OCR RECOGNISING ACHIEVEMENT

Tuesday 17 January 2012 – Morning

AS GCE MATHEMATICS

4722 Core Mathematics 2

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4722
- List of Formulae (MF1)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found in the centre of the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book**. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.

INFORMATION FOR CANDIDATES

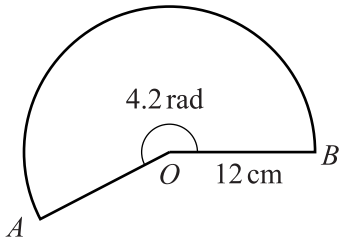
This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTIONS TO EXAMS OFFICER/INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

1

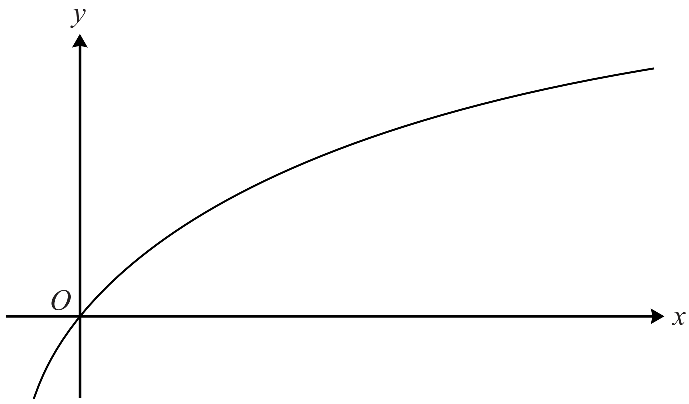


The diagram shows a sector AOB of a circle with centre O and radius 12 cm. The reflex angle AOB is 4.2 radians.

(i) Find the perimeter of the sector. **[3]**

(ii) Find the area of the sector. **[2]**

2



The diagram shows the curve $y = \log_{10}(2x + 1)$.

(i) Use the trapezium rule with 4 strips each of width 1.5 to find an approximation to the area of the region bounded by the curve, the x-axis and the lines $x = 4$ and $x = 10$. Give your answer correct to 3 significant figures. **[4]**

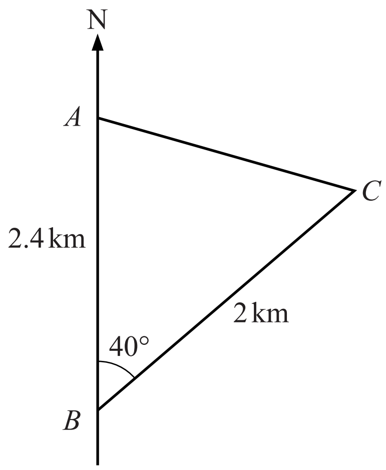
(ii) Explain why this approximation is an under-estimate. **[1]**

3 One of the terms in the binomial expansion of $(4 + ax)^6$ is $160x^3$.

(i) Find the value of a. **[4]**

(ii) Using this value of a, find the first two terms in the expansion of $(4 + ax)^6$ in ascending powers of x. **[2]**

4



The diagram shows two points A and B on a straight coastline, with A being 2.4 km due north of B. A stationary ship is at point C, on a bearing of 040° and at a distance of 2 km from B.

(i) Find the distance AC, giving your answer correct to 3 significant figures. **[2]**

(ii) Find the bearing of C from A. **[3]**

(iii) Find the shortest distance from the ship to the coastline. **[2]**

5 The cubic polynomial $f(x)$ is defined by $f(x) = 2x^3 + 3x^2 - 17x + 6$.

(i) Find the remainder when $f(x)$ is divided by $(x - 3)$. **[2]**

(ii) Given that $f(2) = 0$, express $f(x)$ as the product of a linear factor and a quadratic factor. **[4]**

(iii) Determine the number of real roots of the equation $f(x) = 0$, giving a reason for your answer. **[2]**

