edexcel

Mark Scheme (Results)

January 2013

GCE Maths – Core Mathematics C1 (6663/01)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

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 $\sqrt{}$ or the letters ft will be used for correct follow through
   - 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)
   - d… or dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - $\ast$ The answer is printed on the paper or ag- answer given
   - $\llcorner$ or d… The second mark is dependent on gaining the first mark
   - quotation marks are used to indicate "their value"

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from the first two A or B marks gained, in that part of the question affected. If you are using the annotation facility on ePEN, indicate this action by 'MR' in the body of the script.

6. If a candidate makes more than one attempt at any question:
    - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
    - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

8. Marks for each question are scored by clicking in the marking grids that appear below each student response on ePEN. The maximum mark allocation for each question/part question(item) is set out in the marking grid and you should allocate a score of ‘0’ or ‘1’ for each mark, or “trait”, as shown:

	0	1
aM		●
aA	●	
bM1		●
bA1	●	
bB	●	
bM2		●
bA2		●

9. Be careful when scoring a response that is either all correct or all incorrect. It is very easy to click down the ‘0’ column when it was meant to be ‘1’ and all correct.

General Principles for Core Mathematics Marking

(But note that specific mark schemes may sometimes override these general principles).

Method mark for solving 3 term quadratic:

1. <u>Factorisation</u>

$(x^2 + bx + c) = (x + p)(x + q)$, where $|pq| = |c|$, leading to $x = \ldots$

$(ax^2 + bx + c) = (mx + p)(nx + q)$, where $|pq| = |c|$ and $|mn| = |a|$, leading to $x = \ldots$

2. <u>Formula</u>

Attempt to use <u>correct</u> formula (with values for *a*, *b* and *c*).

3. <u>Completing the square</u>

Solving $x^2 + bx + c = 0$: $(x \pm \frac{b}{2})^2 \pm q \pm c$, $q \neq 0$, leading to $x = \ldots$

Method marks for differentiation and integration:

1. <u>Differentiation</u>

Power of at least one term decreased by 1. ($x^n \to x^{n-1}$)

2. <u>Integration</u>

Power of at least one term increased by 1. ($x^n \to x^{n+1}$)

Use of a formula

Where a method involves using a formula that has been learnt, the advice given in recent examiners' reports is that the formula should be quoted first.

Normal marking procedure is as follows:
Method mark for quoting a correct formula and attempting to use it, even if there are mistakes in the substitution of values.
Where the formula is <u>not</u> quoted, the method mark can be gained by implication from <u>correct</u> working with values, but may be lost if there is any mistake in the working.

Exact answers

Examiners' reports have emphasised that where, for example, an <u>exact</u> answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Answers without working

The rubric says that these <u>may</u> not gain full credit. Individual mark schemes will give details of what happens in particular cases. General policy is that if it could be done "in your head", detailed working would not be required. Most candidates do show working, but there are occasional awkward cases and if the mark scheme does <u>not</u> cover this, please contact your team leader for advice.

January 2013
6663 Core Mathematics C1
Mark Scheme

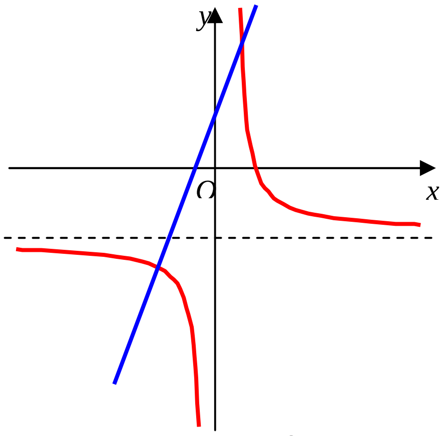
Question Number	Scheme	Marks
1.	$x(1-4x^2)$ Accept $x(-4x^2+1)$ or $-x(4x^2-1)$ or $-x(-1+4x^2)$ or even $4x(\frac{1}{4}-x^2)$ or equivalent	B1
	Factorises quadratic (or initial cubic) into two brackets	M1
	$x(1-2x)(1+2x)$ or $-x(2x-1)(2x+1)$ or $x(2x-1)(-2x-1)$	A1
		[3]
		3 marks
	Notes	
	B1: Takes out a factor of x or $-x$ or even $4x$. This line may be implied by correct final answer, but if this stage is shown it **must be correct**. So **B0** for $x(1+4x^2)$ **M1:** Factorises the quadratic resulting from their first factorisation using usual rules (see note 1 in General Principles). e.g. $x(1-4x)(x-1)$. Also allow attempts to factorise cubic such as $(x-2x^2)(1+2x)$ etc N.B. Should not be completing the square here. **A1:** Accept either $x(1-2x)(1+2x)$ or $-x(2x-1)(2x+1)$ or $x(2x-1)(-2x-1)$. (No fractions for this final answer)	
	Specific situations	
	Note: $x(1-4x^2)$ followed by $x(1-2x)^2$ scores B1M1A0 as factors follow quadratic factorisation criteria **And** $x(1-4x^2)$ followed by $x(1-4x)(1+4x)$ **B1M0A0.**	
	Answers with no working: Correct answer gets all three marks B1M1A1	
	: $x(2x-1)(2x+1)$ gets B0M1A0 if **no working** as $x(4x^2-1)$ would earn B0	
	Poor bracketing: e.g. $(-1+4x^2)-x$ gets B0 unless subsequent work implies bracket round the $-x$ in which case candidate may recover the mark by the following correct work.	
	N.B. If correct factors are followed by $x=0, x=\frac{1}{2}, x=-\frac{1}{2}$ then ignore this as subsequent work.	
	But these answers- $x=0, x=\frac{1}{2}, x=-\frac{1}{2}$ - with no working, or no factors, gets B0M0A0.	
	Ignore "=0" written at the end of lines and mark LHS as in the scheme above. Candidate who changes the question to $4x^3-x=x(4x^2-1)=x(2x-1)(2x+1)$ would earn B0 M1 A0 1/3	

