

# Mark Scheme (Results)

## January 2011

GCE

### GCE Core Mathematics C1 (6663) Paper 1

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## General Instructions for Marking

1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
  - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
  - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
  - **B** marks are unconditional accuracy marks (independent of M marks)
  - Marks should not be subdivided.
3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

- bod - benefit of doubt
- ft - follow through
- the symbol  $\checkmark$  will be used for correct ft
- cao - correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw - ignore subsequent working
- awrt - answers which round to
- SC: special case
- oe - or equivalent (and appropriate)
- dep - dependent
- indep - independent
- dp decimal places
- sf significant figures
- \* The answer is printed on the paper
- $\square$  The second mark is dependent on gaining the first mark

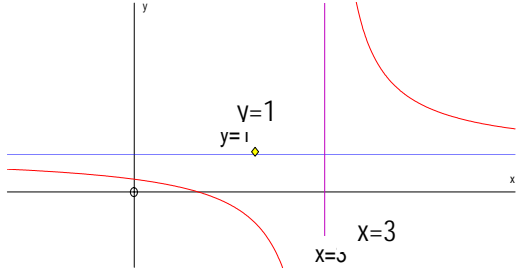
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Mark Scheme

Question Number	Scheme	Marks
1.  (a)	$16^{\frac{1}{4}} = 2$ or $\frac{1}{16^{\frac{1}{4}}}$ or better $\left(16^{-\frac{1}{4}} = \right) \frac{1}{2}$ or 0.5 (ignore $\pm$ )	M1  A1  (2)
(b)	$\left(2x^{-\frac{1}{4}}\right)^4 = 2^4 x^{-\frac{4}{4}}$ or $\frac{2^4}{x^{\frac{4}{4}}}$ or equivalent $x\left(2x^{-\frac{1}{4}}\right)^4 = 2^4$ or 16	M1  A1 cao  (2) 4
<b>Notes</b>		
(a)	M1 for a correct statement dealing with the $\frac{1}{4}$ or the $-$ power This may be awarded if 2 is seen or for reciprocal of their $16^{\frac{1}{4}}$ s.c $\frac{1}{4}$ is M1 A0 , also $2^{-1}$ is M1 A0 $\pm \frac{1}{2}$ is not penalised so M1 A1	
(b)	M1 for <b>correct</b> use of the power 4 on both the 2 and the $x$ terms A1 for cancelling the $x$ and simplifying to one of these two forms. Correct answers with no working get full marks	

Question Number	Scheme	Marks
2.	$\left(\int =\right) \frac{12x^6}{6}, -\frac{3x^3}{3}, +\frac{4x^{\frac{4}{3}}}{\frac{4}{3}}, (+c)$ $= \underline{2x^6 - x^3 + 3x^{\frac{4}{3}} + c}$	M1A1,A1,A1  A1  5
<b>Notes</b>		
<p>M1 for some attempt to integrate: <math>x^n \rightarrow x^{n+1}</math> i.e <math>ax^6</math> or <math>ax^3</math> or <math>ax^{\frac{4}{3}}</math> or <math>ax^{\frac{1}{3}}</math>, where <math>a</math> is a non zero constant</p> <p>1<sup>st</sup> A1 for <math>\frac{12x^6}{6}</math> or better</p> <p>2<sup>nd</sup> A1 for <math>-\frac{3x^3}{3}</math> or better</p> <p>3<sup>rd</sup> A1 for <math>\frac{4x^{\frac{4}{3}}}{\frac{4}{3}}</math> or better</p> <p>4<sup>th</sup> A1 for each term correct and simplified and the <math>+c</math> occurring in the final answer</p>		

Question Number	Scheme	Marks
3.	$\frac{5-2\sqrt{3}}{\sqrt{3}-1} \times \frac{(\sqrt{3}+1)}{(\sqrt{3}+1)}$ $= \frac{\dots}{2} \quad \text{denominator of 2}$ <p>Numerator = <math>5\sqrt{3} + 5 - 2\sqrt{3}\sqrt{3} - 2\sqrt{3}</math></p> <p>So <math>\frac{5-2\sqrt{3}}{\sqrt{3}-1} = -\frac{1}{2} + \frac{3}{2}\sqrt{3}</math></p>	M1  A1  M1  A1  <b>4</b>
	<p><b>Alternative:</b> <math>(p+q\sqrt{3})(\sqrt{3}-1) = 5-2\sqrt{3}</math>, and form simultaneous equations in <math>p</math> and <math>q</math></p> <p><math>-p + 3q = 5</math> and <math>p - q = -2</math></p> <p>Solve simultaneous equations to give <math>p = -\frac{1}{2}</math> and <math>q = \frac{3}{2}</math>.</p>	M1  A1  M1 A1
	<b>Notes</b>	
	<p>1<sup>st</sup> M1 for multiplying numerator and denominator by same correct expression</p> <p>1<sup>st</sup> A1 for a correct denominator as a single number (NB depends on M mark)</p> <p>2<sup>nd</sup> M1 for an attempt to multiply the numerator by <math>(\sqrt{3} \pm 1)</math> and get 4 terms with at least 2 correct.</p> <p>2<sup>nd</sup> A1 for the answer as written or <math>p = -\frac{1}{2}</math> and <math>q = \frac{3}{2}</math>. Allow <math>-0.5</math> and <math>1.5</math>. (Apply isw if correct answer seen, then slip writing <math>p =, q =</math> )</p>	
	Answer only (very unlikely) is full marks if correct – no part marks	

