Mark Scheme (Results)

Summer 2018

Pearson Edexcel GCE Mathematics

Core Mathematics C2 (6664)

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Summer 2018
Publications Code 6664_01_1806_MS

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.

PEARSON 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.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\sqrt{}$ 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)
   - d… or dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - $\ast$ The answer is printed on the paper or ag- answer given
   - $\sqsubset$ or d… The second mark is dependent on gaining the first mark

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 any A or B marks gained, in that part of the question affected.

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.

General Principles for Core Mathematics Marking

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

<u>Method mark for solving 3 term quadratic:</u>

1. Factorisation

$(x^2 + bx + c) = (x + p)(x + q), \text{ where} |pq| = |c|$, leading to x = …

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

2. Formula

Attempt to use the correct formula (with values for a, b and c).

3. Completing the square

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

<u>Method marks for differentiation and integration:</u>

1. Differentiation

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

2. Integration

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

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 small errors in the substitution of values.

Where the formula is not quoted, the method mark can be gained by implication from correct 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 exact answer is asked for, or working with surds is clearly required, marks will normally be lost if the candidate resorts to using rounded decimals.

Question Number	Scheme	Marks
1.	<table><tr><td>x</td><td>-2</td><td>2</td><td>6</td><td>10</td></tr><tr><td>y</td><td>0</td><td>**2**</td><td>$\mathbf{4\sqrt{2}}$</td><td>$6\sqrt{3}$</td></tr></table>	
(a)	$\{\text{At } x=2,\}\ y=2$ and $\{\text{At } x=6,\}\ y=4\sqrt{2}$ or $2\sqrt{8}$ or awrt 5.7	B1 cao
		(1)
(b)	$\frac{1}{2}\times 4$; or $h = 4$	B1 oe
	$\underline{\left\{0+6\sqrt{3}+2\left(their 2+their 4\sqrt{2}\right)\right\}}$ For structure of $\underline{\{..............\}}$	M1<u>A1ft</u>
	$\frac{1}{2}\times 4\ \underline{\left\{0+6\sqrt{3}+2\left(2+4\sqrt{2}\right)\right\}}\ \{=2(25.706)=51.412..\}=$ awrt 51.412	A1
		(4)
		(5 marks)

Notes

(a) B1: 2 and $4\sqrt{2}$ or $2\sqrt{8}$ or awrt 5.7 (or any correct unsimplified surd equivalent given as the final answer to part (a)) These may be stated as a final answer and not appear in the table, or may appear in the table. If a correct surd appears in the working (unsimplified) and is then simplified to give an incorrect answer to (a) which is used in the table and in part (b) then this is B0.

(b) B1: for using $\frac{1}{2}\times 4$ or 2 or equivalent or for stating h

M1: requires the correct $\{......\}$ bracket structure.

It needs the first bracket to contain first y value (as this is zero it may be omitted) **plus** last y value and the second bracket to be multiplied by 2 and to be the summation of the remaining y values in the table with no additional values. If the only mistake is a copying error or is to omit one value from 2nd bracket this may be regarded as a slip and the M mark can be allowed (An extra repeated term forfeits the M mark however). M0 if values used in brackets are x values instead of y values

A1ft: for the correct bracket $\{......\}$ following through candidate's y values found in part (a).

A1: for answer which rounds to 51.412 then isw

NB: Separate trapezia may be used : B1 for 4, M1 for $\frac{1}{2}h(a+b)$ used 3 times (and A1ft if it is all correct)

Then A1 as before.

Special case: Bracketing mistake $2\times(0+6\sqrt{3})+2\left(2+4\sqrt{2}\right)$ scores B1 M1 A0 A0 unless the final answer implies that the calculation has been done correctly (then full marks can be given). An answer of 36.098 usually indicates this error.

