GCE

Mathematics

Advanced Subsidiary GCE

Unit **4722:** Core Mathematics 2

Mark Scheme for June 2013

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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

1. Annotations

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
NGE	Not good enough
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 D*	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
AG	Answer given

2. **Subject-specific Marking Instructions for GCE Mathematics (OCR) 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 or B 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			$\frac{1}{2} \times 2 \times ({}^{8}/_{5} + 2({}^{8}/_{7} + {}^{8}/_{9}) + {}^{8}/_{11})$	M1	Attempt the 4 correct y-coordinates, and no others	M0 if other y-values also found (unless not used) Allow decimal equivs
				M1	Attempt correct trapezium rule, any h, to find area between $x = 5$ and $x = 11$	Correct structure required, including placing of y-values The 'big brackets' must be seen, or implied by later working - this may not be clear if using $h = 2$ so allow BOD for eg $\frac{1}{2} \times 2 \times ({}^{8}/_{5} + {}^{8}/_{11}) + 2({}^{8}/_{7} + {}^{8}/_{9})$ Could be implied by stating general rule in terms of y_0 etc, as long as these have been attempted elsewhere and clearly labelled Could use other than 3 strips as long as of equal width Using x-values is M0 Can give M1, even if error in evaluating y-values as long correct intention is clear Allow BoD if first or last y-value incorrect, unless clearly from an incorrect x-value
				M1	Use correct h (soi) for their y-values (must have equally spaced x-values), to find area between $x = 5$ and $x = 11$	Must be in attempt at trap rule, not Simpson's rule As $h = 2$, allow BOD if ${}^{1}/_{2} \times 2$ not seen explicitly Allow if muddle over placing y-values, including duplication, (but M0 for x-values) Allow if ½ missing Allow other than 3 strips, as long as h is consistent
			$= 6.39$	A1	Obtain 6.39, or better	Allow answers in the range [6.390, 6.391] if >3sf Answer only is 0/4 Using 2 strips of width 3 is M0M1M1 and not a misread Using the trap rule on result of an integration attempt is 0/4 – this includes functions such as $8x$ even if integration is not explicit Using 3 separate trapezia can get full marks – if other than 3 trapezia then mark as above However, using only one trapezium is 0/4
				[4]		

Question			Answer	Marks	Guidance	
2	(i)		$\frac{1}{2}x = 53.1°, 126.9°$	B1	Obtain 106°, or better	Allow answers in the range [106.2, 106.3] Ignore any other solutions for this mark Must be in degrees, so 1.85 rad is B0
			$x = 106°, 254°$	M1	Attempt correct solution method to find second angle	Could be 2(180° – their 53.1°) or (360° – their 106°) Allow valid method in radians, but M0 for eg (360 – 1.85)
				A1	Obtain 254°, or better	Allow answers in the range [253.7°, 254°] A0 if in radians (4.43) A0 if extra incorrect solutions in range **SR** If no working shown then allow B1 for 106° and B2 for 254° (max B2 if additional incorrect angles)
				[3]		
2	(ii)		$\tan x = 3$	B1	State $\tan x = 3$	Allow B1 for correct equation even if no, or an incorrect, attempt to solve Give BOD on notation eg $^{\sin}/_{\cos}(x)$ as long as correct equation is seen or implied at some stage
			$x = 71.6°, 252°$	M1	Attempt to solve $\tan x = k$	Not dep on B1, so could gain M1 for solving eg $\tan x = {}^{1}/_{3}$ Could be implied by a correct solution
				A1	Obtain 71.6° and 252°, or better	A0 if extra incorrect solutions in range **Alt method:** **B1** Obtain $10\sin^2 x = 9$ or $10\cos^2 x = 1$ **M1** Attempt to solve $\sin^2 x = k$ or $\cos^2 x = k$ (allow M1 if just the positive square root used) **A1** Obtain 71.6° and 252°, with no extra incorrect solutions in range **SR** If no working shown at all then allow B1 for each correct angle (max B1 if additional incorrect angles), but allow full credit if $\tan x = 3$ seen first
				[3]		

