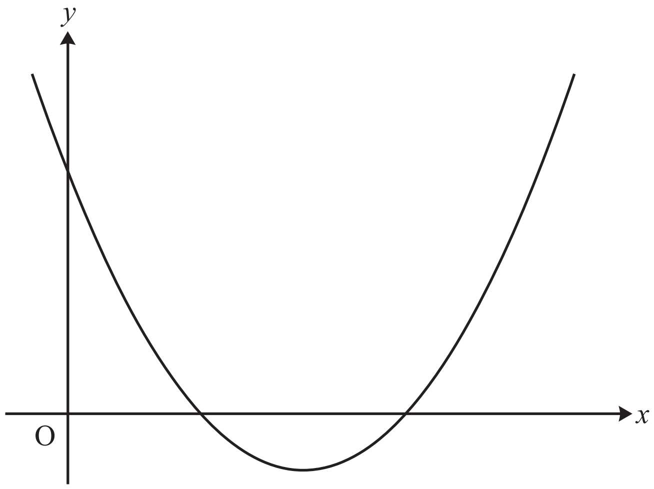


**Fig. 11**

Fig. 11 shows a sketch of the curve with equation $y = (x-4)^2 - 3$.

**(i)** Write down the equation of the line of symmetry of the curve and the coordinates of the minimum point. **[2]**

**(ii)** Find the coordinates of the points of intersection of the curve with the $x$-axis and the $y$-axis, using surds where necessary. **[4]**

**(iii)** The curve is translated by $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$. Show that the equation of the translated curve may be written as $y = x^2 - 12x + 33$. **[2]**

**(iv)** Show that the line $y = 8 - 2x$ meets the curve $y = x^2 - 12x + 33$ at just one point, and find the coordinates of this point. **[5]**

**12**

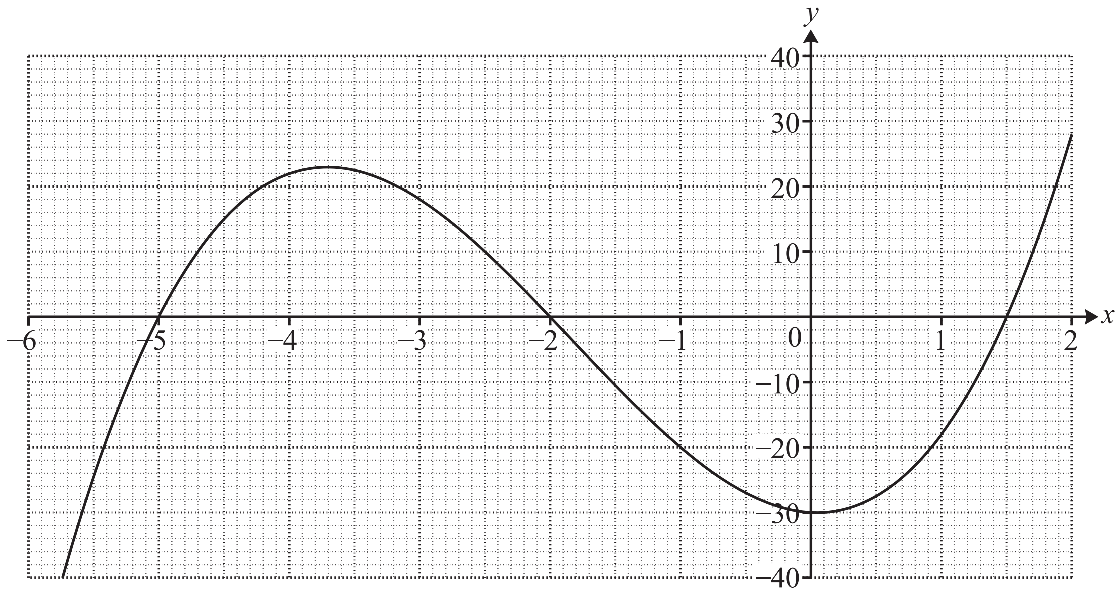


**Fig. 12**

Fig. 12 shows the graph of a cubic curve. It intersects the axes at (–5, 0), (–2, 0), (1.5, 0) and (0, –30).

**(i)** Use the intersections with both axes to express the equation of the curve in a factorised form. **[2]**

**(ii)** Hence show that the equation of the curve may be written as $y = 2x^3 + 11x^2 - x - 30$. **[2]**

**(iii)** Draw the line $y = 5x + 10$ accurately on the graph. The curve and this line intersect at (–2, 0); find graphically the $x$-coordinates of the other points of intersection. **[3]**

**(iv)** Show algebraically that the $x$-coordinates of the other points of intersection satisfy the equation

$$2x^2 + 7x - 20 = 0.$$

Hence find the exact values of the $x$-coordinates of the other points of intersection. **[5]**

**END OF QUESTION PAPER**

 

Monday 19 May 2014 – Morning

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**4751/01** Introduction to Advanced Mathematics (C1)

**PRINTED ANSWER BOOK**

Candidates answer on this Printed Answer Book.