Question Number	Scheme	Marks
2.	$(8^{2x+3} = \left(2^3\right)^{2x+3}) = 2^{3(2x+3)}$ or 2^{ax+b} with $a = 6$ **or** $b = 9$	M1
	$= 2^{6x+9}$ *or* $= 2^{3(2x+3)}$ as **final** answer with no errors or $(y =) 6x + 9$ or $3(2x + 3)$	A1 **[2]**
		2 marks
	Notes	
	M1: Uses $8 = 2^3$, and **multiplies** powers $3(2x + 3)$. Does **not** add powers. (Just $8 = 2^3$ or $8^{\frac{1}{3}} = 2$ is M0) **A1:** Either 2^{6x+9} *or* $= 2^{3(2x+3)}$ or $(y =) 6x + 9$ or $3(2x + 3)$	
	Note: Examples: 2^{6x+3} scores M1A0 **:** $8^{2x+3} = \left(2^3\right)^{2x+3} = 2^{3+2x+3}$ gets M0A0 **Special case:** **:** $= 2^{6x}\,2^9$ without seeing as single power M1A0 **Alternative method using logs:** $8^{2x+3} = 2^y \Rightarrow (2x+3)\log 8 = y\log 2 \Rightarrow y = \dfrac{(2x+3)\log 8}{\log 2}$ **So** $(y =) 6x + 9$ or $3(2x + 3)$	**M1** **A1 [2]**

Question Number	Scheme	Marks
3. (i)	$\left(5-\sqrt{8}\right)\left(1+\sqrt{2}\right)$ $=5+5\sqrt{2}-\sqrt{8}-4$ $=5+5\sqrt{2}-2\sqrt{2}-4$ — $\sqrt{8}=2\sqrt{2}$, seen or implied at any point. $=1+3\sqrt{2}$ — $1+3\sqrt{2}$ or $a=1$ and $b=3$.	 M1 B1 A1 **[3]**
(ii)	Method 1 **Either** $\sqrt{80}+\frac{30}{\sqrt{5}}\left(\frac{\sqrt{5}}{\sqrt{5}}\right)$ $=4\sqrt{5}+...$ $=4\sqrt{5}+6\sqrt{5}$ Method 2 **Or** $\left(\frac{\sqrt{400}+30}{\sqrt{5}}\right)\frac{\sqrt{5}}{\sqrt{5}}$ $=\left(\frac{20+..}{..}\right)\frac{..}{..}$ $=\left(\frac{50\sqrt{5}}{5}\right)$ Method 3 $\sqrt{80}+\frac{\sqrt{900}}{\sqrt{5}}=\sqrt{80}+\sqrt{180}$ $=4\sqrt{5}+...$ $=4\sqrt{5}+6\sqrt{5}$ $=10\sqrt{5}$	 M1 B1 A1 **[3]**
Alternative for (i)	$\left(5-2\sqrt{2}\right)\left(1+\sqrt{2}\right)$ — This earns the B1 mark and is entered on epen as B1 $=5+5\sqrt{2}-2\sqrt{2}-2\sqrt{2}\sqrt{2}$ — Multiplies out correctly with $2\sqrt{2}$. This may be seen or implied and may be simplified e.g. $=5+3\sqrt{2}-2\sqrt{4}$ o.e. For earlier use of $2\sqrt{2}$ $=1+3\sqrt{2}$ — $1+3\sqrt{2}$ or $a=1$ and $b=3$.	 M1 B1 A1 **[3]** **6 marks**
	Notes	
(i) (ii)	**M1:** Multiplies out brackets correctly giving four correct terms or simplifying to correct expansion. (This may be implied by correct answer) – can appear as table **B1:** $\sqrt{8}=2\sqrt{2}$, seen or implied at any point **A1:** Fully and correctly simplified to $1+3\sqrt{2}$ or $a=1$ and $b=3$. **M1:** Rationalises denominator i.e. Multiplies $\left(\frac{k}{\sqrt{5}}\right)$ by $\left(\frac{\sqrt{5}}{\sqrt{5}}\right)$ or $\left(\frac{-\sqrt{5}}{-\sqrt{5}}\right)$, seen or implied or uses Method 3 or similar e.g. $\left(\frac{30}{\sqrt{5}}\right)=\frac{6\times5}{\sqrt{5}}=6\sqrt{5}$ **B1**: (Independent mark) States $\sqrt{80}=4\sqrt{5}$ Or either $\sqrt{400}=20$ *or* $\sqrt{80}\sqrt{5}=20$ at any point if they use Method 2. **A1:** $10\sqrt{5}$ or $c=10$.	
	N.B There are other methods e.g. $\sqrt{80}=\frac{20}{\sqrt{5}}$ (B1) then add $\frac{20}{\sqrt{5}}+\frac{30}{\sqrt{5}}=\frac{50}{\sqrt{5}}$ then M1 A1as before Those who multiply initial expression by $\sqrt{5}$ to obtain $\sqrt{400}+30=20+30=50$ earn M0 B1 A0	