6 A sequence $u_1, u_2, u_3, \ldots$ is defined by $u_n = 85 - 5n$ for $n \geqslant 1$.

(i) Write down the values of u_1, u_2 and u_3. **[2]**

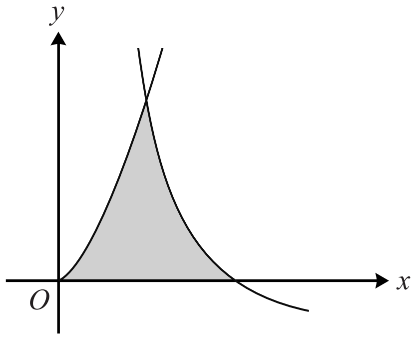
(ii) Find $\sum_{n=1}^{20} u_n$. **[3]**

(iii) Given that u_1, u_5 and u_p are, respectively, the first, second and third terms of a geometric progression, find the value of p. **[4]**

(iv) Find the sum to infinity of the geometric progression in part **(iii)**. **[2]**

7 **(a)** Find $\int (x^2 + 4)(x - 6)\,dx$. **[3]**

(b)



The diagram shows the curve $y = 6x^{\frac{3}{2}}$ and part of the curve $y = \frac{8}{x^2} - 2$, which intersect at the point (1, 6). Use integration to find the area of the shaded region enclosed by the two curves and the x-axis. **[8]**

8 **(a)** Use logarithms to solve the equation $7^{w-3} - 4 = 180$, giving your answer correct to 3 significant figures. **[4]**

(b) Solve the simultaneous equations

$$\log_{10}x + \log_{10}y = \log_{10}3, \qquad \log_{10}(3x + y) = 1.$$ **[6]**

9 **(i)** Sketch the graph of $y = \tan(\frac{1}{2}x)$ for $-2\pi \leqslant x \leqslant 2\pi$ on the axes provided.

On the same axes, sketch the graph of $y = 3\cos(\frac{1}{2}x)$ for $-2\pi \leqslant x \leqslant 2\pi$, indicating the point of intersection with the y-axis. **[3]**

(ii) Show that the equation $\tan(\frac{1}{2}x) = 3\cos(\frac{1}{2}x)$ can be expressed in the form

$$3\sin^2(\tfrac{1}{2}x) + \sin(\tfrac{1}{2}x) - 3 = 0.$$

Hence solve the equation $\tan(\frac{1}{2}x) = 3\cos(\frac{1}{2}x)$ for $-2\pi \leqslant x \leqslant 2\pi$. **[6]**

OCR RECOGNISING ACHIEVEMENT

Question			Answer	Marks	Guidance	
1	(i)		perimeter = (4.2 × 12) + (2 × 12) = 74.4 cm	M1*	Use $s = 12\theta$	Allow equiv method using fractions of a circle If working in degrees, must use 180 and π (or 360 and 2π) to find angle M0 if 12θ used with θ in degrees M0 if 4.2π used instead of 4.2 M1 if attempting arc of minor sector (12 × 2.1 (or better))
				M1d*	Attempt perimeter of sector	Add 24 to their attempt at 12θ M0 if using minor sector
				A1	Obtain 74.4	Units not required Allow a more accurate answer that rounds to 74.4, with no errors seen (poss resulting from working in degrees)
				[3]		
1	(ii)		area = $\frac{1}{2} \times 12^2 \times 4.2$ = 302.45 cm^2	M1	Use $A = (\frac{1}{2})12^2\theta$	Condone omission of $\frac{1}{2}$, but no other error Allow equiv method using fractions of a circle M0 if $(\frac{1}{2})12^2\theta$ used with θ in degrees M0 if 4.2π used instead of 4.2 M1 if attempting area of minor sector
				A1	Obtain 302, or better	Units not required Allow 302 or a more accurate answer that rounds to 302.4, with no errors seen (could be slight inaccuracy if using fractions of a circle)
				[2]		