**OCR supplied materials:**
- Question Paper 4751/01 (inserted)
- MEI Examination Formulae and Tables (MF2)

**Other materials required:**
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**Duration:** 1 hour 30 minutes

| Candidate forename | | Candidate surname | |
|---|---|---|---|

| Centre number | | | | | | Candidate number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

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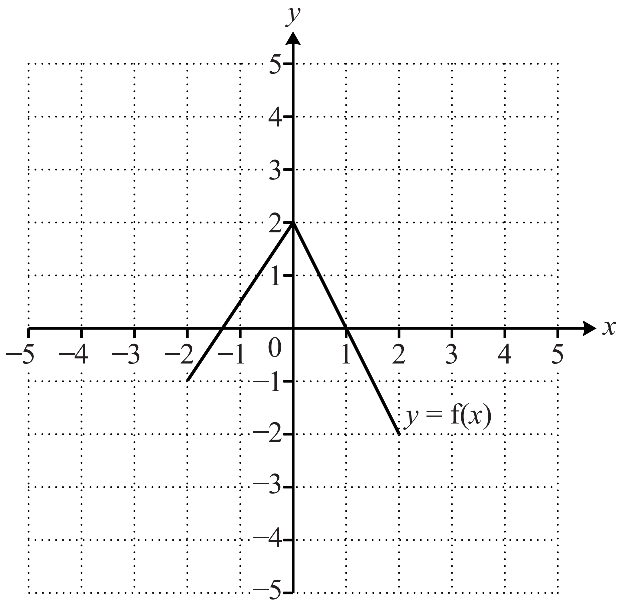
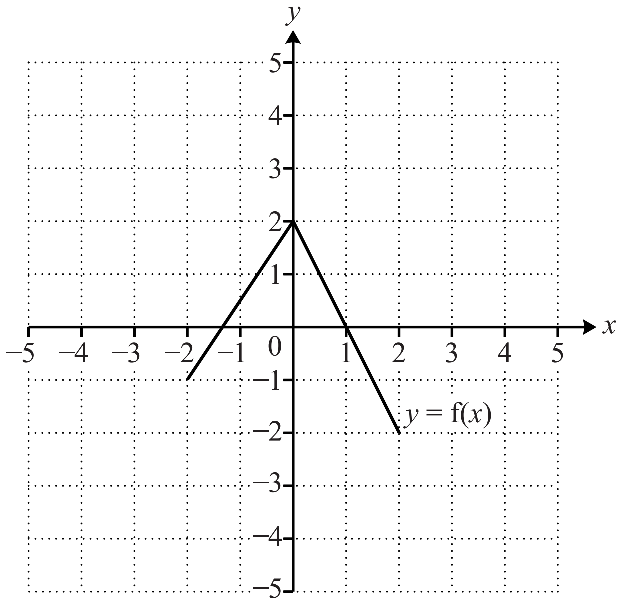
**Section A** (36 marks)

| | |
|---|---|
| **1 (i)** | |
| **1 (ii)** | |
| **2** | |
| **3 (i)** |  |

**3 (ii)**




**4 (i)**

**4 (ii)**

| | |
|---|---|
| 5 | |
| 6 | |
| 7 | |

| | |
|---|---|
| **8** | |
| **9 (i)** | |
| **9 (ii)** | |

**Section B** (36 marks)

| | |
|---|---|
| **10 (i)** | |
| **10 (ii)** | |
| **10 (iii)** | |

| 10 (iv) | |
|---|---|

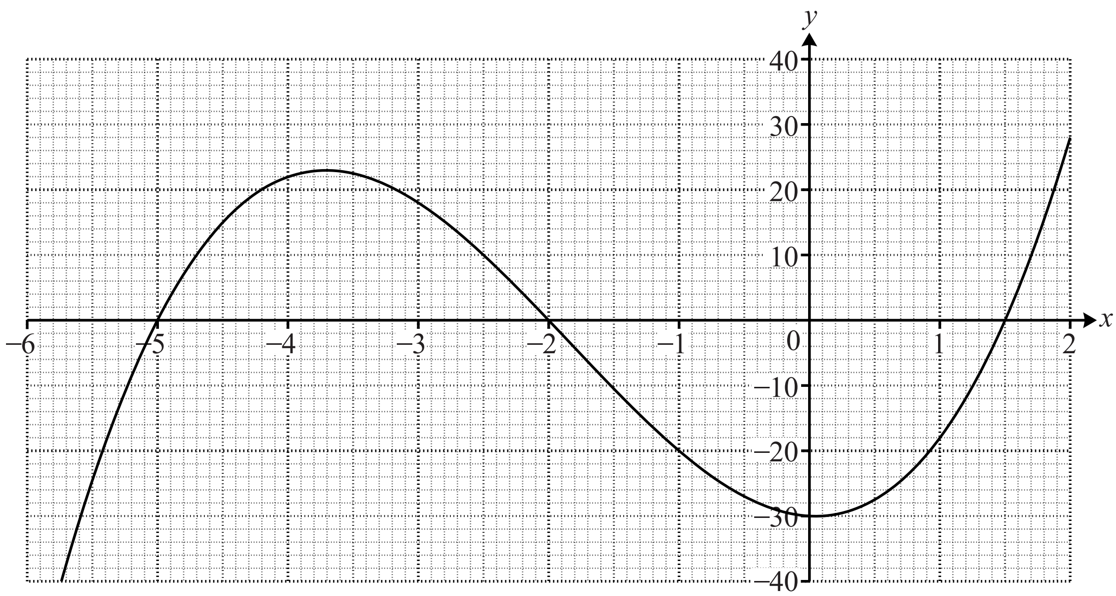
| | |
|---|---|
| **11 (i)** | |
| **11 (ii)** | |
| **11 (iii)** | |

