

**Mathematics (MEI)**

Advanced Subsidiary GCE

Unit **4752**: Concepts for Advanced Mathematics

**Mark Scheme for June 2012**

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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.

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## Annotations and abbreviations

Annotation in scoris	Meaning
✓ 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

**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		$\frac{1}{2}x^{-\frac{1}{2}} - 3x^{-2}$ oe; isw	B3 [3]	need not be simplified B2 for one term correct ignore + c if B0 allow M1 for either $x^{1/2}$ or $x^{-1}$ seen before differentiation deduct one mark for extra term in x
2		(5), 8, 11, (14),...isw $a = 5$ and $d = 3$ soi $S_{50} = \frac{50}{2}(2 \times 5 + (50 - 1) \times 3)$ oe 3925	B1 B1 M1 A1 [4]	if M0, award B2 if 3925 is obtained from summing individual terms or if unsupported if M0, SC1 for use of $a = 8$ and obtaining 4075
3	(i)	$9.8^2 + 6.4^2 - 2 \times 9.8 \times 6.4 \times \cos 53.4$ $9.8^2 + 6.4^2 - 74.79...$ [= 62.2...] 7.887... or 7.89 or 7.9	M1 M1 A1 [3]	for evidence of correct order of operations used; may be implied by correct answer if M0, B3 for 7.89 or more precise www 6.89 implies M0 262.4368 implies M1 (calc in radian mode), (NB $\sqrt{262.436..}=16.199...$ ) NB $9.8\sin 53.4 = 7.87$
3	(ii)	$\frac{1}{2} \times 9.8 \times 7.3 \times \sin (180 - 53.4)$ oe seen 28.716...or 28.72 or 28.7 or 29 isw	M1 A1 [2]	or $\sin 53.4$ used; may be embedded if M0, B2 for 28.7 or more precise www may be split into height = $9.8 \times \sin 53.4$ then Area = $\frac{1}{2} \times 7.3 \times$ height
4	(i)	(6, 9)	2 [2]	1 for each co-ordinate SC0 for (6, 3)
4	(ii)	(1.5, 3)	2 [2]	1 for each co-ordinate SC0 for (6, 3)
5		$45 = \frac{1}{2} r^2 \times 1.6$ oe $r^2 = 90/1.6$ oe $r = 7.5$ or exact equivalent cao  (their 7.5) $\times 1.6$ 27	M1 M1 A1  M1 A1 [5]	$45 = \pi r^2 \times \frac{91.673...}{360}$ or B3 www  $2\pi \times (\text{their } r) \times \frac{91.673...}{360}$ or B2 www allow recovery to 7.5 if working in degrees, but A0 for (eg) 7.49 12 implies M1