Question			Answer	Marks	Guidance	
2	(i)		$0.5 \times 1.5 \times \{\lg 9 + 2(\lg 12 + \lg 15 + \lg 18) + \lg 21\}$ $= 6.97$	**B1**	State, or use, y-values of lg9, lg12, lg15, lg18 and lg21	B0 if other y-values also found (unless not used in trap rule) Allow decimal equivs (0.95, 1.08, 1.18, 1.26, 1.32 or better)
				M1	Attempt correct trapezium rule, any h, to find area between $x = 4$ and $x = 10$	Correct structure required, including correct placing of y-values The 'big brackets' must be seen, or implied by later working 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 4 strips as long as of equal width Using x-values is M0 Can give M1, even if error in y-values eg using 9, 12, 15, 18, 21 or using now incorrect function eg $\log(2x) + 1$ Allow BoD if first or last y-value incorrect, unless clearly from an incorrect x-value (eg $y_0 = \lg 7$, but $x = 4$ not seen)
				M1	Use correct h in recognisable attempt at trap rule	Must be in attempt at trap rule, not Simpson's rule Allow if muddle over placing y-values (but M0 for x-values) Allow if $\frac{1}{2}$ missing Allow other than 4 strips, as long as h is consistent Allow slips which result in x-values not equally spaced
				A1	Obtain 6.97, or better	Allow answers in the range [6.970, 6.975] if >3sf
						Answer only is 0/4 Using the trap rule on result of an integration attempt is 0/4 Using 4 separate trapezia can get full marks – if other than 4 trapezia then mark as above However, using only one trapezium is 0/4
				[4]		

Question			Answer	Marks	Guidance	
2	(ii)		tops of trapezia are below curve	**B1** **[1]**	Convincing reason referring to the top of a trapezium being below the curve, or the gap between a trapezium and the curve – explanation must be sufficient and fully correct	B0 for 'the trapezium is below the curve' (ie 'top' not used) Sketch with explanation is fine, even if just arrow and 'gap' Sketching rectangles / triangles is B0, as is a trapezium that doesn't have both top vertices intended to be on curve Concave / convex is B0, as is comparing to exact area B1 for reference to decreasing gradient
3	(i)		$20 \times 4^3 \times a^3 = 160$ $1280a^3 = 160$ $a^3 = \frac{1}{8}$ $a = \frac{1}{2}$	**M1**	Attempt relevant term	Must be an attempt at a product involving a binomial coeff of 20 (not just ${}^6C_3$ unless later seen as 20), 4^3 and an intention to cube ax (but allow for ax^3) Could come from $4^6(1 + {}^{ax}/_4)^6$ as long as done correctly Ignore any other terms if fuller expansion attempted
				A1	Obtain correct $1280a^3$, or unsimplified equiv	Allow $1280a^3x^3$, or $1280(ax)^3$, but not $1280ax^3$ unless a^3 subsequently seen, or implied by working
				M1	Equate to 160 and attempt to solve for a	Must be equating coeffs – allow if x^3 present on both sides (but not just one) as long as they both go at same point Allow for their coeff of x^3, as long as two, or more, parts of product are attempted eg $20ax^3$ / $64ax^3$ Allow M1 for $1280a = 160$ (giving $a = 0.125$) M0 for incorrect division (eg giving $a^3 = 8$)
				A1 **[4]**	Obtain $a = \frac{1}{2}$	Allow 0.5, but not an unsimplified fraction Answer only gets full credit, as does T&I **SR: max of 3 marks** for $a = 0.5$ from incorrect algebra, eg $1280ax^3 = 160$, so $a = 0.5$ would get M1A1(implied)B1