Question Number	Scheme	Marks
2. (a)	$\left(2+kx\right)^7$ $2^7 + {}^7C_1 2^6(kx) + {}^7C_2 2^5(kx)^2 + {}^7C_3 2^4(kx)^3 ...$ First term of 128 $\left({}^7C_1 \times ... \times x\right) + \left({}^7C_2 \times ... \times x^2\right) + \left({}^7C_3 \times ... \times x^3\right)...$ $=(128 ..) + 448kx + 672k^2x^2 + 560k^3x^3 ..$	 B1 M1 A1, A1 **(4)**
(b)	$560k^3 = 1890$ $k^3 = \frac{1890}{560}$ *so* $k =$ k = 1.5 o.e.	M1 dM1 A1 **(3)** **(7marks)**
Alternative method For (a)	$\left(2+kx\right)^7 = 2^7(1+\frac{kx}{2})^7$ $2^7(1 + {}^7C_1(\frac{k}{2}x) + {}^7C_2(\frac{k}{2}x)^2 + {}^7C_3(\frac{k}{2}x)^3 \ ...)$ Scheme is applied exactly as before	

Notes

(a)

B1: The constant term should be 128 in their expansion (should not be followed by other constant terms)

M1: Two of the three binomial coefficients must be correct and must be with the correct power of x. Accept ${}^7C_1$ or $\binom{7}{1}$ or 7 **as a coefficient, and** ${}^7C_2$ or $\binom{7}{2}$ or 21 **as another and** ${}^7C_3$ or $\binom{7}{3}$ or 35 **as another……..**

Pascal's triangle may be used to establish coefficients.

A1: Two of the final three terms correct (i.e. two of $448kx + 672k^2x^2 + 560k^3x^3..$).

A1: All three final terms correct. (Accept answers without + signs, can be listed with commas or appear on separate lines)

e.g. The common error $=(128..) + 448kx + 672kx^2 + 560kx^3..$ would earn B1, M1, A0, A0, so 2/4 Then would gain a maximum of 1/3 in part (b)

If extra terms are given then isw

If the **final** answer is given as $=(128..) + 448kx + 672(kx)^2 + 560(kx)^3..$ with correct brackets and no errors are seen, this may be given full marks. If they continue and remove the brackets wrongly then they lose the accuracy marks.

Special case using Alternative Method: Uses $2\ (1+\frac{kx}{2})^7$ is likely to result in a maximum mark of B0M1A0A0 then M1M1A0

If the correct expansion is seen award the marks and isw

(b)

M1: Sets their **Coefficient** of x^3 equal to 1890. They should have an equation which does not include a power of x. This mark may be recovered if they continue on to get k = 1.5

dM1: This mark depends upon the previous M mark. Divides then attempts a cube root of their answer to give k – the intention must be clear. (You may need to check on a calculator) The correct answer implies this mark.

A1: Any equivalent to 1.5 If they give – 1.5 as a second answer this is A0

Question Number	Scheme		Marks
3. (a)	Way 1 Use f(1/2) or f (– 1/2) and put equal to 30	Way 2 Long division of f(x) by (2x -1) as far as remainder put = 30	M1
	Stated $\frac{24}{8}+\frac{1}{4}A-\frac{3}{2}+B=30$ and $A + 4B = 114$ *	Obtains $B+\frac{1}{4}A+\frac{3}{2}=30$ (o.e) and $A + 4B = 114$ *	A1* **(2)**
(b)	Way 1 Used f(-1) or f(1) = 0	Way 2 Long division of f(x) by (x +1) as far as remainder put = 0	M1
	Stated -24+A+3+B = 0 so $A + B = 21$	Obtains $B – 21 +A = 0$	A1 **(2)**
(c)	Solves to obtain one of A or B		M1
	Obtains both $A = -10$ and $B = 31$		A1 **(2)**
(d)	$\mathrm{f}(x)=(x+1)(24x^2-34x+31)$ or factor is $(24x^2-34x+31)$		M1A1 **(2)**
			(8 marks)

Notes

(a) Way 1

M1: for attempting either $\mathrm{f}(\frac{1}{2})$ or $\mathrm{f}(-\frac{1}{2})$ – with **numbers substituted into expression and put = 30**

A1*: Obtaining correct equation correctly (Signs and powers of ½ need to be simplified correctly)

(a) Way 2

M1: for attempting long division of f(x) by (2x -1) obtaining $12x^2+...x+...$ as quotient and remainder term **put equal to 30**

A1*: Obtaining correct equation correctly

(b) Way 1

M1: for calculating $\mathrm{f}(-1)$ or f(1) **and put equal to 0** (This may be implied by their equation in part (b))

A1:for obtaining a correct equivalent equation in part (b). (This mark may not be recovered in part (c))

Accept $A + B = 21$ or $-A - B = -21$ or $A + B – 21=0$ or $21 – A – B = 0$ or $B – 21 + A = 0$ and even $-24 + A + 3 + B = 0$ as a final answer to part (b).