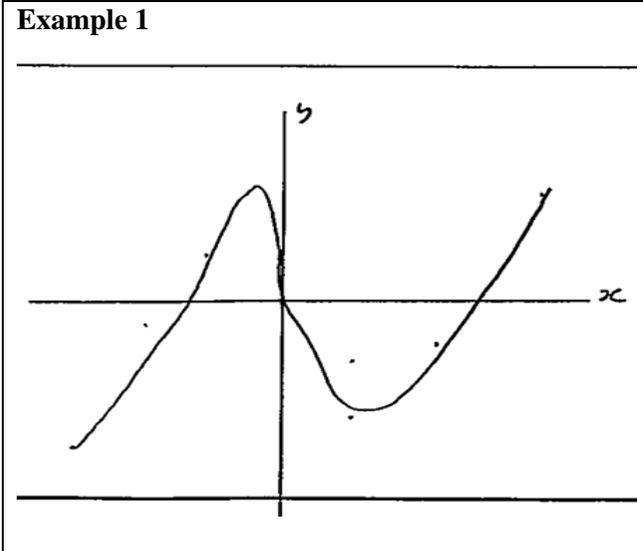
Question	Answer	Marks	Guidance
6	gradient = 3 seen  $\log_{10} y - 5 = (\text{their } 3)(\log_{10} x - 1)$ or using (5, 17)  $\log_{10} y = 3 \log_{10} x + 2$ oe  $y = 10^{3\log_{10} x + 2}$ oe  $y = 100x^3$	B1  M1  A1  M1  A1 <b>[5]</b>	may be embedded  or $\log_{10} y = 3 \log_{10} x + c$ and substitution of (1, 5) or (5, 17) for $\log_{10} x$ and $\log_{10} y$  or $\log_{10} y = \log_{10} x^3 + \log_{10} 100$  condone omission of base throughout  NB may recover from eg $Y = 3X + 2$  or $\log_{10} \frac{y}{x^3} = 2$ or $\log_{10} y = \log_{10} 100x^3$
7	$\frac{6x^{\frac{3}{2}}}{\frac{3}{2}}$ $4x^{\frac{3}{2}}$  $-5x + c$  substitution of (4, 20)  $[y =] 4x^{1.5} - 5x + 8$ or $c = 8$ isw	M1*  A1  B1  M1dep*  A1 <b>[5]</b>	may appear later  B0 if from $y = (6x^{\frac{1}{2}} - 5)x + c$  condone “+ c” not appearing until substitution
8	0.775397.. soi  0.388, 1.18, 3.53, 4.32  in degrees: 22.2, 67.8, 202, 248*	M1  A4        <b>[5]</b>	or 44.427..°  A1 each value  if A0 then B1 for at least two of 2.366..., 7.058..., 8.649... for $2\theta$ or all of 135.57..., 404.427..., 495.57...  if any of final answers not given to three sf deduct 1 mark from total A marks  *if final answers in degrees deduct 1 from total A marks ignore extra values outside range if four correct answers in degrees or radians, deduct 1 for extra values in range

Question		Answer	Marks	Guidance
9	(i)	$\frac{1}{2} \times 0.2 (0 + 0 + 2(0.5 + 0.7 + 0.75 + 0.7 + 0.5))$ $[=0.63]$  (their 0.63) $\times 50$ 31.5	M3   M1 A1 <b>[5]</b>	M2 if one error, M1 if two errors condone omission of zeros or M3 for $0.05 + 0.12 + 0.145 + 0.145 + 0.12 + 0.05$ may be unsimplified, must be summed  basic shape of formula must be correct must be 6 strips M0 if brackets omitted, but allow recovery M0 if $h = 1$ or $1.2$ Area = 6.3 and 0.53 imply M0
9	(ii)	(A) $3.8 \times 0.2^4 - 6.8 \times 0.2^3 + 7.7 \times 0.2^2 - 4.2 \times 0.2$  0.01968 cao isw	M1   A1 <b>[2]</b>	$\pm 0.58032$ implies M1  or B2 if unsupported  condone one sign error  allow $- 0.01968$
9	(ii)	(B) $\frac{3.8x^5}{5} - \frac{6.8x^4}{4} + \frac{7.7x^3}{3} - \frac{4.2x^2}{2} + c$  F(0.9) [ $- F(0)$ ] 50 $\times$ their $\pm F(0.9)$ 24.8 to 24.9 cao	M2   M1* M1dep* A1 <b>[5]</b>	M1 for two terms correct excluding $c$ condone omission of $c$  as long as at least M1 awarded  accept 2.56 to 2.57 for coefficient of $x^3$ allow M1 if all signs reversed  NB $F(0.9) = - 0.496\dots$