Question			Answer	Marks	Guidance	
3	(ii)		$4^6 + 6 \times 4^5 \times \frac{1}{2} = 4096 + 3072x$	**B1**	State 4096	Allow 4^6 if given as final answer Mark final answer – so do not isw if a constant term is subsequently added to 4096 from an incorrect attempt at second term eg using sum rather than product
				B1FT	State $3072x$, or $(6144 \times \text{their } a)x$	Must follow a numerical value of a, from attempt in part **(i)** Must be of form kx so just stating coeff of x is B0 Mark final answer B2 can still be awarded if two terms are not linked by a '+' sign – could be a comma, 'and', or just two separate terms **SR: B1** can be awarded if both terms seen as correct, but then 'cancelled' by a common factor
				[2]		
4	(i)		$b^2 = 2.4^2 + 2^2 - 2 \times 2.4 \times 2 \times \cos 40^o$ $b = 1.55$ km	**M1**	Attempt use of correct cosine rule	Must be correct formula seen or implied, but allow slip when evaluating eg omission of 2, incorrect extra 'big bracket' Allow M1 even if subsequently evaluated in rad mode (4.02) Allow M1 if expression is not square rooted, as long as LHS was intended to be correct ie $b^2 = \ldots$ or $AC^2 = \ldots$
				A1	Obtain 1.55, or better	Actual answer is 1.55112003… so allow more accurate answer as long as it rounds to 1.551 Units not required
				[2]		

Question			Answer	Marks	Guidance	
4	(ii)		$\frac{\sin A}{2} = \frac{\sin 40}{1.55}$ $\frac{\sin C}{2.4} = \frac{\sin 40}{1.55}$ $A = 56^{\circ}$ $C = 84^{\circ}$ hence bearing is 124°	M1 A1 A1ft [3]	Attempt to find one of the other two angles in triangle Obtain $A = 56^{\circ}$, or $C = 84^{\circ}$ Obtain 124°, following their angle A or C	Could use sine rule or cosine rule, but must be correct rule attempted Need to substitute in and rearrange as far as sin A = … / cos A = … etc, but may not actually attempt angle Any angle rounding to 56° or 84°, and no errors seen Allow any answer rounding to 124 Finding bearing of A from C is A0 – ie not a MR
4	(iii)		$d = 2 \times \sin\ 40^{\circ}$ $= 1.29$ km	M1 A1 [2]	Attempt perpendicular distance Obtain 1.29, or better	Any valid method, but must attempt required distance Can still get M1 if using incorrect or inaccurate sides / angles found earlier in question Allow M1 if evaluated in rad mode (1.49) Allow more accurate final answers in range [1.285, 1.286] A0 for inaccurate answers due to PA elsewhere in question (typically $C = 84.4$, so $A = 55.6$, so $d = 1.28$) Units not required
5	(i)		f(3) = 54 + 27 – 51 + 6 = 36	M1 A1 [2]	Attempt f(3) Obtain 36	Allow equiv methods as long as remainder is attempted A0 if answer subsequently stated as –36 ie do not isw

Question			Answer	Marks	Guidance	
5	(ii)		$f(x) = (x-2)(2x^2 + 7x - 3)$	**B1**	State or imply that $(x-2)$ is a factor	Just stating this is enough for B1, even if not used Could be implied by attempting division, or equiv, by $(x-2)$
				M1	Attempt full division, or equiv, by $(x \pm 2)$	Must be complete method – ie all three terms attempted If long division then must subtract lower line (allow one slip); if inspection then expansion must give correct first and last terms and also one of the two middle terms of the cubic; if coefficient matching then must be valid attempt at all 3 quadratic coeffs, considering all relevant terms each time Allow M1 for valid division attempt by $(x+2)$
				A1	Obtain $2x^2$ and at least one other correct term	If coeff matching then allow for stating values eg $A = 2$ etc
				A1 **[4]**	Obtain $(x-2)(2x^2 + 7x - 3)$	Must be stated as a product
5	(iii)		$b^2 - 4ac = 73$ > 0 hence 3 roots	**M1**	Attempt explicit numerical calculation to find number of roots of quadratic	Could attempt discriminant (allow $b^2 \pm 4ac$) , or could use full quadratic formula to attempt to find the roots themselves (implied by stating decimal roots); M0 for factorising unless their incorrect quotient could be factorised M0 for '3 roots as positive discriminant' but no evidence
				A1ft **[2]**	State 3 roots ($\sqrt{}$ their quotient) Condone no explicit check for repeated roots	Sufficient working must be shown, and all values shown must be correct Discriminant needs to be 73 (allow $7^2 - 4(2)(-3)$) Quadratic formula must be correct, though may not necessarily be simplified as far as $\frac{1}{4}(-7 \pm \sqrt{73})$ Need to state no. of roots – just listing them is not enough **SR:** if a conclusion is given in part **(iii)** then allow evidence from part **(ii)** eg finding actual roots