(b) Way 2

M1: for attempting long division of f(x) by (x +1) obtaining $24x^2+...x+...$ as quotient and remainder term **put equal to 0** (This may be implied by their equation in part (b))

A1:for obtaining a correct equivalent equation in part (b). (This mark may not be recovered in part (c))

Accept $A + B = 21$ or $-A - B = -21$ or $A + B – 21=0$ or $21 – A – B = 0$ or $B – 21 + A = 0$ etc..

(c)

M1: Eliminate one variable and solve to obtain A or B

A1: Both correct

(d)

M1: Uses their values of A and B in the given cubic (even the wrong way round) and attempts to divide by $(x+1)$ leading to a 3TQ beginning with the correct term, usually $24x^2$ and including an x term and a constant term. This may be done by a variety of methods including long division, comparison of coefficients, inspection etc. (If values of A and B were wrong there may be a remainder but this may be ignored) If they used division in part (b) they may substitute A and B into their quotient expression from (b).

A1: $24x^2-34x+31\ldots$ Credit when seen and use isw if miscopied later or if attempt is made to solve

Question Number	Scheme	Marks
4. (a)	**Usually answered in radians:** **Uses** Area $ZYW = \frac{1}{2}\times 5^2 \times (angle)$, $= 12.5\times 0.7 = 8.75$ o.e.(cm^2)	M1 A1 **(2)**
(b)	Area of triangle $XYZ = \frac{1}{2}\times 7\times 5\times \sin Y = (11.273)$ (cm^2) Area of whole flag = "8.75" + "11.273", = 20.02 (cm^2)	M1 M1, A1 **(3)**
(c)	$(XZ^2) = 7^2 + 5^2 - 2\times 7\times 5\cos(\pi - 0.7)$, Or $(XZ^2) = (7+5\cos 0.7)^2 + (5\sin 0.7)^2$ Use of arc length formula $s = 5\theta$ (= 3.5) Total perimeter = $12 + "3.5" + "11.293"$ = 26.79 cm	M1, M1 ddM1 A1 **(4)** **(9 marks)**

Notes

(a)

M1: uses $A = 12.5\times\theta$ with θ in radians or completely correct work in degrees.

(If the angle is given as 0.7π and the formula has not been quoted correctly do not give this mark)

A1: 8.75 or $\frac{35}{4}$ or equivalent (do not need to see units)

(b)

M1 for use of $A = \frac{1}{2}\times 7\times 5\times \sin Y$ (where Y = 0.7 or attempt at (π– 0.7) they give the same answer) Do not need to see 11.273 (Do not allow use of 0.7 or π– 0.7 instead of their respective sines)

This may arise from use of $A = \frac{1}{2}\times a\times b\times \sin C$ formula or from $A = \frac{1}{2}\times b\times h$ with h found by a correct method so either $A = \frac{1}{2}\times 7\times (5\sin Y)$ or $A = \frac{1}{2}\times 5\times (7\sin Y)$

This may follow a long method finding all the angles and side lengths of triangle *XYZ*. If their answer rounds to 11.3 credit should be given. E.g. $A = \frac{1}{2}\times 11.293\times 1.996$

M1 for adding two numerical areas – triangle and sector (not dependent on previous M marks)

A1 for 20.02 (do not need to see units) (Allow answers which round to 20.02 e.g. do not allow 20.05)

(c)

M1: Uses cosine rule with correct angle (allow 2.4) or uses right angle triangle with correct sides.

(do not need to see XZ = 11.293) This may be calculated in part (b)

M1: Uses arc length with correct radius (may use wrong angle)

ddM1: (Needs to have earned both previous M marks) Adds 7 + 5 + their arc length + their XZ

This mark should not be awarded if they use their answer for XZ^2 instead of XZ.