Question Number	Scheme		Marks
4.	$u_2 = 9,\ u_{n+1} = 2u_n - 1,\ \ n \geqslant 1$		
(a)	$u_3 = 2u_2 - 1 = 2(9) - 1 \quad (=17)$	$u_3 = 2(9) - 1.$ Can be implied by $u_3 = 17$	M1
	$u_4 = 2u_3 - 1 = 2(17) - 1 = 33$	Both $u_3 = 17$ and $u_4 = 33$	A1
			[2]
(b)	$\sum_{r=1}^{4} u_r = u_1 + u_2 + u_3 + u_4$		
	$(u_1) = 5$	$(u_1) = 5$	B1 (M1 on epen)
	$\sum_{r=1}^{4} u_r = "5" + 9 + "17" + "33" = 64$	Adds their first four terms obtained legitimately (see notes below)	M1
		64	A1
			[3]
			5 marks
	Notes		
(a)	**M1**: Substitutes 9 into RHS of iteration formula **A1**: Needs **both** 17 and 33 (but **allow if either or both seen in part (b)**)		
(b)	**B1: (Appears as M1 on epen) for** u_1=5 (however obtained – may appear in (a)) May be called *a=5* **M1:** Uses their u_1 found from $u_2 = 2u_1 - 1$ stated explicitly, or uses $u_1 = 4$ *or* $5\frac{1}{2}$, and adds it to u_2, their u_3 and their u_4 only. (See special cases below). There should be no fifth term included. Use of sum of AP is irrelevant and scores M0 **A1**: 64		
	Note: Special cases: A candidate who adds u_2, u_3, u_4 and u_5 scores B0M0A0. (M0M0A0 on epen) Such candidates will usually give a final answer of $9 + 17 + 33 + 65 = 124$. Candidates **who invent** an arbitrary (wrong) value for u_1 will also score B0 M0 A0. (M0M0A0 on epen) Uses u_1 = 4 to obtain sum (usually 63) get B0 M1 A0 (M0 M1 A0 on epen) Uses $u_1 = 5\frac{1}{2}$ to obtain sum (usually $64\frac{1}{2}$) also get B0 M1 A0 (M0 M1 A0 on epen)		

Question Number	Scheme	Marks
5.		
(a)	Gradient of l_2 is $\frac{1}{2}$ or 0.5 or $\frac{-1}{-2}$	B1
	Either $y-6="\frac{1}{2}"(x-5)$ or $y="\frac{1}{2}"x+c$ and $6="\frac{1}{2}"(5)+c \Rightarrow c=("\frac{7}{2}")$	M1
	$x-2y+7=0$ or $-x+2y-7=0$ or $k(x-2y+7)=0$ with ***k* an integer**	A1
		[3]
(b)	Puts $x = 0$, or $y = 0$ in **their** equation and solves to find appropriate co-ordinate	M1
	x-coordinate of A is -7 and y-coordinate of B is $\frac{7}{2}$.	A1 cao
		[2]
(c)	Area $OAB = \frac{1}{2}(7)\left(\frac{7}{2}\right) = \frac{49}{4}$ (units)^2 — Applies $\pm\frac{1}{2}$(base)(height)	M1
	$\frac{49}{4}$	A1**cso**
		[2]
		7 marks
	Notes	
(a)	**B1**: Must have ½ or 0.5 or $\frac{-1}{-2}$ o.e. stated and stops, or used in their line equation **M1:** Full method to obtain an equation of the line through (5,6) with their "m". So $y-6=m(x-5)$ with their gradient or uses $y=mx+c$ with $(5, 6)$ and their gradient to find c. Allow any numerical gradient here including –2 or –1 but **not zero** . (Allow (6,5) as a slip **if** $y-y_1=m(x-x_1)$ is quoted first) **A1:** Accept any multiple of the correct equation, provided that the coefficients are integers and equation = 0 e.g. $-x+2y-7=0$ or $k(x-2y+7)=0$ or even $2y-x-7=0$	
(b)	**M1:** Either one of the x or y coordinates using their equation **A1:** Needs both correct values. Accept any correct equivalent.. Need not be written as co-ordinates. **Even** just –7 and 3.5 with **no** indication which is which may be awarded the A1.	
(c)	**M1:** Any correct method for area of triangle AOB, with their values for co-ordinates of A and B (may include negatives) *Method usually half base times height but determinants could be used.* **A1**: Any exact equivalent to 49/4, e.g. 12.25. (**negative final** answer is A0 but replacing by **positive** is A1) Do not need units. **c.s.o.** implies if A0 is scored in (b) then A0 is scored in (c) as well**. However** if candidate has correct line equation in (a) of wrong form may score A0 in (a) and A1 in (b) and (c)	
	Note: Special cases: $\frac{1}{2}(-7)\left(+\frac{7}{2}\right)=-\frac{49}{4}$ (units)^2 is M1 A0 but changing sign to area = $+\frac{49}{4}$ gets M1A1 (recovery) **N.B.** Candidates making sign errors in (b) and obtaining +7 and $-\frac{7}{2}$. may also get $\frac{49}{4}$ as their answer following previous errors. They should be awarded A0 as this answer is not ft and is for correct **solution** only **Special Case**: In (a) and (b): Produces parallel line instead of perpendicular line: So uses m = -2 This is not treated as a misread as it simplifies the question. The marks will usually be B0 M1 A0, M1 A0, M1 A0 i.e. maximum of 3/7	