Question			Answer	Marks	Guidance	
3	(i)		$(2 + 5x)^6 = 64 + 960x + 6000x^2$	M1	Attempt at least first 2 terms– products of binomial coeff and correct powers of 2 and $5x$	Must be clear intention to use correct powers of 2 and $5x$ Binomial coeff must be 6 soi; ${}^6C_1$ is not yet enough Allow BOD if 6 results from ${}^6/_1$ Allow M1 if expanding $k(1 + {}^5/_2\, x)^6$, any k
				A1	Obtain $64 + 960x$	Allow 2^6 for 64 Allow if terms given as list rather than linked by '+'
				M1	Attempt 3rd term – product of binomial coeff and correct powers of 2 and $5x$	Allow M1 for $5x^2$ rather than $(5x)^2$ Binomial coeff must be 15 soi; ${}^6C_2$ is not yet enough Allow M1 if expanding $k(1 + {}^5/_2\, x)^6$, any k $1200x^2$ implies M1, as long as no errors seen (including no working shown)
				A1 **[4]**	Obtain $6000x^2$	A0 if an otherwise correct expansion is subsequently spoiled by attempt to simplify eg $4 + 60x + 375x^2$ **If expanding brackets:** Mark as above, but must consider all 6 brackets for the M marks (allow irrelevant terms to be discarded)
3	(ii)		$(9 + 6cx \ldots)(64 + 960x + \ldots)$	M1*	Expand first bracket and attempt at least one relevant product	Expansion of first bracket does not have to be correct, but must be attempted so M0 if using $(3 + cx)(64 + 960x...)$ No need to see third term in expansion of first bracket Must then consider a product and not just use $6c + 960$ Expansion could include irrelevant / incorrect terms Using an incorrect expansion associated with part **(i)** can get M1 M1
			$(9 \times 960) + (6c \times 64) = 4416$ $8640 + 384c = 4416$ $384c = -4224$	M1d*	Equate sum of the two relevant terms to 4416 and attempt to solve for c	Must now consider just the two relevant terms M0 if additional terms, even if error has resulted in kx BOD if presence of x is inconsistent within equation
			$c = -11$	A1 **[3]**	Obtain $c = -11$	A0 for $c = -11x$

Question			Answer	Marks	Guidance	
4	(a)		$^5/_4x^4 - 3x^2 + x + c$	M1	Attempt integration	Increase in power by 1 for at least two of the three terms Allow M1 if the +1 disappears
				A1	Obtain at least 2 correct (algebraic) terms	Integral must be of form $ax^4 + bx^2 + cx$ Allow for unsimplified $^6/_2\ x^2$ and/or $1x$
				A1	Obtain a fully correct integral, including + c	Coeff of x^2 must now be simplified, as well as x not $1x$ A0 if integral sign or dx still present in final answer Ignore notation on LHS such as $\int$ = ..., y = ..., $^{dy}/_{dx}$ = ...
				[3]		
4	(b)	(i)	$-12x^{-2} + c$	M1	Obtain integral of form kx^{-2}	Any k, including unsimplified
				A1	Obtain fully correct integral, including + c	Coeff must now be simplified A0 if integral sign or dx still present in final answer Do not penalise again if already penalised in part **(a)**, even if different error including omission of + c Ignore notation on LHS such as $\int$ = ..., y = ..., $^{dy}/_{dx}$ = ...
				[2]		
4	(b)	(ii)	$(0) - (-12a^{-2}) = 3$	M1*	Attempt F(∞) – F(a) and use or imply that F(∞) = 0	Must be subtraction and correct order Could use a symbol for the upper limit, eg s, and then consider $s \to \infty$ $0 - 12a^{-2}$, with no other supporting method, is M0 as this implies addition Allow BOD for $-12 \times (0)^{-2}$ as long as it then becomes 0 Allow M1 for using incorrect integral from **(b)(i)** as long as it is of the form kx^{-n} with $n \neq 3$
			$a^2 = 4$	M1d*	Equate to 3 and attempt to find a	Dependent on first M1 soi Allow muddle with fractions eg $a^2 = {^1/_4}$
			$a = 2$	A1	Obtain $a = 2$ only	A0 if –2 still present as well
				[3]		Answer only is 0/3 **NB** watch for $a = 2$ as a result of solving $24a^{-3} = 3$, which gets no credit