A1: 26.79 – allow awrt

Question number	Scheme	Marks
5	**You may mark (a) and (b) together** $x^2 + y^2 - 2x + 14y = 0$	
(a)	Obtain LHS as $\underline{(x \pm 1)^2} + \underline{\underline{(y \pm 7)^2}} = ...$	M1
	Centre is $(1, -7)$.	A1 **(2)**
(b)	Uses $r^2 = a^2 + b^2$ or $r = \sqrt{a^2 + b^2}$ where their centre was at $(\pm a, \pm b)$ $r = \sqrt{50}$ or $5\sqrt{2}$	M1 A1 **(2)**
(c)	Substitute $x = 0$ in either form of equation of circle and solve resulting quadratic to give $y =$	M1
	$y^2 + 14y = 0$ *so* $y = 0$ *and* -14 **or** $\underline{\underline{(y \pm 7)^2 - 49}} = 0$ *so* $y = 0$ *and* -14	A1 **(2)**
(d)	Gradient of radius joining centre to (2,0) is $\frac{"-7"-0}{"1"-2}$ $(= 7)$	M1
	Gradient of tangent is $\frac{-1}{m}$ $(= -\frac{1}{7})$	M1
	So equation is $y - 0 = -\frac{1}{7}(x - 2)$ and so $x + 7y - 2 = 0$	M1, A1 **(4)** **(10 marks)**
	Alternative Methods which may be seen	
(a)	Method 2: Comparing with $x^2 + y^2 + 2gx + 2fy + c = 0$ to write down centre $(-g, -f)$ directly. Condone sign errors for this M mark**.** Centre is $(1, -7)$.	M1 A1 **(2)**
(b)	Method 2: Using $\sqrt{g^2 + f^2 - c}$. So $r = \sqrt{50}$ or $5\sqrt{2}$	M1 A1 **(2)**
(d)	Method 3: Using Implicit Differentiation	
	$2x + 2y\frac{dy}{dx} - 2 + 14\frac{dy}{dx} = 0$ **or** $2(x-1) + 2(y+7)\frac{dy}{dx} = 0$	M1
	$\frac{dy}{dx} = ...\left(\frac{2-2x}{14+2y} = \frac{-2}{14}\right)$	M1
	So equation is $y - 0 = -\frac{1}{7}(x - 2)$ and so $x + 7y - 2 = 0$	M1, A1 (4)
	Method 4: Making y the subject of the formula and differentiating	
	$y = -7 \pm \sqrt{\{50 - (x-1)^2\}}$ so $\frac{dy}{dx} = \pm\frac{1}{2} \times -2(x-1)\{50 - (x-1)^2\}^{-\frac{1}{2}}$	M1
	At $x = 2$, $\frac{dy}{dx} = \mp\frac{1}{7}$	M1 (contd next page)

	So equation is $y - 0 = \mp\frac{1}{7}(x-2)$	M1
	Chooses $\frac{dy}{dx} = -\frac{1}{7}$ and so $x + 7y - 2 = 0$	A1

Notes

(a)
M1: as in scheme and can be <u>implied</u> by $(\pm 1, \pm 7)$ even if this follows some poor working.
A1: (1, −7)
(b)
M1 : Uses $r^2 = a^2 + b^2$ or $r = \sqrt{a^2+b^2}$ where their centre was at $(\pm a, \pm b)$
A1**:** √50 or 5√2 not 50 only
Special case: if centre is given as $(-1, -7)$ or (1, 7) or (-1, 7) or coordinates given wrong way round- allow M1A1 for $r = 5\sqrt{2}$ worked correctly. $r^2 = "1" + "49"$
If they get $r = 5\sqrt{2}$ after wrong statements such as $r^2 = "-1" + "-49"$ then this is M0A0
$r = 5\sqrt{2}$ with no working earns M1A1 as there is no wrong work.