Question Number	Scheme		Marks
6. (a)	 **Check graph in question for possible answers and space below graph for answers to part (b)**	$y = \frac{2}{x}$ is translated up or down. $y = \frac{2}{x} - 5$ is in the correct position. Intersection with x-axis at $\left(\frac{2}{5}, \{0\}\right)$ **only** Independent mark. $y = 4x + 2$: attempt at straight line, with positive gradient with positive y intercept. Intersection with x-axis at $\left(-\frac{1}{2}, \{0\}\right)$ **and** y-axis at $\left(\{0\}, 2\right)$.	M1 A1 B1 B1 B1 **[5]**
(b)	Asymptotes : $x = 0$ (or y-axis) and $y = -5$. (Lose second B mark for extra asymptotes)	An asymptote stated correctly. Independent of (a) These two lines only. Not ft their graph.	B1 B1 **[2]**
(c)	Method 1: $\frac{2}{x} - 5 = 4x + 2$ $4x^2 + 7x - 2 = 0 \Rightarrow x =$ $x = -2, \frac{1}{4}$ When $x = -2,\ y = -6$, When $x = \frac{1}{4},\ y = 3$	Method 2: $\frac{y-2}{4} = \frac{2}{y+5}$ $y^2 + 3y - 18 = 0 \rightarrow y =$ $y = -6, 3$ When $y = -6,\ x = -2$ When $y = 3,\ x = \frac{1}{4}$.	M1 dM1 A1 M1A1 **[5]**
			12 marks

Notes

(a) **M1:** Curve implies y axis as asymptote and does not change shape significantly. Changed curve needs horizontal asymptote (roughly) Asymptote(s) need not be **shown** but shape of curve should be implying asymptote(s) parallel to x axis. Curve should not remain where it was in the given figure. Both sections move in the same direction. There should be no reflection

A1: Crosses positive x axis. Hyperbola has moved down. Both sections move by **almost** same amount. See sheet on page 19 for guidance.

B1: Check diagram and text of answer. Accept 2/5 or 0.4 shown on x -axis or x = 2/5, or (2/5 , 0) stated clearly in text or on graph. This is **independent** of the graph. Accept (0, 2/5) if clearly on x axis. Ignore any intersection points with y axis. Do not credit work in table of values for this mark.

B1: Must be attempt at astraight line, with positive gradient & with positive y intercept (need not cross x axis)

B1: Accept x = -1/2, or –0.5 shown on x -axis or (-1/2 , 0) or (-0.5,0) in text or on graph and similarly accept 2 on y axis or y = 2 or (0, 2) in text or on graph. **Need not cross curve and allow on separate axes.**

(b) **B1:** For either correct asymptote equation. Second **B1**: For both correct (lose this if extras e.g. $x = \pm 1$ are given also). These asymptotes may follow correctly from equation after wrong graph in (a)

Just y = -5 **is B1 B0** **This may be awarded if given on the graph.** However for other B mark it must be clear that $x = 0$ (or the y-axis) is an asymptote. NB $x \neq 0,\ y \neq -5$ is B1B0

(c) **M1**: Either of these equations is enough for the method mark (May appear labelled as part (b))

dM1: Attempt to solve a 3 term quadratic by factorising, formula, completion of square or implied by correct answers. (see note 1) This mark depends on previous mark.

A1: Need both correct x answers (Accept equivalents e.g. 0.25) or both correct y values (Method 2)

M1: At least one attempt to find *second variable* (usually y) using their *first variable* (usually x) related to line meeting curve. Should not be substituting x or y values from part (a) or (b). This mark is **independent** of previous marks. Candidate may substitute in equation of line or equation of curve.