Question Number	Scheme	Marks
4 (a)	$(a_2 =) 6 - c$	B1 (1)
(b)	$a_3 = 3(\text{their } a_2) - c \quad (= 18 - 4c)$ $a_1 + a_2 + a_3 = 2 + "(6 - c)" + "(18 - 4c)"$ $"26 - 5c" = 0$ So $c = 5.2$	M1 M1 A1ft A1 o.a.e (4) 5
<b>Notes</b>		
(b)	1 <sup>st</sup> M1 for attempting $a_3$ . Can follow through their answer to (a) but it must be an expression in $c$ . 2 <sup>nd</sup> M1 for an attempt to find the sum $a_1 + a_2 + a_3$ must see evidence of sum 1 <sup>st</sup> A1ft for their sum put equal to 0. Follow through their values but answer must be in the form $p + qc = 0$ A1 – accept any correct equivalent answer	

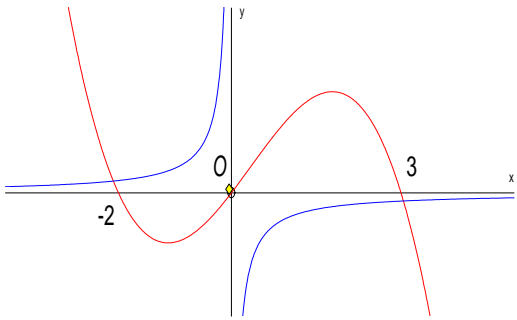
Question Number	Scheme	Marks
5. (a)	 <p data-bbox="868 286 1222 353">Correct shape with a single crossing of each axis</p> <p data-bbox="868 398 1166 432"><math>y = 1</math> labelled or stated</p> <p data-bbox="868 472 1166 506"><math>x = 3</math> labelled or stated</p>	<p data-bbox="1294 309 1326 342">B1</p> <p data-bbox="1294 398 1326 432">B1</p> <p data-bbox="1294 472 1326 506">B1</p> <p data-bbox="1433 506 1469 539">(3)</p>
(b)	<p data-bbox="272 622 935 656">Horizontal translation so crosses the <math>x</math>-axis at <math>(1, 0)</math></p> <p data-bbox="272 689 699 768">New equation is <math>(y =) \frac{x \pm 1}{(x \pm 1) - 2}</math></p> <p data-bbox="272 779 496 813">When <math>x = 0</math> <math>y =</math></p> $= \frac{1}{3}$	<p data-bbox="1294 656 1326 689">B1</p> <p data-bbox="1294 701 1326 734">M1</p> <p data-bbox="1294 801 1326 835">M1</p> <p data-bbox="1294 880 1326 913">A1</p> <p data-bbox="1433 936 1469 1003">(4) 7</p>
<b>Notes</b>		
(b)	<p data-bbox="272 1055 1262 1122">B1 for point <math>(1,0)</math> identified - this may be marked on the sketch as 1 on <math>x</math> axis. Accept <math>x = 1</math>.</p> <p data-bbox="272 1126 1209 1193">1<sup>st</sup> M1 for attempt at new equation and either numerator or denominator correct</p> <p data-bbox="272 1198 1209 1232">2<sup>nd</sup> M1 for setting <math>x = 0</math> in their new equation and solving as far as <math>y = \dots</math></p> <p data-bbox="272 1236 1158 1350">A1 for <math>\frac{1}{3}</math> or exact equivalent. Must see <math>y = \frac{1}{3}</math> or <math>(0, \frac{1}{3})</math> or point marked on <math>y</math>-axis.</p> <p data-bbox="272 1355 432 1388"><b>Alternative</b></p> <p data-bbox="272 1393 1209 1460"><math>f(-1) = \frac{-1}{-1-2} = \frac{1}{3}</math> scores M1M1A0 unless <math>x = 0</math> is seen or they write the</p> <p data-bbox="272 1464 663 1532">point as <math>(0, \frac{1}{3})</math> or give <math>y = 1/3</math></p> <p data-bbox="272 1554 1078 1588">Answers only: <math>x = 1, y = 1/3</math> is full marks as is <math>(1,0) (0, 1/3)</math></p> <p data-bbox="272 1592 679 1626">Just 1 and <math>1/3</math> is B0 M1 M1 A0</p> <p data-bbox="272 1666 759 1700">Special case : Translates 1 unit to left</p> <p data-bbox="320 1704 517 1738">(a) B0, B1, B0</p> <p data-bbox="320 1742 612 1776">(b) Mark (b) as before</p> <p data-bbox="320 1780 1222 1848">May score B0 M1 M1 A0 so 3/7 or may ignore sketch and start again scoring full marks for this part.</p>	