(c)
M1: As in the scheme – allow for just one value of y
A1: Accept (0, 0), (0, -14) or $y = 0$, $y = -14$ or just 0 and -14

(d) Method 1:
M1: Correct method for gradient – if no method shown answer must be correct to earn this mark
If x and y coordinates are confused and fraction is upside down this is M0 even if the formula is quoted as there is no evidence of understanding.
M1: Correct negative reciprocal of their gradient
M1: Line equation through (2,0) with changed gradient so if they use $y = mx + c$ they need to use (2, 0) to find c
A1: For any multiple of the answer in the scheme. (The answer must be an equation so if "=0" is missing this is A0)
(d) Method 3:
M1: Correct implicit differentiation (no errors)
M1: Rearranges their differentiated expression and substitutes $x = 2$, $y = 0$ to obtain gradient – allow slips. (It should be $\frac{dy}{dx} = \frac{2-2x}{14+2y} = \left(\frac{-2}{14}\right)$)
If there is no y term this mark may be earned for substitution of $x = 2$ as $y = 0$ is not needed
M1: Line equation through (2,0) with their obtained gradient so if they use $y = mx + c$ they need to use (2, 0) to find c
A1: For any multiple of the answer in the scheme (The answer must be an equation so if "=0" is missing this is A0)
Method 4:
M1: Correct rearrangement and differentiation (no errors)
M1: Substitutes $x = 2$ to obtain gradient – allow minus and plus.
M1: Line equation through (2,0) with their obtained gradient so if they use $y = mx + c$ they need to use (2, 0) to find c
A1: For any multiple of the answer in the scheme (The answer must be an equation so if "= 0" is missing this is awarded A0)

Question Number	Scheme	Marks
6.(a)	$10000 = \dfrac{a}{1-(-0.9)}$	M1
	$a = 19000$	A1 **(2)**
(b)	Use ar^4	M1
	$19000 \times (-0.9)^4 = 12465.9$ (accept awrt 12466)	A1 **(2)**
(c)	$S = \dfrac{a(1-r^{12})}{1-r}$ or lists and adds their first twelve terms with their a	M1
	$S = \dfrac{\text{"19000"}(1-(-0.9)^{12})}{1-(-0.9)}$ or $S = 10000(1-(-0.9)^{12})$	A1ft
	= 7176 only	A1cso (3)
		[7]

Notes

(a) M1: Correct use of formula for sum to infinity as above, or states correct formula and makes small slip such as replacing r with 0.9 instead of – 0.9
A1: Correct answer

(b) M1: Correct use of formula with n – 1 = 4, allow 0.9 instead of -0.9 here. Condone invisible brackets.
A1: accept awrt 12466 (even following use of 0.9) Correct answer implies M1A1 even with no method shown. Accept correct equivalents such as mixed or improper fractions

(c) M1: Correct use of formula with power 12 (or adds 12 terms) with their a (not 10000) and r = +0.9 or -0.9
A1ft: Correct unsimplified with their a and with r = +0.9 or -0.9 or for listing method as follows
19000 + -17100 + 15390 + -13851 + 12465.9 + -11219.31 + 10097.379 + -9087.6411 + 8178.87699 + -7360.989291 + 6624.890362 + -5962.401326 = (Do not follow through for listing method)
A1cso: 7176 only

Special case: $S = \dfrac{a(1-r^n)}{1-r}$ so $S = \dfrac{\text{"19000"}(1+(0.9)^{12})}{1+(0.9)}$ is M1A0A0

Whereas $S = \dfrac{\text{"19000"}(1+(0.9)^{12})}{1+(0.9)}$ on its own with no formula quoted is M0A0A0

$S = \dfrac{\text{"19000"}(1--0.9^{12})}{1--0.9}$ should have M1 (bod) then final two A marks depend on whether answer is correct so if this is followed by 7176 the A1A1 should be awarded. If it is followed by 12824 then A0A0 is implied.

Question Number	Scheme	Marks
7. (i)	Use of power rule so $(y-1)\log 1.01 = \log 500$ or $(y-1) = \log_{1.01} 500$	M1
	625.56	A1
		(2)
(ii) (a)	Ignore labels (a) and (b) in part ii and mark work as seen	
	$\log_4 (3x+5)^2 =$ Applies power law of logarithms	M1
	Uses $\log_4 4 = 1$ or $4^1 = 4$	M1
	Uses quotient or product rule so e.g. $\log(3x+5)^2 = \log 4(3x+8)$ or $\log\dfrac{(3x+5)^2}{(3x+8)} = 1$	M1
	Obtains with no errors $9x^2 + 18x - 7 = 0$ *	A1* cso
		(4)
(b)	Solves given or "their" quadratic equation by any of the standard methods	M1
	Obtains $x = \frac{1}{3}$ and $-\frac{7}{3}$ and rejects $-\frac{7}{3}$ to give just $\frac{1}{3}$	A1
		(2)
		[8]