Question			Answer	Marks	Guidance	
6	(i)		$u_1 = 80$	B1	State 80	Just a list of numbers is fine, no need for labels
			$u_2 = 75$, $u_3 = 70$	B1 [2]	State 75 and 70	Ignore extra terms beyond u_3
6	(ii)		$S_{20} = \frac{20}{2}(2 \times 80 + 19 \times -5)$ $= 650$	M1	Show intention to sum 1st 20 terms of an arithmetic sequence	Any recognisable attempt at the sum of an AP, including manual addition of terms – no need to list all of the terms, but intention (inc no of terms) must be clear
				M1	Attempt use of correct sum formula for an AP, with $n = 20$, $a = 80$, $d = \pm 5$	Must use correct formula – only exception is $10(2a + 9d)$ If using $\frac{1}{2}n(a + l)$, must be a valid attempt at l, either from $a + 19d$ or from u_{20}
				A1 [3]	Obtain 650	Answer only gets full marks, as does manual addition

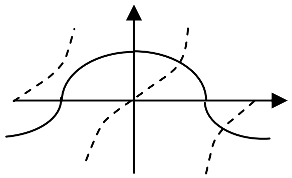
Question			Answer	Marks	Guidance	
6	(iii)		$r = \frac{60}{80} = 0.75$ $u_p = 80 \times 0.75^2 = 45$ $85 - 5p = 45$ $p = 8$	**M1***	Attempt to find u_p	Allow any valid method, inc informal Allow if first and/or second terms of their GP are incorrect Allow ratio of $\frac{4}{3}$ if used correctly to find 3rd term ($60 \div \frac{4}{3}$)
				A1	Obtain 45	Seen or implied **SR: M1* A0** if 45 results from using $u_n = ar^n$. The following M1A1 are still available.
				M1d*	Attempt to solve $85 - 5p = k$	k must be from attempt at third term of GP LHS could be $80 + (p - 1)(-5)$, from p^{th} term of the AP, but M0 if incorrect eg $80 + (p - 1)(5)$
				A1 **[4]**	Obtain $p = 8$	Allow full credit for answer only Any variable, including n
6	(iv)		$S_\infty = \frac{80}{1 - 0.75}$ $= 320$	**M1**	Use correct formula for sum to infinity	Must be from attempt at r for their GP
				A1 **[2]**	Obtain 320	A0 for 'tends to 320', 'approximately 320' etc