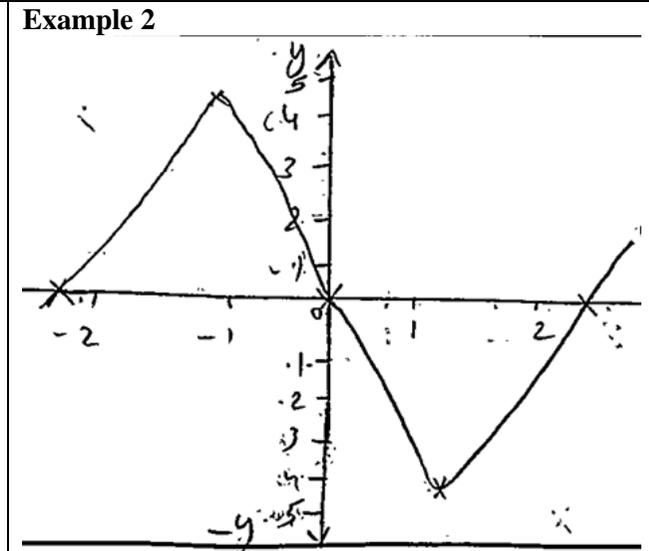
Question		Answer	Marks	Guidance	
10	(i)	$y' = 3x^2 - 5$ their $y' = 0$  (1.3, -4.3) cao (-1.3, 4.3) cao	M1 M1  A1 A1  <b>[4]</b>	or A1 for $x = \pm\sqrt{\frac{5}{3}}$ oe soi  allow if not written as co-ordinates if pairing is clear	ignore any work relating to second derivative
10	(ii)	crosses axes at (0, 0)  and $(\pm\sqrt{5}, 0)$ sketch of cubic with turning points in correct quadrants and of correct orientation and passing through origin x-intercepts $\pm\sqrt{5}$ marked	B1 B1 B1  B1 <b>[4]</b>	condone x and y intercepts not written as co-ordinates; may be on graph $\pm(2.23 \text{ to } 2.24)$ implies $\pm\sqrt{5}$  may be in decimal form ( $\pm 2.2\dots$ )	See examples in Appendix  must meet the x-axis three times B0 eg if more than 1 point of inflection
10	(iii)	substitution of $x = 1$ in $f'(x) = 3x^2 - 5$  -2 $y - -4 = (\text{their } f'(1)) \times (x - 1)$ oe $-2x - 2 = x^3 - 5x$ and completion to given result www use of Factor theorem in $x^3 - 3x + 2$ with -1 or $\pm 2$  $x = -2$ obtained correctly	M1  A1 M1* M1dep*  M1  A1  <b>[6]</b>	or $-4 = -2 \times (1) + c$  or any other valid method; must be shown	sight of -2 does not necessarily imply M1: check $f'(x) = 3x^2 - 5$ is correct in part (i)  eg long division or comparing coefficients to find $(x - 1)(x^2 + x - 2)$ or $(x + 2)(x^2 - 2x + 1)$ is enough for M1 with both factors correct NB M0A0 for $x(x^2 - 3) = -2$ so $x = -2$ or $x^2 - 3 = -2$ oe

Question		Answer	Marks	Guidance
<b>11</b>	<b>(i)</b>	$ar = 6$ oe $\frac{a}{1-r} = 25$ oe $25 = \frac{a}{1-\frac{6}{a}}$ $a^2 - 25a + 150 [= 0]$ $a = 10$ obtained from formula, factorising, Factor theorem or completing the square  $a = 15$  $r = 0.4$ and $0.6$	 B1 B1  M1  A1 A1  A1  A1  <b>[7]</b>	 must be in $a$ and $r$ must be in $a$ and $r$  or $\frac{6}{r} = 25(1-r)$  or $25r^2 - 25r + 6 [= 0]$ $r = 0.4$ and $r = 0.6$  $a = 15$  $a = \frac{6}{0.6} = 10$ oe  NB assuming $a = 10$ earns M0  All signs may be reversed  if M0, B1 for $r = 0.4$ <b>and</b> $0.6$ and B1 for $a = 15$ by trial and improvement mark to benefit of candidate
<b>11</b>	<b>(ii)</b>	$10 \times (3/5)^{n-1}$ and $15 \times (2/5)^{n-1}$ seen  $15 \times 2^{n-1} : 10 \times 3^{n-1}$ or $3 \times \frac{2^{n-1}}{5^{n-1}} : 2 \times \frac{3^{n-1}}{5^{n-1}}$  $3 \times 2^{n-1} : 2 \times 3^{n-1}$	 M1  M1  A1  <b>[3]</b>	  may be implied by $3 \times 2^{n-1} : 2 \times 3^{n-1}$  and completion to given answer www  condone ratio reversed  condone ratio reversed