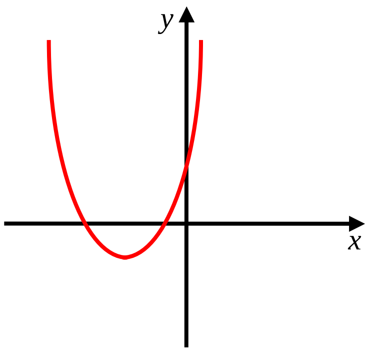
A1: Need both correct *second variable* answers Need not be written as co-ordinates (allow as in the scheme)

Note: Special case: Answer only with no working in part (c) can have 5 marks if completely correct, with **both** points found. If co-ordinates of just one of the points is correct – with no working – this earns M0 M0 A0 M1 A0 (i.e. 1 / 5)

Question Number	Scheme	Marks
7.	Lewis; arithmetic series, $a = 140$, $d = 20$.	
(a)	$T_{20} = 140 + (20 - 1)(20); = 520$ Or lists 20 terms to get to 520	M1; A1
	OR 120 + (20)(20)	**[2]**
	Method 1 / Method 2	
(b)	**Either:** Uses $\frac{1}{2}n(2a + (n-1)d)$ / **Or:** Uses $\frac{1}{2}n(a + l)$	M1
	$\frac{20}{2}\left(2\times140 + (20-1)(20)\right)$ / $\frac{20}{2}\left(140 + "520"\right)$ ft 520	A1
	6600	A1
		[3]
(c)	Sian; arithmetic series,	
	$a = 300$, $l = 700$, $S_n = 8500$	
	Either: Attempt to use $8500 = \frac{n}{2}(a + l)$ / **Or:** May use both $8500 = \frac{1}{2}n(2a + (n-1)d)$ and $l = a + (n-1)d$ **and eliminate** d	M1
	$8500 = \frac{n}{2}\left(300 + 700\right)$ / $8500 = \frac{n}{2}\left(600 + 400\right)$	A1
	$\Rightarrow n = 17$	A1
		[3]
		8 marks
	Notes	
(a)	**M1:** Attempt to use formula for **20th term** of Arithmetic series with first term **140** and d = **20. Normal formula rules** apply – see General principles at the start of the mark scheme re "Method Marks" **Or:** uses 120 + 20n with n = 20 **Or: Listing method :** Lists 140, 160, 180, 200, 220, 240, 260, 280, … 520. M1A1 if correct M0A0 if wrong. (So 2 marks or zero) **A1:** For 520	
(b)	**M1:** An attempt to apply $\frac{1}{2}n(2a + (n-1)d)$ **or** $\frac{1}{2}n(a + l)$ with their values for a, n, d and l **A1:** Uses a = 140, d = 20, n = 20 in their formula (two alternatives given above) but **ft on their value of l** from (a) if they use Method 2. **A1:** 6600 cao **Or: Listing method :** Lists 140, 160, 180, 200, 220, 240, 260, 280, … 520 and adds **6600** gets M1A1A1- any other answer gets M1 A0A0 provided there are 20 numbers, the first is 140 and the last is 520.	
(c) **First method**	**M1:** Attempt to use $S_n = \frac{n}{2}(a + l)$ with their values for a, and l and S =8500 **A1:** Uses formula with correct values **A1:** Finds exact value 17	
Alternative method	**M1:** If both formulae $8500 = \frac{1}{2}n(2a + (n-1)d)$ and $l = a + (n-1)d$ are used, then d **must be eliminated** before this mark is awarded by valid work. Should not be using d = 400. This would be **M0**. **A1:** Correct equation in n only then **A1** for 17 exactly **Trial and error methods:** Finds d = 25 and n = 17 and list from 300 to 700 with total checked – 3/3 BUT: Just n = 17 no working – send to review.	

Question Number	Scheme		Marks
8.	$\left(\frac{dy}{dx}=\right)\quad -x^3+"2"x^{-2}-"\left(\frac{5}{2}\right)"x^{-3}$		M1
	$(y=)\quad -\frac{1}{4}x^4+\frac{"2"x^{-1}}{(-1)}-"\left(\frac{5}{2}\right)"\frac{x^{-2}}{(-2)}\ (+c)$	Raises power correctly on any one term. Any two follow through terms correct.	M1 A1ft
	$(y=)\quad -\frac{1}{4}x^4+\frac{2x^{-1}}{(-1)}-\frac{5}{2}\frac{x^{-2}}{(-2)}\ (+c)$	This is not follow through – must be correct	A1
	Given that $y=7$, at $x=1$, then $7=-\frac{1}{4}-2+\frac{5}{4}+c \Rightarrow c=$		M1
	So, $(y=)\quad -\frac{1}{4}x^4-2x^{-1}+\frac{5}{4}x^{-2}+c$, $c=8$ **or** $(y=)-\frac{1}{4}x^4-2x^{-1}+\frac{5}{4}x^{-2}+8$		A1 **[6]**
			6 marks
	Notes		
	M1: Expresses as three term polynomial with powers 3, -2 and –3. Allow slips in coefficients. This may be implied by later integration having all three powers 4, -1 and -2. **M1:** An attempt to integrate at least one term so $x^n \to x^{n+1}$ (not a term in the numerator or denominator) **A1ft:** Any two integrations are correct – coefficients may be unsimplified (follow through errors in **coefficients only here**) so should have two of the powers 4, -1 and –2 after integration – depends on 2nd method mark only. There should be a maximum of three terms here. **A1:** Correct three terms – coefficients **may be unsimplified-** do not need constant for this mark Depends on both Method marks **M1: Need constant for this mark.** Uses $y=7$ and $x=1$ in their changed expression in order to find *c*, and attempt to find *c*. *This mark is available even after there is suggestion of differentiation.* **A1:** Need **all four** correct terms to be **simplified** and need $c=8$ here.		