| 11 (iv) | |
|---|---|

**12 (i)**

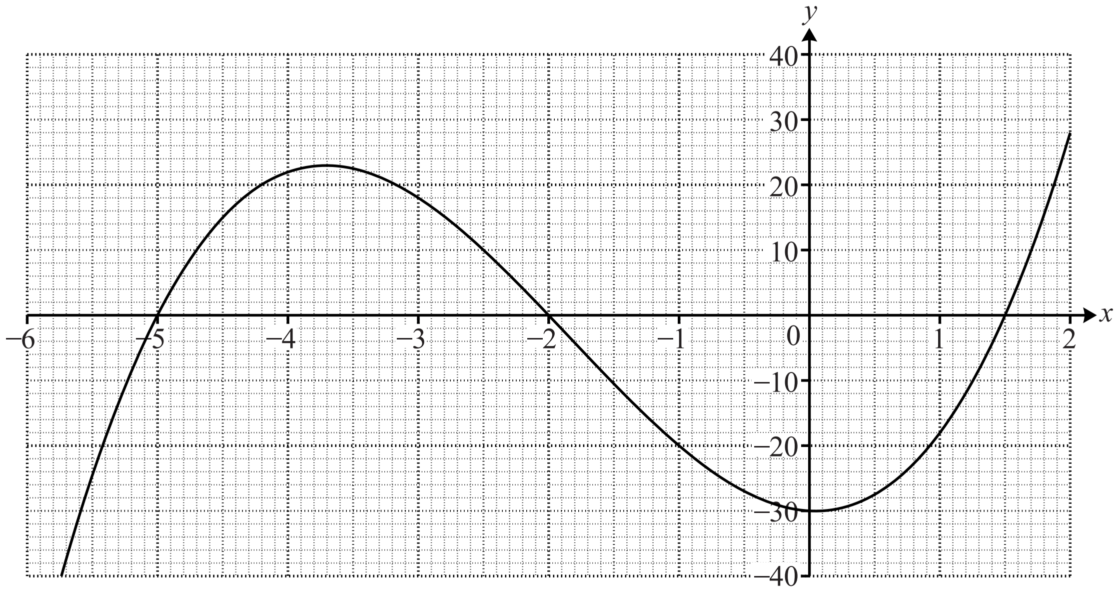
**12 (ii)**

**12 (iii)** **A spare copy of this graph can be found on page 12.**



| 12 (iv) | |
|---|---|

**12 (iii)** **Spare copy of graph for question 12(iii)**




**PLEASE DO NOT WRITE IN THIS SPACE**

## 1. Annotations and abbreviations

| Annotation in scoris | Meaning |
|---|---|
| BP | Blank Page – this annotation **must** be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response. |
| ✓and ✗ | |
| BOD | Benefit of doubt |
| FT | Follow through |
| ISW | Ignore subsequent working |
| M0, M1 | Method mark awarded 0, 1 |
| A0, A1 | Accuracy mark awarded 0, 1 |
| B0, B1 | Independent mark awarded 0, 1 |
| SC | Special case |
| ^ | Omission sign |
| MR | Misread |
| Highlighting | |
| | |
| **Other abbreviations in mark scheme** | **Meaning** |
| E1 | Mark for explaining |
| U1 | Mark for correct units |
| G1 | Mark for a correct feature on a graph |
| M1 dep* | Method mark dependent on a previous mark, indicated by * |
| cao | Correct answer only |
| oe | Or equivalent |
| rot | Rounded or truncated |
| soi | Seen or implied |
| www | Without wrong working |
| | |
| | |

## 2. Subject-specific Marking Instructions for GCE Mathematics (MEI) Pure strand

a Annotations should be used whenever appropriate during your marking.

**The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks.** It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

b An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

c The following types of marks are available.

**M**
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

**A**
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

**B**
Mark for a correct result or statement independent of Method marks.

**E**
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d When a part of a question has two or more ‘method’ steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation ‘dep *’ is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be ‘follow through’. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

g Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

h For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A mark in the question.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| 1 | (i) | | $\frac{1}{9}$ | 2<br><br>**[2]** | isw conversion to decimal<br>M1 for 9 or for $3^{-2}$ or for $\frac{1}{3}$<br>Except M0 for 9 from 27/3 or $\sqrt[3]{27}$ | ie M1 for evidence of $(\sqrt[3]{27})^2$ or $1/(\sqrt[3]{27})$ found correctly |
| 1 | (ii) | | $2a^2c^{-4}$ or $\frac{2a^2}{c^4}$ as final answer | 3<br><br>**[3]** | B1 for each element; must be multiplied<br><br>if B0, allow SC1 for $64a^6c^3$ obtained from numerator or for all elements correct but added | |
| 2 | | | midpt M of AB = $\left(\frac{1+6}{2}, \frac{5-1}{2}\right)$ oe isw soi<br><br>subst of their midpt into $y = 2x - 5$ and attempting to evaluate<br><br>all work correct and 'Yes' oe | M1<br><br>M1<br><br>A1<br>**[3]** | condone lack of brackets; accept in the form $x = 7/2$ oe, $y = 2$ oe<br><br>eg 2 × their 3.5 – 5 = their result<br><br>accept 2 = 2 × 3.5 – 5 | <u>alt methods</u>: allow 2nd M1 for finding correct eqn of AB as $y = -\frac{6x}{5} + \frac{31}{5}$ oe <u>and</u> attempting to solve as simult eqn with $y = 2x - 5$ for $x$ or $y$<br>or<br><br>allow M1 for finding in unsimplified form the eqn of the line through their midpt with gradient 2 and A1 for showing it is $y = 2x - 5$, so Yes |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| **3** | **(i)** | | graph of shape with vertices at (–2, –3), (0, 0) and (2, –4) | 2 **[2]** | M1 for 2 vertices correct | condone lines unruled; condone just missing vertex: ¼ grid square tolerance |
| **3** | **(ii)** | | graph of shape with vertices at (1, –1), (3, 2) and (5, –2) | 2 **[2]** | M1 for 2 vertices correct or for shape with vertices at (–5, –1), (–3, 2) and (–1, –2) | condone lines unruled; condone just missing vertex: ¼ grid square tolerance |
| **4** | **(i)** | | $61-28\sqrt{3}$ | 3 **[3]** | B2 for 61 or B1 for 49 + 12 found in expansion (may be in a grid)<br>and B1 for $-28\sqrt{3}$<br>if B0, allow M1 for at least three terms correct in $49-14\sqrt{3}-14\sqrt{3}+12$<br>the correct answer obtained then spoilt earns SC2 only | |
| **4** | **(ii)** | | $4\sqrt{3}$ | 2 **[2]** | M1 for $\sqrt{50}=5\sqrt{2}$ or $\sqrt{300}=10\sqrt{3}$ or $20\sqrt{300}=200\sqrt{3}$ or $\sqrt{48}=2\sqrt{12}$ seen | |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| **5** | | | $3a + 12$ [$= ac + 5f$] | M1 | for expanding brackets correctly | annotate this question if partially correct |
| | | | $3a - ac = 5f - 12$ or ft | M1 | for collecting $a$ terms on one side, remaining terms on other | ft only if two $a$ terms |
| | | | $a(3 - c) = 5f - 12$ or ft | M1 | for factorising $a$ terms; may be implied by final answer | ft only if two $a$ terms, needing factorising<br>may be earned before 2nd M1 |
| | | | $[a =]\dfrac{5f-12}{3-c}$ oe or ft as final answer | M1 | for division by their two-term factor;<br>for all 4 marks to be earned, work must be fully correct | |
| | | | | **[4]** | | |
| **6** | | | $(3x + 1)(x + 3)$ | M1 | or $3(x + 1/3)(x + 3)$<br><br>or for $-1/3$ and $-3$ found as endpoints eg by use of formula | |
| | | | $x < -3$<br>[or] | A1 | | |
| | | | $x > -1/3$ oe | A1 | mark final answers; | |
| | | | | | allow only A1 for $-3 > x > -1/3$ oe as final answer or for $x \le -3$ and $x \ge -1/3$ | A0 for combinations with only one part correct eg $-3 > x < -1/3$, though this would earn M1 if not already awarded |
| | | | | | if M0, allow SC1 for sketch of parabola the right way up with their solns ft their endpoints | |
| | | | | **[3]** | | |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| **7** | | | 70 000 www | 4 | throughout, condone $x$s included eg $(2x)^4$ | annotate this question if partially correct<br><br>allow 4 for 70 000$x^4$ www;<br><br>may also include other terms in expansion. Allow marks even if wrong term selected; mark the coefficient of $x^4$ |
| | | | | | M3 for $35 \times 5^3 \times 2^4$ oe | may be unsimplified, but do not allow 35 in factorial form unless evaluated later |
| | | | | | or M2 for two of these elements multiplied | or for all three elements seen together (eg in table) but not multiplied |
| | | | | | or M1 for 35 oe or for 1 7 21 35 35 21 7 1 row of Pascal's triangle seen | |
| | | | | **[4]** | | |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| **8** | | | use of $f(2)$ | M1 | 2 substituted in $f(x)$ or $f(2) = 42$ seen<br>or correct division of $4x^3 + kx + 6$ by $x - 2$ as far as obtaining $4x^2 + 8x + (k + 16)$ oe<br>[may have $4x^2 + 8x + 18$] | |
| | | | $4 \times 2^3 + 2k + 6 = 42$ | M1 | or $6 + 2(k + 16) = 42$ oe<br>or finding (usually after division) that the constant term is 36 and then working with the $x$ term to find $k$ eg $kx + 16x = 18x$ | |
| | | | $k = 2$ | A1 | | |
| | | | [$x$ =] $-1$ | A1 | as their answer, not just a trial;<br><br>A0 for just $f(-1) = 0$ with no further statement<br><br>A0 if confusion between roots and factors in final statement eg '$x + 1$ is a root', even if they also state $x = -1$ | accept with no working since it can be found by inspection |
| | | | | **[4]** | | |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| 9 | (i) | | $3n^2 + 6n + 5$ isw | B2<br><br>**[2]** | M1 for a correct expansion of at least one of $(n + 1)^2$ and $(n + 2)^2$ | |
| 9 | (ii) | | odd numbers with valid explanation | B2<br><br>**[2]** | marks dep on 9(i) correct or starting again<br><br>for B2 must see at least odd × odd = odd [for $3n^2$] (or when $n$ is odd, [3]$n^2$ is odd) and odd [+ even] + odd = even soi,<br><br>condone lack of odd × even = even for $6n$; condone no consideration of $n$ being even<br><br>or B2 for deductive argument such as: $6n$ is always even [and 5 is odd] so $3n^2$ must be odd so $n$ is odd<br><br>B1 for odd numbers with a correct partial explanation or a partially correct explanation<br><br>or B1 for an otherwise fully correct argument for odd numbers but with conclusion positive odd numbers or conclusion negative odd numbers<br><br>B0 for just a few trials and conclusion | accept a full valid argument using odd and even from starting again<br><br>Ignore numerical trials or examples in this part – only a generalised argument can gain credit |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| **10** | **(i)** | | (7, 0) | 1<br>**[1]** | accept $x = 7$, $y = 0$ | condone 7, 0 |