Notes

(i)
M1: Applies power law of logarithms correctly or changes base (Allow missing brackets)
A1: Accept answers which round to 625.56 (This may follow 624.56 + 1 = or may follow $y = \log_{1.01} 505$ or $\dfrac{\log 505}{\log 1.01}$ or may appear with no working)

(ii) (a)
M1: Applies power law of logarithms $2\log_4(3x+5) = \log_4(3x+5)^2$
M1: Uses $\log_4 4 = 1$ or $4^1 = 4$
M1: Applying the subtraction or addition law of logarithms **correctly** to make **two** log **terms into one** log term in x (*see note below)
A1cso: This is a given answer and needs a correct algebraic statement such as $9x^2 + 30x + 25 = 4(3x+8)$ followed by a conclusion, such as $9x^2 + 18x - 7 = 0$
(ii) (b)
M1: Solves by factorisation or by completion of the square or by correct use of formula (see general principles)
A1: Needs to find two answers and reject one to give the correct $\frac{1}{3}$ (This may be indicated by underlining just the 1/3 for example).
Special case: States $\dfrac{\log(3x+5)^2}{\log(3x+8)} = \log\dfrac{(3x+5)^2}{(3x+8)} = 1$, loses the third M mark in part ii(a) and the A1 cso

Question Number	Scheme	Marks
8. (i)	$4\cos(x+70°)=3$	
	$\cos(x+70°)=0.75$, so $x+70°=41.4(1)°$	M1A1
	x = 248.6º or 331.4º	M1 A1
		(4)
(ii)	$6\cos^2\theta-5=6\sin^2\theta+\sin\theta$ so $6(1-\sin^2\theta)-5=6\sin^2\theta+\sin\theta$	M1
	$12\sin^2\theta+\sin\theta-1=0$	A1
	$(4\sin\theta-1)(3\sin\theta+1)=0$ *so* $\sin\theta=$	M1
	θ = 0.253, 2.89, 3.48, 5.94	A1 A1
		(5)
		[9]

Notes

(i)
M1: Divides by 4 and then uses inverse cosine
A1: Any Correct answer for $x+70°$ or for x (not necessarily in the range) Accept awrt 41.4
Or (x =) -28.6. If an intermediate answer here is not seen the final correct answers imply this mark.
M1: One correct answer (awrt) so awrt 331.4 or 248.6
A1: Both answers – accept awrt (Lose this mark for extra answers in the range) Ignore extra answers outside the range.
4.3 radians and 5.8 radians is special case: M1A0M1A0

(ii)
M1: Uses $\cos^2\theta=1-\sin^2\theta$
A1: correct three term quadratic – any equivalent - so $12\sin^2\theta+\sin\theta=1$ is acceptable
M1: Solves their quadratic to give values for sin θ (implied if arcsin is used on their answer(s))
1st A1: Need two correct angles (accept awrt)
A1: All four solutions correct accept awrt 3 sf and ignore subsequent rounding or copying errors. (Extra solutions in range lose this A mark, but outside range - ignore)
Special case: All four angles correct but in degrees (awrt 14.5, 166, 199, 341) gets A1 A0