Question Number	Scheme	Marks
9. (a)	**Method 1:** Attempts $b^2 - 4ac$ for $a = (k+3)$, $b = 6$ and their c. $c \neq k$	M1
	$b^2 - 4ac = 6^2 - 4(k+3)(k-5)$	A1
	$(b^2 - 4ac =)$ $-4k^2 + 8k + 96$ or $-(b^2 - 4ac =)$ $4k^2 - 8k - 96$ (with no prior algebraic errors)	B1 (M1 on epen)
	As $b^2 - 4ac > 0$, then $-4k^2 + 8k + 96 > 0$ and so, $k^2 - 2k - 24 < 0$	A1 *
	Method 2: Considers $b^2 > 4ac$ for $a = (k+3)$, $b = 6$ and their c. $c \neq k$	M1
	$6^2 > 4(k+3)(k-5)$	A1
	$4k^2 - 8k - 96 < 0$ or $-4k^2 + 8k + 96 > 0$ or $9 > (k+3)(k-5)$ (with no prior algebraic errors)	B1 (M1 on epen)
	and so, $k^2 - 2k - 24 < 0$ following correct work	A1 *
		[4]
(b)	Attempts to solve $k^2 - 2k - 24 = 0$ to give $k =$ ($\Rightarrow$ Critical values, $k = 6, -4$.)	M1
	$k^2 - 2k - 24 < 0$ gives $-4 < k < 6$	M1 A1
		[3] **7 marks**
	Notes	
(a)	**Method 1: M1:** Attempts $b^2 - 4ac$ for $a = (k+3)$, $b = 6$ and their c. $c \neq k$ or uses quadratic formula and has this expression under square root. (ignore > 0, < 0 or = 0 for first 3 marks) **A1:** Correct expression for $b^2 - 4ac$ - need not be simplified (may be under root sign) **B1:** Uses algebra to manipulate result **without error** into **one of these** three term quadratics. Again may be under root sign in quadratic formula. (This mark is given as second M on epen). If inequality is used early in "proof" may see $4k^2 - 8k - 96 < 0$ and B1 would be given for $4k^2 - 8k - 96$ correctly stated. **A1:** Applies $b^2 - 4ac > 0$ correctly (**or writes** $b^2 - 4ac > 0$ **)** to achieve the **result given** in the question. No errors should be seen. Any incorrect line of argument should be penalised here. There are several ways of reaching the answer; either multiplication of both sides of inequality by –1, or taking every term to other side of inequality. If doubtful send to review. **Need conclusion i.e. printed answer.** **Method 2: M1:** Allow $b^2 > 4ac$, $b^2 < 4ac$ or $b^2 = 4ac$ for $a = (k+3)$, $b = 6$ and their c. $c \neq k$ **A1:** Correct expressions on either side (ignore >, < or =). **B1:** Uses algebra to manipulate result into one of the two three term quadratics or divides both sides by 4 **again without error** **A1:** Produces result with no errors seen from initial consideration of $b^2 > 4ac$ **.**	
(b)	**M1:** Uses factorisation, formula, completion of square method to find two values for k , or finds two **correct** answers with no obvious method **M1:** Their Lower Limit $< k <$ Their Upper Limit . Allow the M mark mark for $\leq$. (Allow k < upper and k > lower) **A1:** $-4 < k < 6$ Lose this mark for $\leq$ Allow (-4, 6) [not square brackets] or $k > -4$ **and** $k < 6$ (must be **and** not **or**) Can also use intersection symbol $\cap$ **NOT** $k > -4$, $k < 6$ (M1A0)	
	Special case : **In part (a)** uses $c = k$ instead of k - 5 - scores 0 . Allow k + 5 for method marks	
	Special Case: In part (b) Obtaining $-6 < k < 4$ This is a common wrong answer. Give M1 M1 A0 special case.	
	Special Case: In part (b) Use of x instead of k – M1M1A0	
	Special Case: $-4 < k < 6$ and $k < -4$, $k > 6$ both given is M0A0 for last two marks. Do not treat as isw.	