Question			Answer	Marks	Guidance	
5	(i)		sector area = ½ × 16^2 × 0.8 = 102.4	M1*	Attempt area of sector using (½) $r^2\theta$, or equiv	Condone omission of ½, but no other errors Must have r = 16, not 7 M0 if 0.8π used not 0.8 M0 if (½) $r^2\theta$ used with θ in degrees Allow equiv method using fractions of a circle
			triangle area = ½ × 16 × 7 × sin 0.8 = 40.2	M1*	Attempt area of triangle using (½) $ab\sin C$ or equiv	Condone omission of ½, but no other errors Angle could be in radians (0.8 not 0.8π) or degrees (45.8°) Must have sides of 16 and 7 Allow even if evaluated in incorrect mode (gives 0.78) If using ½ × b × h, then must be valid use of trig to find b and h
				M1d*	Attempt area of sector – area of triangle	Using ½ × 16^2 × (0.8 – sin 0.8) will get M1 M0 M0
			area BDC = 62.2 cm^2	A1 **[4]**	Obtain 62.2, or better	Allow answers in range [62.20, 62.25] if > 3sf
5	(ii)		$BD^2 = (16^2 + 7^2 - 2×16×7×\cos 0.8)$ BD = 12.2	M1	Attempt length of BD using correct cosine rule	Must be correct cosine rule Allow M1 if not square rooted, as long as BD^2 seen M0 if 0.8π used not 0.8 Allow if evaluated in degree mode (gives 9.00) Allow if incorrectly evaluated - using $(16^2 + 7^2 - 2 × 16 × 7) × \cos 0.8$ gives 7.51 Allow any equiv method, as long as valid use of trig Attempting the cosine rule in part **(i)** will only get credit if result appears in part **(ii)**
				A1	Obtain 12.2, or better	Allow any answer rounding to 12.2, with no errors seen Could be implied in method rather than explicit
			arc BC = 16 × 0.8 = 12.8	B1	State or imply that arc BC is 12.8	Allow if 16 × 0.8 seen, even if incorrectly evaluated
			per = 12.2 + 12.8 + 9 = 34.0 cm	A1 **[4]**	Obtain 34, or better	Accept 34 or 34.0, or any answer rounding to 34.0 if >3sf

Question			Answer	Marks	Guidance	
6	**(i)**		$S_{30} = {}^{30}/_{2}\ (2 \times 6 + 29 \times 1.8)$	M1	Use $d = 1.8$ in AP formula	Could be attempting S_{30} or u_{30} Formula must be recognisable, though not necessarily fully correct, so allow M1 for eg 15(6 + 29 × 1.8), 15(12 + 14 × 1.8) or even 15(12 + 19 × 1.8) Must have $d = 1.8$ (not 1.3), $n = 30$ and $a = 6$
				A1	Correct unsimplified S_{30}	Formula must now be fully correct Allow for any unsimplified correct expression If using ${}^{1}/_{2}n(a + l)$ then l must be correct when substituted
			$= 963$	A1 **[3]**	Obtain 963	Units not required
6	**(ii)**		$r = {}^{7.8}/_{6} = 1.3$	M1	Use $r = 1.3$ in GP formula	Could be attempting S_N , u_N or even S_∞ Formula must be recognisable, though not necessarily fully correct Must have $r = 1.3$ (not 1.8) and $a = 6$
			$\frac{6(1-1.3^N)}{1-1.3} \leq 1800$	A1	Correct unsimplified S_N	Formula must now be fully correct Allow for any unsimplified correct expression
			$1 - 1.3^N \geq -90$	M1	Link sum of GP to 1800 and attempt to rearrange to $1.3^N \leq k$	Must have used correct formula for S_N of GP Allow =, ≥ or ≤ Allow slips when rearranging, including with indices, so rearranging to $7.8^N \leq k$ could get M1
			$1.3^N \leq 91$ **AG**	A1	Obtain given inequality	Must have correct inequality signs throughout Correct working only, so A0 if 6×1.3^N becomes 7.8^N, even if subsequently corrected

Question			Answer	Marks	Guidance	
			$N \log 1.3 \le \log 91$	M1	Introduce logs throughout and attempt to solve equation / inequality	Must be using $1.3^N \le 91$, $1.3^N = 91$ or $1.3^N \ge 91$ This M1 (and then A1) is independent of previous marks Must get as far as attempting N M0 if no evidence of use of logarithms M0 if invalid use of logarithms in attempt to solve
			$N \le 17.19$ hence $N = 17$	A1	Conclude $N = 17$	Must come from solving $1.3^N \le 91$or $1.3^N = 91$ (ie not incorrect inequality sign) Answer must be integer value Answer must be equality, so A0 for $N \le 17$ **SR** Candidates who use numerical value(s) for N can get M1 Use $r = 1.3$ in a recognisable GP formula (M0 if N is not an integer value) A1 Obtain a correct unsimplified S_N Candidates who solve $1.3^N \le 91$ and then use a value associated with their N (usually 17 and/or 18) in a GP formula will be eligible for the M1A1 for solving the inequality and also the M1A1 in the **SR** above
				[6]		