| **10** | **(ii)** | | $\sqrt{13}$<br><br><br><br><br>$(x-4)^2 + (y-2)^2 = 13$ or ft their evaluated $r^2$, isw | 2<br><br><br><br><br>2<br><br><br><br>**[4]** | M1 for Pythagoras used correctly eg $[r^2 =]\ 3^2 + 2^2$ or for subst A or their B in $(x-4)^2+(y-2)^2\left[=r^2\right]$<br><br>or B1 for $[r = ]\ \pm\sqrt{13}$<br>M1 for one side correct, as part of an equation with $x$ and $y$ terms | annotate this question if partially correct<br><br>allow recovery if some confusion between squares and roots but correct answer found<br><br>do not accept $(\sqrt{13})^2$ instead of 13;<br>allow M1 for LHS for $(x-4)^2+(y-2)^2=r^2$ (or worse, $(x-4)^2+(y-2)^2=r$) (may be seen in attempt to find radius) |
| **10** | **(iii)** | | (7, 4) | 2<br><br><br><br><br>**[2]** | B1 each coord<br>accept $x = 7$, $y = 4$<br>if B0, then M1 for a vector or coordinates approach such as '3 along and 2 up' to get from A to C oe<br>or M1 for $\frac{x_D+1}{2}=4$ and $\frac{y_D+0}{2}=2$ | condone 7, 4<br><br>or M1 for longer method, finding the equation of the line CD as $y = 2/3\ (x - 1)$ oe <u>and</u> then attempting to find intn with their circle |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| **10** | **(iv)** | | grad tgt = –3/2 oe | M2 | correctly obtained or ft their D if used<br><br>M1 for grad AD = $\frac{4-0}{7-1}$ oe isw or 2/3 oe seen or used in this part or for their grad tgt = –1/ their grad AD | annotate this question if partially correct<br>may use AD, CD or AC<br><br>NB grad AD etc may have been found in part (iii); allow marks if used in this part – mark the copy of part (iii) that appears below the image for part (iv) |
| | | | $y$ – their 4 = their (–3/2) ($x$ – their 7) | M1 | or subst (7, 4) into $y$ = their (–3/2) $x + b$<br><br>M0 if grad AD oe used or if a wrong gradient appears with no previous working | |
| | | | $y = -1.5x + 14.5$ oe isw | A1 | must be in form $y = ax + b$ | condone $y = \frac{-3x+29}{2}$<br><br>condone $y = -1.5x + b$ and $b = 14.5$ oe |
| | | | | **[4]** | | |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| **11** | **(i)** | | $x = 4$ | B1 | | |
| | | | (4, –3) | B1 | or $x = 4$, $y = –3$ | condone 4, –3 |
| | | | | **[2]** | | |
| **11** | **(ii)** | | (0, 13) isw | 1 | or [when $x = 0$], $y = 13$ isw<br>0 for just (13, 0) or ($k$, 13) where $k \neq 0$ | annotate this question if partially correct |
| | | | [when $y = 0$, ] $(x – 4)^2 = 3$ | M1 | or $x^2 – 8x + 13$ [= 0] | may be implied by correct value(s) for $x$ found<br><br>allow M1 for $y = x^2 – 8x + 13$ only if they go on to find values for $x$ as if $y$ were 0 |
| | | | $[x =] 4 \pm \sqrt{3}$ or $\frac{8 \pm \sqrt{12}}{2}$ isw | A2 | need not go on to give coordinate form<br><br>A1 for one root correct | |
| | | | | **[4]** | | |
| **11** | **(iii)** | | replacement of $x$ in their eqn by $(x – 2)$ | M1 | may be simplified; eg [$y$ = ] $(x – 6)^2 – 3$<br>or allow M1 for $(x – 6 – \sqrt{3})(x – 6 + \sqrt{3})$ [=0 or $y$] | condone omission of '$y$ =' for M1, but must be present in final line for A1 |
| | | | completion to given answer $y = x^2 – 12x + 33$, showing at least one correct interim step | A1 | cao; condone using f($x$ – 2) in place of $y$ | |
| | | | | **[2]** | | |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| **11** | **(iv)** | | $x^2 - 12x + 33 = 8 - 2x$ or $(x-6)^2 - 3 = 8 - 2x$ | M1 | for equating curve and line; correct eqns only; or for attempt to subst $(8 - y)/2$ for $x$ in $y = x^2 - 12x + 33$ | annotate this question if partially correct |
| | | | $x^2 - 10x + 25 = 0$ | M1 | for rearrangement to zero, condoning one error such as omission of '= 0' | |
| | | | $(x-5)^2$ [= 0] | A1 | or showing $b^2 = 4ac$ | allow $\frac{10 \pm \sqrt{0}}{2}$ oe if $b^2 - 4ac = 0$ is not used explicitly<br>A0 for $(x-5)^2 = y$ |
| | | | $x = 5$ www [so just one point of contact] | A1 | may be part of coordinates $(5, k)$ | allow recovery from $(x-5)^2 = y$ |
| | | | point of contact at $(5, -2)$ | A1 | dependent on previous A1 earned; allow for $y = -2$ found | |
| | | | <u>alt. method</u> | **or** | | examiners: use one mark scheme or the other, to the benefit of the candidate if both methods attempted, but do not use a mixture of the schemes |
| | | | for curve, $y' = 2x - 12$ | M1 | | |
| | | | $2x - 12 = -2$ | M1 | for equating their $y'$ to $-2$ | |
| | | | $x = 5$, and $y$ shown to be $-2$ using eqn to curve | A1 | | |
| | | | tgt is $y + 2 = -2(x - 5)$ | A1 | | |
| | | | deriving $y = 8 - 2x$ | A1 | | condone no further interim step if all working in this part is correct so far |
| | | | | **[5]** | | |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| 12 | (i) | | $y = (x + 5)(x + 2)(2x - 3)$ or<br>$y = 2(x + 5)(x + 2)(x - 3/2)$ | 2<br><br>**[2]** | M1 for $y = (x + 5)(x + 2)(x - 3/2)$ or<br>$(x + 5)(x + 2)(2x - 3)$ with no equation or<br>$(x + 5)(x + 2)(2x - 3) = 0$<br>but M0 for $y = (x + 5)(x + 2)(2x - 3) - 30$ or $(x + 5)(x + 2)(2x - 3) = 30$ etc | allow 'f($x$) =' instead of '$y$ = '<br><br>ignore further work towards (ii)<br><br>but do not award marks for (i) in (ii) |
| 12 | (ii) | | correct expansion of a pair of their linear two-term factors ft isw<br><br>correct expansion of the correct linear and quadratic factors and completion to given answer $y = 2x^3 + 11x^2 - x - 30$ | M1<br><br>M1<br><br>**[2]** | ft their factors from (i); need not be simplified; may be seen in a grid<br><br>must be working for this step before given answer<br>or for direct expansion of all three factors, allow M2 for<br>$2x^3 + 10x^2 + 4x^2 - 3x^2 + 20x - 15x - 6x - 30$ oe (M1 if one error)<br>or M1M0 for a correct direct expansion of<br>$(x + 5)(x + 2)(x - 3/2)$<br><br>condone lack of brackets if used as if they were there | allow only first M1 for expansion if their (i) has an extra –30 etc<br><br>do not award 2nd mark if only had $(x - 3/2)$ in (i) and suddenly doubles RHS at this stage<br><br>condone omission of '$y$ =' or inclusion of '= 0' for this second mark (some cands have already lost a mark for that in (i))<br><br>allow marks if this work has been done in part (i) – mark the copy of part (i) that appears below the image for part (ii) |