Question			Answer	Marks	Guidance	
7	(a)		$\int(x^3-6x^2+4x-24)\,dx$	M1	Expand and attempt in	Must attempt to expand brackets first Increase in power by 1 for the majority of their terms Allow if the constant term disappears
			$=\frac{1}{4}x^4-2x^3+2x^2-24x+c$	A1ft	Obtain at least two correct (algebraic) terms	At least two correct from their expansion Allow for unsimplified coefficients
				A1	Obtain fully correct expression, inc + c	All coefficients now simplified A0 if integral sign or dx still present in their answer (but allow $\int = \ldots$)
				[3]		
7	(b)		$\int 6x^{\frac{3}{2}}dx=\frac{12}{5}x^{\frac{5}{2}}$	M1	Obtain $kx^{\frac{5}{2}}$	Any exact equiv for the index
				A1	Obtain $\frac{12}{5}x^{\frac{5}{2}}$, or any exact equiv	Including unsimplified coefficient
			$\int(8x^{-2}-2)\,dx=-8x^{-1}-2x$	M1	Obtain at least one of $-8x^{-1}$ and $-2x$	Allow M1 even if –2 disappears Could be part of a sum or difference; with consistent signs
			$\left[\frac{12}{5}x^{\frac{5}{2}}\right]_0^1=\frac{12}{5}$ $\left[-8x^{-1}-2x\right]_1^2=(-8)-(-10)=2$	A1	Obtain $-8x^{-1}-2x$	Allow unsimplified expressions If subtraction from other curve attempted before integration then allow for $8x^{-1}+2x$
			hence total area = $\frac{22}{5}$	B1	State or imply that pt of intersection is (2, 0)	Could imply by using it as a limit
				M1	Use limits correctly at least once	Must be using correct x limits, and subtracting, with the appropriate function (allow implicit use of $x = 0$); the only error allowed is an incorrect (2, 0) Allow use in any function other than the original, inc from differentiation

7	(b) con			M1	Attempt fully correct process to find required area	Use both pairs of limits correctly (allow an incorrect (2, 0)), in appropriate functions and sum the two areas
				A1	Obtain $\frac{22}{5}$, or any exact equiv	
				[8]		Answer only is 0/8, as no evidence is provided of integration
			Alternative scheme for those who integrate between the curves and the y-axis Some solutions may involve both integration onto x-axis and y-axis, so you may need to combine aspects of both schemes	M1	Obtain $ky^{\frac{5}{3}}$	
				A1	Obtain $6^{\frac{-2}{3}} \times \frac{3}{5} \times y^{\frac{5}{3}}$	
				M1	Obtain $k\sqrt{2+y}$	
				A1	Obtain $2\sqrt{8}\sqrt{2+y}$	
				M1	Use limits of 6 (and 0) correctly at least once	
				M1	Attempt correct method to find required area – correct use of limits required	
				A2	Obtain 4.4	

Question			Answer	Marks	Guidance	
8	(a)		$\log 7^{w-3} = \log 184$ $(w-3)\log 7 = \log 184$ $w - 3 = 2.68$ $w = 5.68$	M1*	Rearrange, introduce logs and use $\log a^b = b \log a$	Must first rearrange to $7^{w-3} = k$, with k from attempt at 180±4, before introducing logs Can use logs to any base, as long as consistent on both sides If taking $\log_7$ then base must be explicit
				A1	Obtain $(w-3)\log 7 = \log 184$, or equiv eg $w - 3 = \log_7 184$	Condone lack of brackets ie $w - 3 \log 7 = \log 184$, as long clearly implied by later working
				M1d*	Attempt to solve linear equation	Attempt at correct process ie $w = {}^{\log k}/_{\log 7} \pm 3$, or equiv following expanding bracket first
				A1	Obtain 5.68, or better	More accurate final answer must round to 5.680
				[4]		Answer only, or T&I, is 0/4