Question			Answer	Marks	Guidance	
7	(i)		$\int_1^4 \left(x^{\frac{3}{2}} - 1\right) dx = \left[\frac{2}{5}x^{\frac{5}{2}} - x\right]_1^4$	M1	Attempt integration	Increase in power by 1 for at least one term - allow the –1 to disappear
				A1	Obtain fully correct integral	Coeff could be unsimplified eg $^1/_{2.5}$ Could have + c present
			= (12.8 – 4) – (0.4 – 1)	M1	Attempt correct use of limits	Must be explicitly attempting F(4) – F(1), either by clear substitution of 4 and 1 or by showing at least (8.8) – (–0.6) Allow M1 if + c still present in both F(4) and F(1), but M0 if their c is now numerical Allow use in any function other than the original
			= $9^2/_5$ **AG**	A1 **[4]**	Obtain $9^2/_5$	**AG**, so check method carefully Allow $^{47}/_5$ or 9.4
7	(ii)		$m = {}^3/_2 \times \sqrt{4} = 3$	M1*	Attempt to find gradient at (4, 7) using differentiation	Must be reasonable attempt at differentiation ie decrease the power by 1 Need to actually evaluate derivative at $x = 4$
			$y = 3x - 5$	M1d*	Attempt to find point of intersection of tangent with x-axis or attempt to find base of triangle	Could attempt equation of tangent and use $y = 0$ Could use equiv method with gradient eg $3 = {}^7/_{4-x}$ Could just find base of triangle using gradient eg $3 = {}^7/_b$
			tangent crosses x-axis at $({}^5/_3, 0)$	A1	Obtain $x = {}^5/_3$ as pt of intersection or obtain $^7/_3$ as base of triangle	Allow decimal equiv, such as 1.7, 1.67 or even 1.6 www Allow M1M1A1 for $x = {}^5/_3$ with no method shown
			area of triangle = $^1/_2 \times (4 - {}^5/_3) \times 7$ = $8^1/_6$	M1d**	Attempt complete method to find shaded area	Dependent on both previous M marks Find area of triangle and subtract from $9^2/_5$ Must have 1 < their x < 4, and area of triangle < $9^2/_5$ If using $\int(3x - 5)dx$ then limits must be 4 and their x M1 for area of trapezium – area between curve and y-axis
			shaded area = $9^2/_5 - 8^1/_6 = 1^7/_{30}$	A1 **[5]**	Obtain $1^7/_{30}$, or exact equiv	A0 for decimal answer (1.23), unless clearly a recurring decimal (but not eg 1.2333...)

Question			Answer	Marks	Guidance	
8	**(i)**	**(a)**	(0, 1)	B1 **[1]**	State (0, 1)	Allow no brackets B1 for $x = 0$, $y = 1$ – must have $x = 0$ stated explicitly B0 for $y = a^0 = 1$ (as $x = 0$ is implicit)
		(b)	(0, 4)	B1 **[1]**	State (0, 4)	Allow no brackets B1 for $x = 0$, $y = 4$ – must have $x = 0$ stated explicitly B0 for $y = 4b^0 = 4$ (as $x = 0$ is implicit)
		(c)	State a possible value for *a* State a possible value for *b*	B1 B1 **[2]**	Must satisfy $a > 1$ Must satisfy $0 < b < 1$	Must be a single value Could be irrational eg e Must be fully correct so B0 for eg 'any positive number such as 3' Must be a single value Could be irrational eg e^{-1} Must be fully correct **SR** allow B1 if both *a* and *b* given correctly as a range of values