| Question | | | Answer | Marks | Guidance | |
|---|---|---|---|---|---|---|
| **12** | **(iii)** | | ruled line drawn through (–2, 0) and (0, 10) and long enough to intersect curve at least twice | B1 | tolerance half a small square on grid at (–2, 0) and (0, 10) | insert BP on spare copy of graph if not used, to indicate seen – this is included as part of image, so scroll down to see it |
| | | | –5.3 to –5.4 and 1.8 to 1.9 | B2 | B1 for one correct<br>ignore the solution –2 but allow B1 for both values correct but one extra or for wrong 'coordinate' form such as (1.8, –5.3) | accept in coordinate form ignoring any $y$ coordinates given; |
| | | | | **[3]** | | |
| **12** | **(iv)** | | $2x^3 + 11x^2 - x - 30 = 5x + 10$ | M1 | for equating curve and line; correct eqns only | annotate this question if partially correct |
| | | | $2x^3 + 11x^2 - 6x - 40$ [= 0] | M1 | for rearrangement to zero, condoning one error | |
| | | | division by $(x + 2)$ and correctly obtaining $2x^2 + 7x - 20$ | M1 | or showing that $(x + 2)(2x^2 + 7x - 20) = 2x^3 + 11x^2 - 6x - 40$, with supporting working | |
| | | | substitution into quadratic formula or for completing the square used as far as $x+\frac{7}{4}\ ^2=\frac{209}{16}$ oe | M1 | condone one error eg $a$ used as 1 not 2, or one error in the formula, using given $2x^2 + 7x - 20 = 0$ | |
| | | | $[x=]\frac{-7\pm\sqrt{209}}{4}$ oe isw | A1 | dependent only on 4th M1 | |
| | | | | **[5]** | | |

# 4751 Introduction to Advanced Mathematics (C1)

**General Comments:**

Candidates in the main were confident with much of the content of this paper, being usually well-practised in using routine skills. Examiners were pleased to see that many candidates were able to make a good attempt at most of the questions. However there remained a couple of question parts which stretched the most able in applying their knowledge, in particular the last question.

Candidates did not always appreciate the difference between an equation and an expression, which led to loss of marks in 11(iii) and/or 12(i). Candidates did not always understand that, when asked to 'Show that...' evidence has to be provided, and so the full method must be shown. The worst confusion of language was seen in question 8, where many candidates did not distinguish correctly between a factor and a root, so that answers such as '$x$ + 1 is a root' were common.

Arithmetic errors were seen frequently in question 7, where many attempted long multiplication and made errors, rather than using simpler methods using the powers of 2 and 5. In question 12, having substituted correctly in the quadratic formula, errors in simplifying the discriminant were common. Lack of facility in working with fractions caused errors in question 10iv.

**Comments on Individual Questions:**

Section A

Question No. 1
Most candidates knew what to do and handled the indices well. Errors such as $\sqrt[3]{27} = 9$ were seen occasionally in the first part. In the second, the most frequent errors came from failing to cube the 4 or the $a^2$ correctly.