Question Number	Scheme	Marks
6. (a)	$S_{10} = \frac{10}{2}[2a + 9d] \text{ or}$ $S_{10} = a + a + d + a + 2d + a + 3d + a + 4d + a + 5d + a + 6d + a + 7d + a + 8d + a + 9d$ $162 = 10a + 45d \quad *$	M1  A1cso (2)
(b)	$(u_n = a + (n-1)d \Rightarrow )17 = a + 5d$ $10 \times (b) \text{ gives } 10a + 50d = 170$ $(a) \text{ is } 10a + 45d = 162$ Subtract $5d = 8$ so $d = \underline{1.6}$ o.e. Solving for $a$ $a = 17 - 5d$ so $a = \underline{9}$	B1 (1)  M1  A1  M1  A1 (4) 7
<b>Notes</b>		
(a)	M1 for use of $S_n$ with $n = 10$	
(b)	1 <sup>st</sup> M1 for an attempt to eliminate $a$ or $d$ from their two linear equations 2 <sup>nd</sup> M1 for using their value of $a$ or $d$ to find the other value.	

Question Number	Scheme	Marks
7.	$(f(x) =) \frac{12x^3}{3} - \frac{8x^2}{2} + x(+c)$ $(f(-1) = 0 \Rightarrow) 0 = 4 \times (-1) - 4 \times 1 - 1 + c$ $c = \underline{9}$ $[f(x) = 4x^3 - 4x^2 + x + 9]$	M1 A1 A1 M1 A1  5
<b>Notes</b>		
	1 <sup>st</sup> M1 for an attempt to integrate $x^n \rightarrow x^{n+1}$ 1 <sup>st</sup> A1 for at least 2 terms in $x$ correct - needn't be simplified, ignore $+c$ 2 <sup>nd</sup> A1 for all the terms in $x$ correct but they need not be simplified. No need for $+c$ 2 <sup>nd</sup> M1 for using $x = -1$ and $y = 0$ to form a linear equation in $c$ . No $+c$ gets M0A0 3 <sup>rd</sup> A1 for $c = 9$ . Final form of $f(x)$ is not required.	
8 .	(a) $b^2 - 4ac = (k - 3)^2 - 4(3 - 2k)$ $k^2 - 6k + 9 - 4(3 - 2k) > 0$ or $(k - 3)^2 - 12 + 8k > 0$ or better $\underline{k^2 + 2k - 3 > 0}$ *	M1  M1 A1cso  (3)
(b)	$(k + 3)(k - 1)[= 0]$ Critical values are $k = 1$ or $-3$ (choosing "outside" region) $\underline{k > 1}$ or $\underline{k < -3}$	M1 A1 M1 A1 cao  (4) 7
<b>Notes</b>		
(a)	1 <sup>st</sup> M1 for attempt to find $b^2 - 4ac$ with one of $b$ or $c$ correct 2 <sup>nd</sup> M1 for a correct inequality symbol and an attempt to expand. A1cso no incorrect working seen	
(b)	1 <sup>st</sup> M1 for an attempt to factorize <b>or</b> solve leading to $k = (2$ values) 2 <sup>nd</sup> M1 for a method that leads them to choose the "outside" region. Can follow through their critical values. 2 <sup>nd</sup> A1 Allow " , " instead of "or" $\geq$ loses the final A1 $1 < k < -3$ scores M1A0 unless a correct version is seen before or after this one.	