Question Number	Scheme	Marks
10. (a)	This may be done by completion of square or by expansion and comparing coefficients	
	$a = 4$	B1 (M1 on epen)
	$b = 1$	B1 (A1 on epen)
	All three of $a = 4$, $b = 1$ and $c = -1$	B1 (A1 on epen) **[3]**
(b)		
	U shaped quadratic graph.	M1
	The curve is correctly positioned with the minimum in the third quadrant. . It crosses x axis twice on negative x axis and y axis once on positive y axis.	A1
	Curve cuts y-axis at $(\{0\}, 3)$ only	B1
	Curve cuts x-axis at $\left(-\frac{3}{2}, \{0\}\right)$ and $\left(-\frac{1}{2}, \{0\}\right)$.	B1 **[4]**
		7 marks
	Notes	
(a)	**B1: (M1 on epen)** States $a = 4$ or obtains $4(x+b)^2 + c$, **B1: (A1 on epen)** States $b = 1$ or obtains $a(x+1)^2 + c$, **B1: (A1 on epen)** States $a = 4$, $b = 1$ **and** $c = -1$ or $4(x+1)^2 - 1$ (Needs all 3 correct for final mark) **Special cases:** If answer is left as $(2x+2)^2 - 1$ treat as misread B1B0B0 or as $2(x+1)^2 - 1$ then the mark is B0B1B0 from scheme	
(b)	**M1:** Any position provided U shaped (be generous in interpretation of U shape but V shape is M0) **A1 :** The curve is correctly positioned with the minimum in the third quadrant. It crosses x axis twice on negative x axis and y axis once on positive y axis. **B1:** Allow 3 on y axis and allow either $y = 3$ or $(0, 3)$ if given in text Curve does not need to pass through this point and this mark may be given even if there is no curve at all or if it is drawn as a line. **B1:** Allow –3/2 and –1/2 if given on x axis – need co-ordinates if given in text or $x = -3/2$, $x = -1/2$. Accept decimal equivalents. Curve does not need to pass through these points and this mark may be given even if there is no curve. Ignore third point of intersection and allow touching instead of cutting. So even a cubic curve *might* get M0A0 B1 B1. A V shape with two ruled lines for example might get M0A0B1B1	

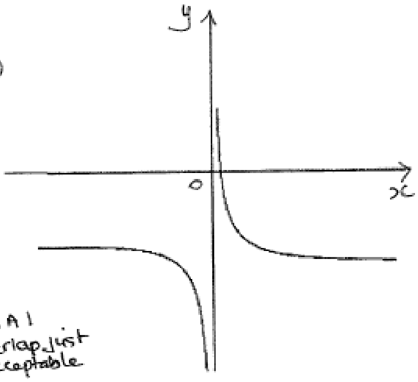
Question Number	Scheme	Marks
11.	$C: y = 2x - 8\sqrt{x} + 5, \quad x \geqslant 0$	
(a)	So, $y = 2x - 8x^{\frac{1}{2}} + 5$	
	$\frac{dy}{dx} = 2 - 4x^{-\frac{1}{2}} + \{0\} \qquad (x > 0)$	M1 A1 A1
		[3]
(b)	(When $x = \frac{1}{4}$, $y = 2\left(\frac{1}{4}\right) - 8\sqrt{\left(\frac{1}{4}\right)} + 5$ so) $\quad y = \frac{3}{2}$	B1
	(gradient $= \frac{dy}{dx} =$) $2 - \frac{4}{\sqrt{\left(\frac{1}{4}\right)}} \quad \{= -6\}$	M1
	Either : $y - "\frac{3}{2}" = "-6"\left(x - \frac{1}{4}\right)$ **or**: $y = "-6"x + c$ and $"\frac{3}{2}" = "-6"\left(\frac{1}{4}\right) + c \Rightarrow c = "3"$	dM1
	So $\underline{y = -6x + 3}$	A1
		[4]
(c)	Tangent at Q is parallel to $2x - 3y + 18 = 0$	
	($y = \frac{2}{3}x + 6 \Rightarrow$) Gradient $= \frac{2}{3}$. so tangent gradient is $\frac{2}{3}$	B1
	So, $"2 - \frac{4}{\sqrt{x}}" = "\frac{2}{3}"$ Sets their gradient function = their numerical gradient.	M1
	$\Rightarrow \frac{4}{3} = \frac{4}{\sqrt{x}} \Rightarrow x = 9$ Ignore extra answer x = -9	A1
	When $x = 9$, $y = 2(9) - 8\sqrt{9} + 5 = -1$ Substitutes their found x into equation of curve. $y = -1$.	dM1 A1
		[5]
		12 marks
	Notes	
(a)	**M1:** Evidence of differentiation, so $x^n \to x^{n-1}$ at least once so $x^1 \to 1$ or x^0 or $x^{\frac{1}{2}} \to x^{-\frac{1}{2}}$ not just $5 \to 0$ **A1:** Any two of the three terms correct – do not need to see zero – the 5 disappearing is sufficient; need not be simplified. **A1:** $2 - 4x^{-\frac{1}{2}}$ Both terms correct, and simplified. Do not need to include domain $x > 0$	
(b)	**B1:** Obtaining y = 3/2 or fractional or decimal equivalent (no working need be seen) **M1:** An attempt to substitute $x = \frac{1}{4}$ into $\frac{dy}{dx}$. to establish **gradient**. This may be implied by –6 or m = -6 but not y = - 6. Can earn this M mark if they go on to use $m = \frac{1}{6}$ or use their numerical value of $\frac{dy}{dx}$. **dM1: This depends on previous method mark.** Complete method for obtaining the equation of the tangent**,** using their **tangent** gradient and their value for y_1 (obtained from x = ¼, allow slip) i.e. $y - y_1 = m_T\left(x - \frac{1}{4}\right)$ with their tangent gradient and their y_1 or uses $y = mx + c$ with $\left(\frac{1}{4}, \text{ their } y_1\right)$ and their tangent gradient. **A1:** y = -6x + 3 or y= 3 – 6x or a = -6 and b = 3	
(c)	**B1:** For the value 2/3 **not** 2/3 x **not** -3/2 **M1:** Sets their gradient function dy/dx = their numerical gradient **A1:** Obtains x = 9 **dM1:** Substitutes their x (from gradient equation) into original equation of curve C i.e. original expression y = **A1:** (9, -1) or x = 9, y = -1, or just y = -1	
	Special Cases: In (b) Finds normal could get B1 M1 M0 A0 i.e. max of 2/4	
	In (c) Uses **perpendicular** instead of **parallel** then award B0 M1 A0 M1 A0 i.e max 2/5 – see over	