Question			Answer	Marks	Guidance	
8	(ii)		$\log_2 a^x = \log_2(4b^x)$	M1	Equate a^x and $4b^x$ and introduce logarithms at some stage	Could either use the two given equations, or b could have already been eliminated so using two eqns in a only Must take logs of each side soi so M0 for $4\log_2(b^x)$ Allow just log, with no base specified, or $\log_2$ Allow logs to any base, or no base, as long as consistent
			$\log_2 a^x = \log_2 4 + \log_2 b^x$	M1	Use $\log ab = \log a + \log b$ correctly	Or correct use of $\log {}^a/_b = \log a - \log b$ Used on a correct expression eg $\log_2(4b^x)$ or $\log_2 4({}^2/_a)^x$ Equation could either have both a and b or just a Must be used on an expression associated with $a^x = 4b^x$, either before or after substitution, so M0 for $\log_2(ab) = 1$ hence $\log_2 a + \log_2 b = 1$ Could be an equiv method with indices before using logs eg $a^{2x} = 4 \times 2^x$ hence $a^{2x} = 2^{2+x}$
			$x\log_2 a = \log_2 4 + x\log_2 b$	M1	Use $\log a^b = b \log a$ correctly at least once	Allow if used on an expression that is possibly incorrect Allow M1 for $x\log_2 a = x\log_2 4b$ as one use is correct Equation could either have both a and b or just a
			$x\log_2 a = \log_2 4 + x\log_2({}^2/_a)$	B1	Use $b = {}^2/_a$ to produce a correct equation in a and x only	Can be gained at any stage, including before use of logs If logs involved then allow for no, or incorrect, base as long as equation is fully correct – ie if $\log 2^k = k$ used then base must be 2 throughout equation Could be an equiv method eg $(a \times a)^x = 4(a \times b)^x$ hence $a^{2x} = 4 \times 2^x$ Must be eliminating b, so $({}^2/_b)^x = 4b^x$ is B0 unless the equation is later changed to being in terms of a
			$x\log_2 a = 2 + x\log_2 2 - x\log_2 a$ $x(2\log_2 a - 1) = 2$ $x = \dfrac{2}{2\log_2 a - 1}$ **AG**	A1 **[5]**	Obtain given relationship with no wrong working	Proof must be fully correct with enough detail to be convincing Must use $\log_2$ throughout proof for A1 – allow 1 slip Using numerical values for a and b will gain no credit Working with equation(s) involving y is M0 unless y is subsequently eliminated

Question			Answer	Marks	Guidance	
9	**(i)**		f(2) = 32 – 14 –3 = 15	M1	Attempt f(2) or equiv	M0 for using $x = -2$ (even if stated to be f(2)) At least one of the first two terms must be of the correct sign Must be evaluated and not just substituted Allow any other valid method as long as remainder is attempted (see guidance in part **(ii)** for acceptable methods)
				A1	Obtain 15	Do not ISW if subsequently given as –15 If using division, just seeing 15 on bottom line is fine unless subsequently contradicted by eg –15 or $^{15}/_{x-2}$
				[2]		
9	**(ii)**		$f(^{-1}/_2) = {}^{-1}/_2 + {}^{7}/_2 - 3 = 0$ **AG**	B1	Confirm $f(^{-1}/_2) = 0$, with at least one line of working	$4(^{-1}/_2)^3 - 7(^{-1}/_2) - 3 = 0$ is enough B0 for just $f(^{-1}/_2) = 0$ If, and only if, $f(^{-1}/_2)$ is **not** attempted then allow B1 for other evidence such as division / coeff matching etc If using division must show '0' on last line or make equiv comment such as 'no remainder' If using coefficient matching must show 'R = 0' Just writing f(x) as the product of the three correct factors is not enough evidence on its own for B1
			$f(x) = (2x + 1)(2x^2 - x - 3)$	M1	Attempt complete division by $(2x + 1)$, or another correct factor	Could divide by $(x + 1)$, $(x + {}^1/_2)$, $(2x - 3)$, $(x - {}^3/_2)$ Must be complete method - ie all 3 terms attempted Long division - must subtract lower line (allow one slip) Inspection - expansion must give at least three correct terms of the cubic Coefficient matching - must be valid attempt at all coeffs of quadratic, considering all relevant terms each time