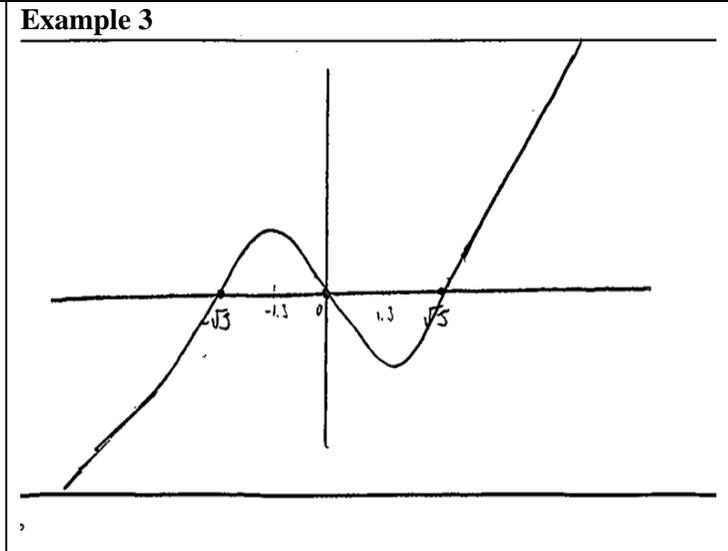
Appendix: examples for Question 10(ii)