Question			Answer	Marks	Guidance	
8	(b)		$\log xy = \log 3$ hence $xy = 3$ $3x + y = 10$	M1	Attempt correct use of log law to combine 2 (or more) logs	Must be used on at least two of $\log x$ / $\log y$ / $\log 3$ Allow $\log\left(\frac{xy}{3}\right)$ (condone no = 0)
			$x(10 - 3x) = 3$ $3x^2 - 10x + 3 = 0$	A1	Obtain $xy = 3$	aef as long as no logs present, or equiv in one variable
			$(3x - 1)(x - 3) = 0$ **or** $\frac{1}{3}(10 - y)y = 3$ $y^2 - 10y + 9 = 0$ $(y - 1)(y - 9) = 0$	B1	Obtain $3x + y = 10$	aef as long as no logs present, or equiv in one variable **SR:** if A0 B0 given above, then allow **B1** for a correct combination of the 2 eqns eg $9x + 3y = 10xy$ (others poss)
			$x = \frac{1}{3},\ y = 9 \quad x = 3, y = 1$	M1	Attempt to eliminate one variable, and solve the resulting three term quadratic	Elimination of one variable could happen prior to removal of logs from one equation – as long as logs are then removed completely to obtain three term quadratic
				A1	Obtain two correct values	Could be for two values for one variable, or for one pair of correct (x, y) values
				A1 **[6]**	Obtain $x = \frac{1}{3},\ y = 9$ and $x = 3, y = 1$	Pairings must be clear, but not necessarily as coordinates **SR: B1** for each pair of correct (x, y) values but no method **M1A1B1B1** - 1 pair of (x, y) values, from 2 correct eqns but no other method shown (but 6/6 if both pairs found)

Question			Answer	Marks	Guidance	
9	(i)			B1	Correct shape for $y = k\cos(\frac{1}{2}x)$	Must show intention to pass through $(-\pi, 0)$ and $(\pi, 0)$ Should be roughly symmetrical in the y-axis, but condone slightly different y-values at -2π and 2π Ignore graph outside of given range
				B1	Correct shape for $y = \tan(\frac{1}{2}x)$	Must show intention to pass through $(-2\pi, 0)$, $(0, 0)$, $(2\pi, 0)$ Asymptotes need not be marked, but there should be no clear overlap of the limbs, nor significant gaps between them Ignore graph outside of given range
				B1	(0, 3) stated or clearly indicated	Can still be given if $y = 3\cos(\frac{1}{2}x)$ graph is incorrect or not attempted If more than one point marked on the y-axis then mark the label on the graph intercept
				[3]		

Question			Answer	Marks	Guidance	
9	(ii)		$\dfrac{\sin(\frac{1}{2}x)}{\cos(\frac{1}{2}x)} = 3\cos(\frac{1}{2}x)$ $\sin(\frac{1}{2}x) = 3\cos^2(\frac{1}{2}x)$ $\sin(\frac{1}{2}x) = 3(1 - \sin^2(\frac{1}{2}x))$ $3\sin^2(\frac{1}{2}x) + \sin(\frac{1}{2}x) - 3 = 0$ **AG**	**M1**	Attempt use of relevant identities to show given equation	Must attempt use of both identities; these must be correct but allow poor notation eg using $\frac{\sin}{\cos}(\frac{1}{2}x)$ and/or $3(1 - \sin^2)(\frac{1}{2}x)$ could get M1A0
				A1	Obtain given equation, with no errors seen	Use both identities correctly, to obtain given equation Brackets around the $\frac{1}{2}x$ not required
			$\sin(\frac{1}{2}x) = 0.847, -1.18$ $\frac{1}{2}x = 1.01, 2.13$ $x = 2.02, 4.26$	**M1**	Attempt to solve given quadratic to find solution(s) for $\sin(\frac{1}{2}x)$	Must use quadratic formula (or completing the square) – M0 if attempting to factorise Allow variables other than $\sin(\frac{1}{2}x)$, eg $y =$, or even $x =$ Allow –1.18 to be discarded at any stage
				M1	Attempt to solve $\sin(\frac{1}{2}x) = k$	Attempt $\sin^{-1}$ (their root) and then double the answer
				A1	Obtain one correct angle	Allow in degrees (116° and 244°)
				A1	Obtain both correct angles, and no others in given range	Must both be in radians (allow equivs as multiples of π) A0 if extra, incorrect, angles in given range of $[-2\pi, 2\pi]$ but ignore any outside of given range **SR:** if no working shown then allow B1 for each correct solution (max of B1if in degrees, or extra solns in range)
				[6]		