Question No. 2
Many obtained three marks here without any difficulty, with many candidates choosing to use the quick substitution of midpoint method to prove that the point was on the line. A minority failed to state a clear conclusion once this step had been performed. Longer methods were seen occasionally but were rarely completed successfully, with the equation of AB sometimes being found simply because the candidate did not know what to do.

Question No. 3
Both parts of this question were done correctly by a high proportion of candidates. In the first part very occasionally a horizontal translation was seen or a translation upwards. In the second part there were more errors, with a translation to the left instead of the right being given.

Question No. 4
Most candidates gained at least one mark in the first part for $-28\sqrt{3}$. Those who failed to reach the correct final answer often incorrectly expanded the last terms of the brackets, obtaining $\pm 4\sqrt{3}$, 6 or 12 rather than +12. For most candidates the second part was more challenging than the first part. Errors tended to be introduced when rationalising the denominator, with many choosing to multiply by $\sqrt{50}$ or $-\sqrt{50}$. Those that did rationalise were then unsure how to simplify the numerator, often obtaining large roots which they were unable to simplify accurately. Those that had the most success in this question expressed the $\sqrt{50}$ in the denominator as $5\sqrt{2}$ and were then comfortable dividing surds and cancelling fractions.

Question No. 5
Rearranging the formula was usually done well. Those who found this difficult generally attempted to isolate just one *a* term and hence scored only the first mark. Other errors seen occasionally included sign errors and a final spoiling of the answer by invalidly 'cancelling' 3 into - 12.

Question No. 6
In solving the quadratic inequality, most candidates were able to factorise the quadratic expression correctly, though a few produced incorrect factors. A small number resorted to using the formula to determine the end points, often failing to do so correctly. It was very clear that those candidates who drew a sketch to help them were generally successful in identifying the two different regions. But without a diagram many either just gave the single region between the end points, or having written down two correct inequalities tried incorrectly to combine them. Another error often seen was to believe that since $(3x + 1)(x + 3) > 0$, then $(3x + 1) > 0$ and/or $(x + 3) > 0$.

Question No. 7
Many candidates were able to establish the desired product of $35 \times 5^3 \times 2^4$ in finding the binomial coefficient. There were fewer failing to cope correctly with $(2x)^4$ than in similar past questions on this topic. However, few candidates were confident enough with their number bonds, or quick mental methods such as repeated doubling, to realise that $5^3 \times 2^4$ or $125 \times 16$ could be easily evaluated as 2000, often unsuccessfully attempting 35x125 or similar.

Question No. 8
Most candidates successfully used the remainder theorem to set up an equation to solve for *k*. They understood how to write down the expression for f(2) and equated it to 42. The correct solution was usually found though a few errors were made in evaluating $4 \times 2^3$. An occasional error seen was to put f(-2) =42. A number of candidates chose to ignore the guidance, and proceeded with long algebraic division with some degree of success, but with no $x^2$ term there was plenty of opportunity to go wrong. There were a few attempts at using synthetic division.

Confusion between factors and roots continues to be in evidence with many candidates. Some clearly stated the root was $(x + 1)$, whilst others gave both $(x + 1)$ and $x = -1$ without making it clear which one was the root. Some gave the answer as $f(-1) = 0$.

Question No. 9
The straightforward algebra in the first part was done correctly by most candidates. The most common errors were to write $(n + 1)^2$ as $n^2 + 1$, or sometimes $n^2 + 2n + 2$ and $(n + 2)^2$ as $n^2 + 4$.

There was some encouraging work in the proof part with a number of slightly different methods being demonstrated. The majority considered the three terms that they had found in (i) but others went further and expressed the quadratic function as $3n(n + 2) + 5$ or $3(n + 1)^2 + 2$. As these were the more capable candidates they were then often argued the case elegantly. Some candidates returned to the original function successfully with a few replacing *n* by $2m + 1$ and expanding to find a factor of 2. The candidates who fared badly were those who failed to draw any conclusion at all, those who attempted to use an incorrect expression from (i) or those who just tried to show it with some numerical values.

Section B

Question No. 10
(i) This was usually correct, with most candidates appreciating the symmetry about $x = 4$.

(ii) The correct method for finding the radius was usually seen; however, some candidates were let down by their poor arithmetic, for instance, 9 + 4 = 11. Most knew the form for the circle equation, although some failed to square the root 13 (or their number), or made some mistake in the left-hand side of the equation, such as sign errors or omitting the squared signs.

(ii) Most candidates found the coordinates of D correctly using a step/vector method. A few tried to find the intersection of AD with the circle, but these were usually unsuccessful.

(iii) Attempts at this part were variable. Whilst many recognised that they had to find the gradient of AD first, quite a few made errors in doing this. Most recognised that the gradient of the tangent was the negative reciprocal of this number and substituted this into either $y - y_1 = m(x - x_1)$ or $y = mx + c$. A few used their gradient of AD in the equation of the line. Quite a number of errors were seen in reaching the final answer, most of these associated with dealing with fractions. A few candidates did not give their answer in the required form.

Question No. 11

(i) The minimum point was generally well found, although some just gave the *y* coordinate. The question said, "Write down …", which should suggest to candidates that differentiating and putting the differential equal to zero was not needed. The line of symmetry was also usually well done, but some gave $x = -4$ or $y = 4$.

(ii) The *y* intercept was usually correct. For the *x* intercept, many went the long way round: expanding brackets and then using the quadratic formula rather than using the completing the square method.