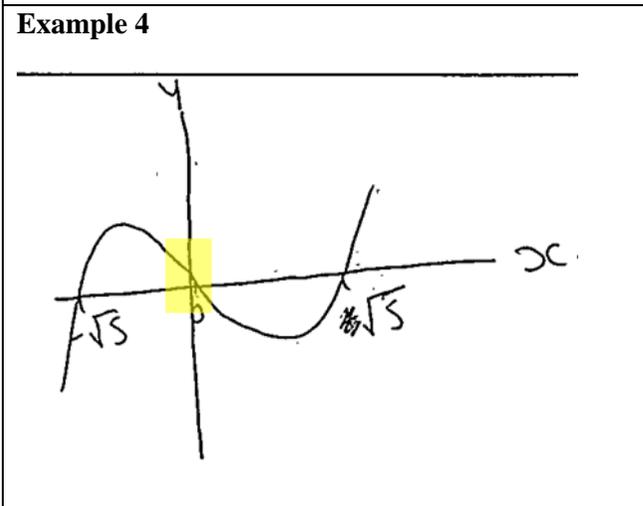
3<sup>rd</sup> B1 BOD inflection



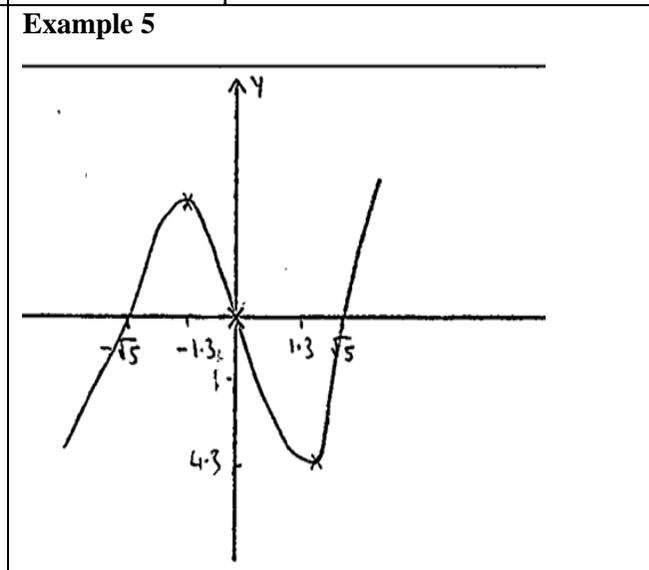
3<sup>rd</sup> B1 BOD Shape



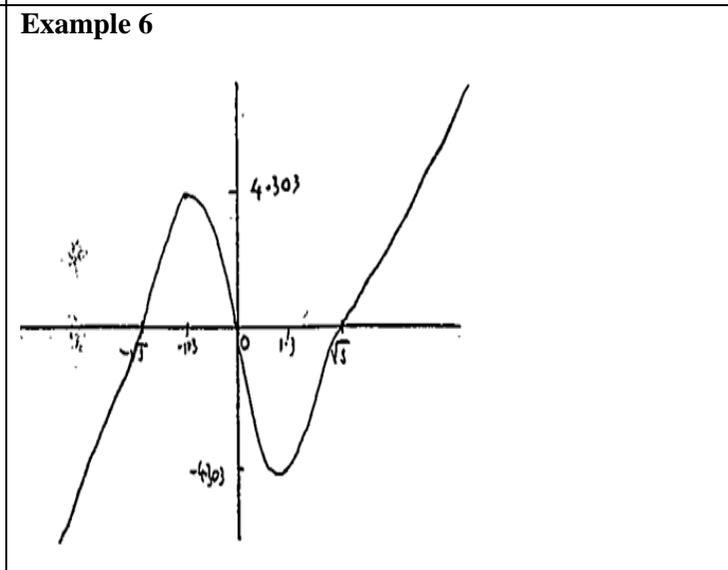
3<sup>rd</sup> B1 BOD Point of inflection on left



Clearly does not pass through origin  
3<sup>rd</sup> B0

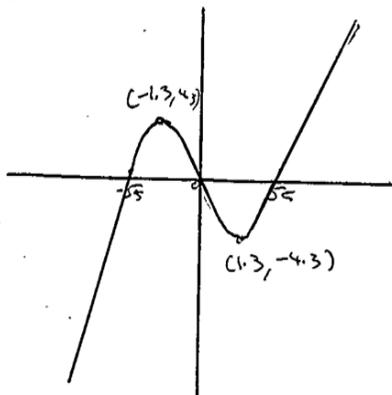


3<sup>rd</sup> B1



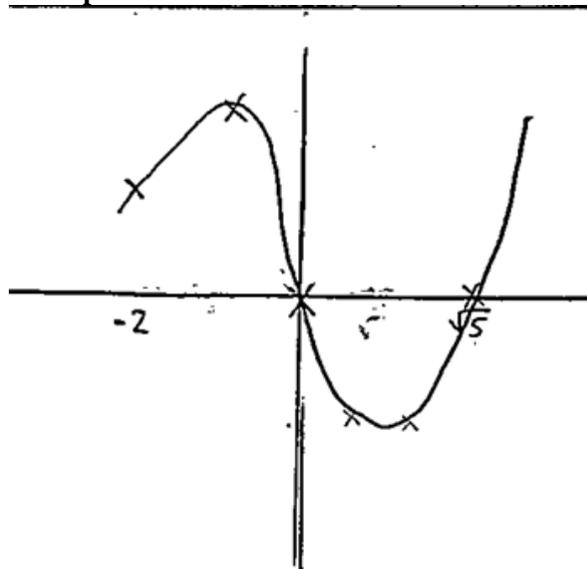
3<sup>rd</sup> B1 condone RHS

Example 7



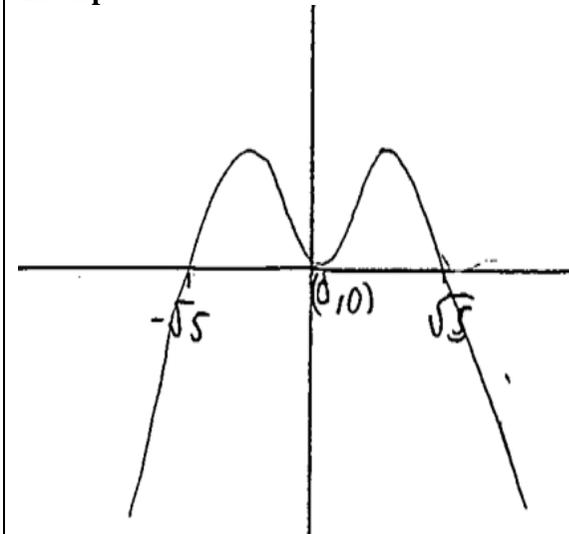
3<sup>rd</sup> B1 condone extreme ends ruled