(c)	**Special case: Erroneous method** Tangent at Q is **perpendicular** to $2x - 3y + 18 = 0$		
	Uses – 3/2		B0
	So, $"2 - \frac{4}{\sqrt{x}}" = "-\frac{3}{2}"$	Sets their gradient function = their numerical gradient.	M1
	$\Rightarrow \frac{7}{2} = \frac{4}{\sqrt{x}} \Rightarrow x = \frac{64}{49}$	**…**	A0
	When $x = \frac{64}{49}$, $y = 2\left(\frac{64}{49}\right) - 8 \times \frac{8}{7} + 5 =$ …	Substitutes their found x into y.	dM1
		…	A0
			[2/5]

See next page for notes on graphs in qu 6:

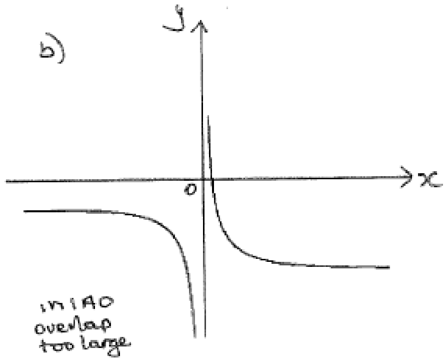
Q6 Examples for Guidance.

a)



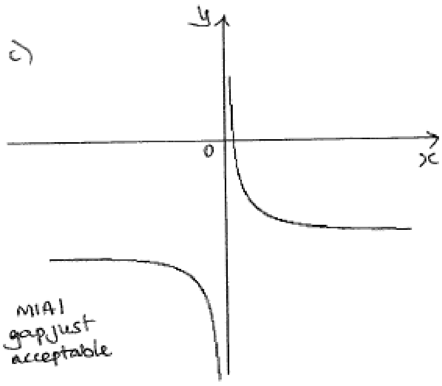
M1A1
overlap just
acceptable

b)



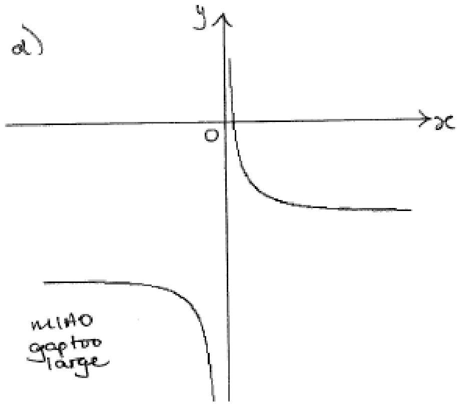
M1A0
overlap
too large

c)



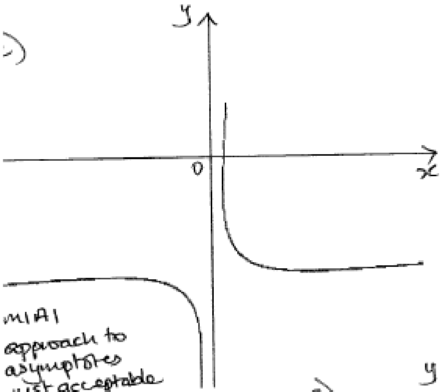
M1A1
gap just
acceptable

d)



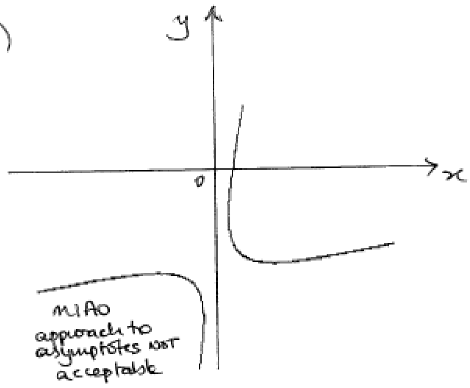
M1A0
gap too
large

e)



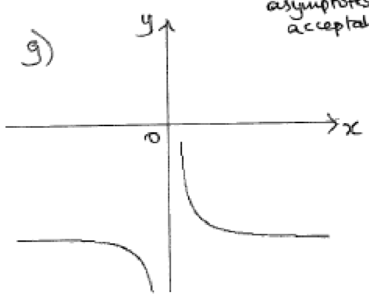
M1A1
approach to
asymptotes
just acceptable

f)



M1A0
approach to
asymptotes NOT
acceptable

g)



M1A0 (stops short of
x axis).

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