Question Number	Scheme	Marks
9.		
(a)	$(8 - 3 - k = 0)$ so $k = 5$	B1 (1)
(b)	$2y = 3x + k$ $y = \frac{3}{2}x + \dots$ and so $m = \frac{3}{2}$ o.e.	M1 A1 (2)
(c)	Perpendicular gradient = $-\frac{2}{3}$ Equation of line is: $y - 4 = -\frac{2}{3}(x - 1)$ $3y + 2x - 14 = 0$ o.e.	B1ft M1A1ft A1 (4)
(d)	$y = 0, \Rightarrow B(7, 0)$ or $x = 7$ $x = 7$ or $-\frac{c}{a}$	M1A1ft (2)
(e)	$AB^2 = (7 - 1)^2 + (4 - 0)^2$ $AB = \sqrt{52}$ or $2\sqrt{13}$	M1 A1 (2) 11
<b>Notes</b>		
(b)	M1 for an attempt to rearrange to $y = \dots$ A1 for clear statement that gradient is 1.5, can be $m = 1.5$ o.e.	
(c)	B1ft for using the perpendicular gradient rule correctly on their "1.5"  M1 for an attempt at finding the equation of the line through A using their gradient. Allow a sign slip 1 <sup>st</sup> A1ft for a correct equation of the line follow through their changed gradient  2 <sup>nd</sup> A1 as printed or equivalent with integer coefficients – allow <u><math>3y + 2x = 14</math></u> or <u><math>3y = 14 - 2x</math></u>	
(d)	M1 for use of $y = 0$ to find $x = \dots$ in their equation A1ft for $x = 7$ or $-\frac{c}{a}$	
(e)	M1 for an attempt to find $AB$ or $AB^2$ A1 for any correct surd form- need not be simplified	

Question Number	Scheme	Marks
10. (a)	 <p>(i) correct shape ( -ve cubic) Crossing at (-2, 0) Through the origin Crossing at (3,0)</p> <p>(ii) 2 branches in correct quadrants not crossing axes One intersection with cubic on each branch</p>	B1 B1 B1 B1 B1 B1 (6)
(b)	“2” solutions  Since only “2” intersections	B1ft  dB1ft  (2) 8
<b>Notes</b>		
(b)	B1ft for a value that is compatible with their sketch dB1ft This mark is dependent on the value being compatible with their sketch. For a comment relating the number of solutions to the number of intersections.  [ Only allow 0, 2 or 4]	
11. (a)	$\left(\frac{dy}{dx} = \right) \frac{3}{2}x^2 - \frac{27}{2}x^{\frac{1}{2}} - 8x^{-2}$	M1A1A1A1  (4)
(b)	$x = 4 \Rightarrow y = \frac{1}{2} \times 64 - 9 \times 2^3 + \frac{8}{4} + 30$ $= 32 - 72 + 2 + 30 = \underline{-8} *$	M1  A1cso  (2)
(c)	$x = 4 \Rightarrow y' = \frac{3}{2} \times 4^2 - \frac{27}{2} \times 2 - \frac{8}{16}$ $= 24 - 27 - \frac{1}{2} = -\frac{7}{2}$ <p>Gradient of the normal = <math>-1 \div \frac{7}{2}</math></p> <p>Equation of normal: <math>y - -8 = \frac{2}{7}(x - 4)</math></p> $\underline{7y - 2x + 64 = 0}$	M1  A1  M1 M1A1ft  A1  (6) 12

Question Number	Scheme	Marks
	<b>Notes</b>	
(a)	1 <sup>st</sup> M1 for an attempt to differentiate $x^n \rightarrow x^{n-1}$ 1 <sup>st</sup> A1 for one correct term in $x$ 2 <sup>nd</sup> A1 for 2 terms in $x$ correct 3 <sup>rd</sup> A1 for all correct $x$ terms. No 30 term and no $+c$ .	
(b)	M1 for substituting $x = 4$ into $y =$ and attempting $4^{\frac{3}{2}}$ A1 note this is a printed answer	
(c)	1 <sup>st</sup> M1 Substitute $x = 4$ into $y'$ (allow slips) A1 Obtains $-3.5$ or equivalent 2 <sup>nd</sup> M1 for correct use of the perpendicular gradient rule using their gradient. (May be slip doing the division) Their gradient must have come from $y'$  3 <sup>rd</sup> M1 for an attempt at equation of tangent or normal at $P$ 2 <sup>nd</sup> A1ft for correct use of their changed gradient to find <b>normal</b> at $P$ . Depends on 1 <sup>st</sup> , 2 <sup>nd</sup> and 3 <sup>rd</sup> Ms 3 <sup>rd</sup> A1 for any equivalent form with integer coefficients	

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