Question			Answer	Marks	Guidance	
			$= (2x + 1)(2x - 3)(x + 1)$	A1	Obtain $2x^2$ and one other correct term	Could be middle or final term depending on method Must be correctly obtained Coeff matching - allow for $A = 2$ etc Or lead term and one another correct for their factor
				A1	Obtain fully correct quotient of $2x^2 - x - 3$	Could appear as quotient in long division, or as part of a product if using inspection. For coeff matching it must now be explicit not just $A = 2$, $B = -1$, $C = -3$ Or fully correct quotient for their factor
				M1	Attempt to factorise their quadratic quotient from division attempt by correct factor	Allow M1 if brackets would give two correct terms on expansion **SR** allow even if their quadratic does not have rational roots If solving quadratic (eg using the formula) then must attempt factors for M1, but allow eg $(x - {}^3/_2)(x + 1)$
				A1	Obtain $(2x + 1)(2x - 3)(x + 1)$	Final answer must be seen as a product of all three factors Allow factorised equiv such as $2(2x + 1)(x - {}^3/_2)(x + 1)$ but A0 for $(2x + 1)(x - {}^3/_2)(2x + 2)$ as not fully factorised isw if subsequent confusion over 'roots' and 'factors' **SR** If repeated use of factor theorem, or answer given with no working, then allow a possible B1for $f({}^{-1}/_2) = 0$ with an additional **B5** for $(2x + 1)(2x - 3)(x + 1)$, or **B3** for a multiple such as $(2x + 1)(x - {}^3/_2)(x + 1)$
				[6]		

Question			Answer	Marks	Guidance	
9	**(iii)**		$2\cos\theta + 1 = 0$ $\cos\theta + 1 = 0$ $2\cos\theta - 3 = 0$	M1*	Identify relationship between factors of f(cos θ) and factors of f(x)	Replace x with cos θ in at least one of their factors (could be implied by later working, inc their solutions)
			$\cos\theta = {}^{-1}/_{2}$ $\cos\theta = -1$ $\cos\theta = {}^{3}/_{2}$	M1d*	Attempt to solve cos $\theta = k$ at least once	Must actually attempt θ, with $-1 \le k \le 1$
			$\theta = {}^{2\pi}/_{3}$, ${}^{4\pi}/_{3}$ $\theta = \pi$	A1	Obtain at least 2 correct angles	Allow angles in degrees (120°, 240°, 180°) Allow decimal equivs (2.09, 4.19, 3.14) Allow if $2\cos\theta + 1 = 0$ is the only factor used, or if other incorrect factors are also used Allow M1M1A1 for 2 correct angles with no working shown
				A1 **[4]**	Obtain all 3 correct angles	Must be exact and in radians A0 if additional incorrect angles in range Allow full credit if no working shown Angles must come from 3 correct roots of f(x), but allow if a factor was eg ($x - {}^{3}/_{2}$) not ($2x - 3$) A0 if incorrect root, even if it doesn't affect the three solutions eg one of their factors was ($2x + 3$) not ($2x - 3$)

APPENDIX 1

Guidance for marking C2

Accuracy
Allow answers to 3sf or better, unless an integer is specified or clearly required.
Answers to 2 sf are penalised, unless stated otherwise in the mark scheme.
3sf is sometimes explicitly specified in a question - this is telling candidates that a decimal is required rather than an exact answer eg in logs, and more than 3sf should not be penalised unless stated in mark scheme.
If more than 3sf is given, allow the marks for an answer that falls within the guidance given in the mark scheme, with no obvious errors.

Extra solutions
Candidates will usually be penalised if an extra, incorrect, solution is given. However, in trigonometry questions only look at solutions in the given range and ignore any others, correct or incorrect.

Solving equations
With simultaneous equations, the method mark is given for eliminating one variable. Any valid method is allowed ie balancing or substitution for two linear equations, substitution only if at least one is non-linear.

Solving quadratic equations
Factorising - candidates must get as far as factorising into two brackets which, on expansion, would give the correct coefficient of x^2 and at least one of the other two coefficients. This method is only credited if it is possible to factorise the quadratic – if the roots are surds then candidates are expected to use either the quadratic formula or complete the square.
Completing the square - candidates must get as far as $(x + p) = \pm \sqrt{q}$, with reasonable attempts at p and q.
Using the formula - candidates need to substitute values into the formula, with some attempt at evaluation (eg calculating $4ac$). Sign slips are allowed on b and $4ac$, but all other aspects of the formula must be seen correct, either algebraic or numerical. The division line must extend under the entire numerator (seen or implied by later working). If the algebraic formula is quoted then candidates are allowed to make one slip when substituting their values. Condone not dividing by $2a$ as long as it has been seen earlier.

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