(iii) Some candidates lost a mark as they forgot that an equation has 2 sides and omitted the '$y$=', only giving an expression. Most candidates realised that they should replace *x* with $(x - 2)$. A minority expanded brackets before replacing *x* with $(x - 2)$ which was a less efficient method.

(iii) Since both equations were given, those were the ones which had to be used, and most candidates did so successfully. Some candidates did not realise that obtaining $(x - 5)^2 = 0$ led to sufficient evidence of a repeated root and also showed that the discriminant was zero. Some, of course, did not attempt to factorise anyway but opted for using the formula. The main error was in the very last mark, where some candidates substituted their *x* value back into the quadratic that they had just solved to find $y = 0$, rather than using the line or the curve to give $y = -2$.

Question No. 12

(i) Candidates struggled with this question. Often they managed to produce the product of binomial factors $(x+2)(x+5)(x-1.5)$ and failed to put it equal to *y* or put it equal to 0. Those who did have the correct product still very often had an expression only or equated to 0. Many candidates thought that the information about the *y*-intercept indicated that they should perform a vertical translation and an answer of $y=(x+2)(x+5)(x-1.5)-30$ was fairly common. Some candidates had an epiphany in part (ii) when they realised that their coefficients should be twice the size and sensibly went back to this part and corrected their error.

(ii) Many scored only one mark in this part, for correctly expanding a pair of their binomial factors, even after making an error in part (i). As said previously, the light dawned for many in this question and it was good to see that some of these made corrections to part (i). However, many did not and very often there would be a multiplication by 2 done at the end – with or without some attempt at justification for it.

(iii) Candidates found this straightforward on the whole, with many scoring full marks for this part. Nearly all drew an accurate line of sufficient length to intersect the curve in three places.

Occasionally some read the scale incorrectly when finding the negative solution or were careless with signs, omitting the negative when writing it down.

(iv) There were many attempts to substitute their answers from part (iii) into the given quadratic. Many candidates did not know how to obtain this quadratic, although most eventually went on to attempt to solve it using the formula, sometimes making arithmetic errors in so doing. Of those who did attempt to derive the quadratic, there were several attempts at equating the wrong pair of equations. Some who started correctly expected to see the given answer immediately and stopped at the simplified cubic they had obtained, sometimes having an erroneous - 20. Relatively few were able to show that the quadratic factor was the required one, by long division or by showing multiplying out. A very few candidates used an elegant method of equating the line and cubic and using the factorised form of each to cancel a factor of $x + 2$ on both sides before simplifying..

## Unit level raw mark and UMS grade boundaries June 2014 series

### AS GCE / Advanced GCE / AS GCE Double Award / Advanced GCE Double Award

**GCE Mathematics (MEI)**

| | | Max Mark | a | b | c | d | e | u |
|---|---|---|---|---|---|---|---|---|
| 4751/01 (C1) MEI Introduction to Advanced Mathematics | Raw | 72 | 61 | 56 | 51 | 46 | 42 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4752/01 (C2) MEI Concepts for Advanced Mathematics | Raw | 72 | 57 | 51 | 45 | 39 | 33 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4753/01 (C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper | Raw | 72 | 58 | 52 | 47 | 42 | 36 | 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 | 68 | 61 | 54 | 47 | 41 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4755/01 (FP1) MEI Further Concepts for Advanced Mathematics | Raw | 72 | 63 | 57 | 51 | 45 | 40 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4756/01 (FP2) MEI Further Methods for Advanced Mathematics | Raw | 72 | 60 | 54 | 48 | 42 | 36 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4757/01 (FP3) MEI Further Applications of Advanced Mathematics | Raw | 72 | 57 | 51 | 45 | 39 | 34 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4758/01 (DE) MEI Differential Equations with Coursework: Written Paper | Raw | 72 | 63 | 56 | 50 | 44 | 37 | 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 | 57 | 49 | 41 | 34 | 27 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4762/01 (M2) MEI Mechanics 2 | Raw | 72 | 57 | 49 | 41 | 34 | 27 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4763/01 (M3) MEI Mechanics 3 | Raw | 72 | 55 | 48 | 42 | 36 | 30 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4764/01 (M4) MEI Mechanics 4 | Raw | 72 | 48 | 41 | 34 | 28 | 22 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4766/01 (S1) MEI Statistics 1 | Raw | 72 | 61 | 53 | 46 | 39 | 32 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4767/01 (S2) MEI Statistics 2 | Raw | 72 | 60 | 53 | 46 | 40 | 34 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4768/01 (S3) MEI Statistics 3 | Raw | 72 | 61 | 54 | 47 | 41 | 35 | 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 | 46 | 41 | 36 | 31 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| 4772/01 (D2) MEI Decision Mathematics 2 | Raw | 72 | 46 | 41 | 36 | 31 | 26 | 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 | 54 | 48 | 43 | 38 | 32 | 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 |
| 4798/01 (FPT) Further Pure Mathematics with Technology | Raw | 72 | 57 | 49 | 41 | 33 | 26 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |

**GCE Statistics (MEI)**

| | | Max Mark | a | b | c | d | e | u |
|---|---|---|---|---|---|---|---|---|
| G241/01 (Z1) Statistics 1 | Raw | 72 | 61 | 53 | 46 | 39 | 32 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| G242/01 (Z2) Statistics 2 | Raw | 72 | 55 | 48 | 41 | 34 | 27 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |
| G243/01 (Z3) Statistics 3 | Raw | 72 | 56 | 48 | 41 | 34 | 27 | 0 |
| | UMS | 100 | 80 | 70 | 60 | 50 | 40 | 0 |