Question Number	Scheme	Marks
9. (a)	$\frac{dy}{dx} = 70x - 35x^{\frac{3}{2}}$	M1A1
	Put $\frac{dy}{dx} = 0$ to give $70x - 35x^{\frac{3}{2}} = 0$ *so* $x^{\frac{1}{2}} = 2$	M1
	$x = 4$	A1
	$y = 112$	A1 **(5)**
(b) (Way 1)	When $y = 0$, $35x^2 = 14x^{\frac{5}{2}}$ *and* $x^{\frac{1}{2}} = \frac{35}{14}$ *or* $5 = 2\sqrt{x}$ *so* $\sqrt{x} = \frac{5}{2}$	M1
	$x = \frac{25}{4}$	A1 **(2)**
(b) (Way 2)	When $y = 0$, $35x^2 = 14x^{\frac{5}{2}}$ *so* $1225x^4 = 196x^5$ *or* $5 = 2\sqrt{x}$ *so* $25 = 4x$	M1
	$x = \frac{25}{4}$ or $x = \frac{1225}{196}$	A1 **(2)**
(c) Way 1	$\int 35x^2 - 14x^{\frac{"5"}{2}} dx = \frac{35}{3}x^3 - \frac{14x^{\frac{"7"}{2}}}{\frac{"7"}{2}} \ (+c)$	M1A1ft
	$\left[\frac{35}{3}x^3 - 4x^{\frac{7}{2}}\right]_4^{\frac{25}{4}} = 406.901.. - 234.667 = 172.23$	dM1
	Hence Area $=$ "*their* $112 \times (6\frac{1}{4} - 4)$" $-$ "172.23" or “252” – “ 172.23”	ddM1
	79.77	A1 **(5)**
(c) Way 2	$\int "112" - \{35x^2 - 14x^{\frac{5}{2}}\} dx = (112x) - \frac{35}{3}x^3 + \frac{14x^{\frac{7}{2}}}{\frac{7}{2}} \ (+c)$	M1A1ft
	$\left[(112x) - (\frac{35}{3}x^3 - 4x^{\frac{7}{2}})\right]_{"4"}^{"\frac{25}{4}"}$ with correct use of limits	dM1
	Integrated their 112 to give $112x$ with correct use of limits	ddM1
	79.77	A1 **(5)** **[12]**

Notes

(a)

M1: Attempt at differentiation after multiplying out - may be awarded for $70x$ term correct

(If product rule is used it must be of correct form i.e. $\frac{dy}{dx} = 7x^2\left(-2kx^{k-1}\right) + 14x(5-2x^k)$)

A1: the derivative must be completely correct but may be unsimplified

For product rule this is $\frac{dy}{dx} = 7x^2\left(-x^{-\frac{1}{2}}\right) + 14x(5-2\sqrt{x})$

M1: uses derivative = 0 to find $x^k =$ or $x =$ with correct work for their equation (even without fractional powers)

A1: obtains $x = 4$ then

A1: for $y = 112$ (may be credited if seen in part (a) or in part(c))

(b)

Way 1 (Dividing first)

M1: Puts $y = 0$ and obtains expression of the form $x^k = A$ (where k is not equal to 1) after correct algebra for their equation (may be a sign slip)

A1: Obtains $x = 6.25$ or equivalent correct answer

(b)

Way 2 (dealing with fractional power first i.e. Squaring)

M1: Puts $y = 0$ and squares each term correctly for their equation obtaining expression of the form $A^2 x^m = B^2 x^n$ after correct algebra

A1: Obtains $x = 6.25$ or equivalent correct answer

(c)

Way 1

M1: Correct integration of one of their terms – e.g. see x^2 term integrated correctly (not just raised power)

A1ft: completely correct integral for their power which must have been a fraction **(may be unsimplified)**

dM1: (dependent on previous M) substituting their 25/4 and their 4 and subtracting

ddM1 (depends on both method marks) **Correct** method **to obtain shaded area** so their rectangle minus their area under curve

A1: Accept answers which round to 79.77

(c)

Way 2

M1: Attempt at integration – x^2 term integrated correctly

A1ft: completely correct integral for second and their third terms (provided one has a fractional power) (ignore sign errors) **(may be unsimplified)**

dM1: (dependent on previous M) substituting their 25/4 and their 4 and subtracting (either way)

ddM1 (depends on both method marks) **Correct** method **to obtain shaded area** so their 112 integrated correctly and correct signs for the other two terms in the integrand

A1: Accept answers which round to 79.77

Answer with no working – send to review

If they have the wrong fractional power on their second term after expansion in part (a) (usually 3/2), all the method marks are available throughout the question and the A1ft is available in (c). The A mark in part (b) may also be accessible. Maximum score is likely to be 8/12

If they have the trivial power 1 on their second term, then two method marks are available in (a) and three method marks are available in part (c) Maximum score is likely to be 5/12

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