Example 8



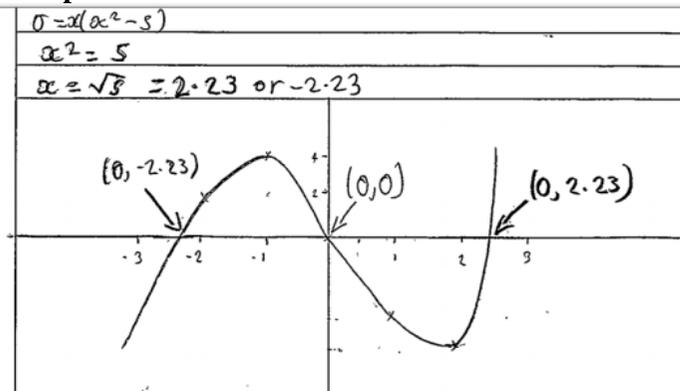
3<sup>rd</sup> B0 doesn't meet x-axis 3 times

Example 9



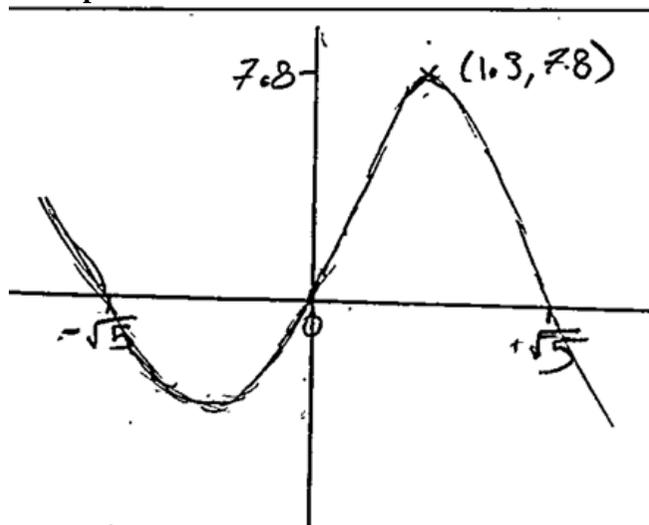
4<sup>th</sup> B1 is earned in spite of the curve not being a cubic

Example 10



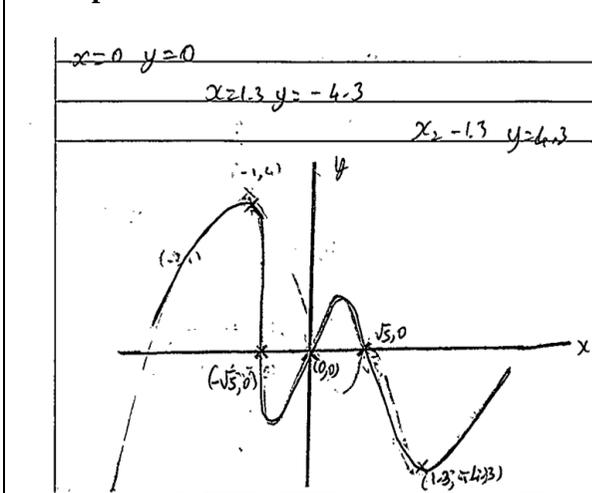
x-intercepts: co-ordinates reversed but condone this as candidates who write  $-2.23, 2.23$  only would not be penalised  
4<sup>th</sup> B1

Example 11



(3<sup>rd</sup> B0: incorrect orientation) 4<sup>th</sup> B1

Example 12



4<sup>th</sup> B1 earned.

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