

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

**Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education**

MEI STRUCTURED MATHEMATICS

2601

Pure Mathematics 1

Wednesday **12 JANUARY 2005** Afternoon 1 hour 20 minutes

Additional materials:

- Answer booklet
- Graph paper
- MEI Examination Formulae and Tables (MF12)

TIME 1 hour 20 minutes

INSTRUCTIONS TO CANDIDATES

- Write your Name, Centre Number and Candidate Number in the spaces provided on the answer booklet.
- Answer **all** questions.
- You are permitted to use only a scientific calculator in this paper.

INFORMATION FOR CANDIDATES

- The allocation of marks is given in brackets [] at the end of each question or part question.
- You are advised that an answer may receive no marks unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The total number of marks for this paper is 60.

This question paper consists of 3 printed pages and 1 blank page.

Section A (30 marks)

- 1 State the exact value of $\tan 30^\circ$. Write 30° in radians as simply as possible in the form $k\pi$. [3]
- 2 Solve the equation $|2x - 5| = 13$. [3]
- 3 Sketch the graph of $y = \sin x$ for $0^\circ \leq x \leq 360^\circ$.
Solve the equation $\sin x = -0.3$ for $0^\circ \leq x \leq 360^\circ$. [4]
- 4 Obtain the binomial expansion of $(1 - 5x)^4$, simplifying the coefficients. [4]
- 5 Find the x -coordinates of the points on the curve $y = x^3 - 4x^2 + 2$ where the gradient is 3. [4]
- 6 The equation $5x^2 + 3x + c = 0$ has a repeated root. Find the value of c and the value of the repeated root. [4]
- 7 A circle of radius 7 cm has a sector of angle 1.6 radians. Calculate the arc length of the sector.
The arc length is measured with a flexible ruler as 10.2 cm. Calculate the relative error in this measurement. Give your answer to 2 significant figures. [4]
- 8 Given that $y = 5x$, find $\int_0^3 \pi x^2 dy$. State clearly what this integral represents. [4]

Section B (30 marks)

9

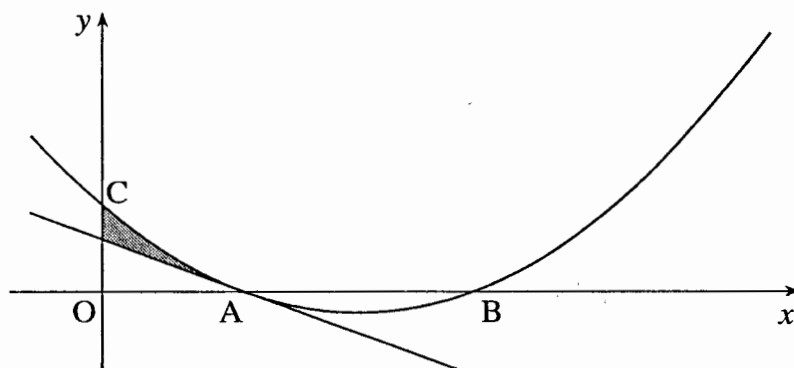


Fig. 9

The curve $y = x^2 - 7x + 10$ cuts the x -axis at A and B and the y -axis at C as shown in Fig. 9.

- (i) Write down the coordinates of C.

Show that A is $(2, 0)$ and find the coordinates of B.

Hence or otherwise find the coordinates of the turning point of the curve. [5]

- (ii) Solve the inequality $x^2 - 7x + 10 > 0$. [2]

- (iii) Show that the equation of the tangent to the curve at A is $y = -3x + 6$. [3]

- (iv) Calculate the area of the region bounded by the portion AC of the curve, the tangent at A and the y -axis. This region is shown shaded in Fig. 9. [5]

10 A circle with centre $(2, 4)$ has equation $x^2 + y^2 - 4x - 8y = 25$.

- (i) Show that the radius of the circle is $\sqrt{45}$. [3]

- (ii) Prove that the point $(8, 8)$ is outside the circle. [2]

- (iii) Find the equation of the line which is perpendicular to the line $y + 2x = 8$ and which passes through the centre of the circle. [3]

- (iv) P and Q are the points where the line $y + 2x = 8$ crosses the circle. Show that PQ is a diameter of the circle and find the coordinates of P and Q. [7]

Mark Scheme

	Section A			
1	$1/\sqrt{3}$ or $\sqrt{3}/3$ isw $\frac{1}{6}\pi$ or $0.1\dot{6}\pi$ or $\pi/6$	1 2	accept exact equivs M1 for $180^\circ = \pi$ radians soi eg $\times \pi/180$ or for 0.17π etc	3
2.	9 -4	1 2	M1 for $2x - 5 = -13$ o.e. B2 for 9 and -4 with inequality or modulus	3
3.	sketch of correct shape and period 1 and -1 indicated on y-axis 342.54239.. or 197.4576.. rot to 3 or more sf	G1 G1 1+1	allow one period drawn as implying 0 to 360 dep on attempt at sin or cos graph of correct amplitude 1 for both correct + extras in range; ignore extras outside range SCB1 for 359.6(9...) <u>and</u> 180.3(...) [rad mode] SCB1 for 340.6(..) <u>and</u> 199.3(9..) [grad mode]	4
4.	$1 - 20x + 150x^2 - 500x^3 + 625x^4$	4	B3 if signs incorrect or one error in digits, B2 for both of these errors or two errors in digits, B1 for 1 4 6 4 1 soi or SCB1 for $(1 - 10x + 25x^2)^2$	4
5.	$3x^2 - 8x$ their $y' = 3$ $(3x + 1)(x - 3)$ $x = 3$ or $-1/3$	M1 M1 M1 A1	condone one error attempt at factorising or quadratic formula after their $y' - 3 = 0$ or B4; allow -0.33 or better	4
6.	9/20 o.e. -0.3 o.e	2 2	M1 for $3^2 - 4 \times 5 \times c = 0$ or 9/20 found with inequality or for $5(-0.3)^2 + 3(-0.3) + c = 0$ M1 for subst. in formula with zero discriminant or for use of $y' = 0$ or M2 for $5[(x + 0.3)^2 - 0.3^2] + c = 0$ o.e.; M1 for $(x + 0.3)^2$ o.e.	4
7.	11.2 [-]0.089 or 8.9%	2 2	M1 for 7×1.6 M1 for $(\text{their } 11.2 - 10.2) \div \text{their } 11.2$ or other versions of 0.0892..;	4
8.	integral of $\pi y^2/25$ or $\pi(y/5)^2$ $\pi y^3/75$ $27\pi/75$, $9\pi/25$, 0.36π or 1.13(0...) volume [of revolution] about y-axis	M1 M1 A1 E1	iif first M not gained, allow ft for omission of π or 5 not squared allow sketch of cone in correct orientation	4

		Section B			
9	(i)	(0, 10)	1	condone 10	
		$(x - 2)(x - 5)$	M1	attempt to factorise or use quadratic formula	
		2 or 5	A1	allow as implying A and B coords <u>or</u> B1 for verifying A, B1 for (5,0) or ft for x coord from their B coord	5
	(ii)	$(7/2, -9/4)$ $x > 5$ ft and $x < 2$	1+1 1+1	B1 for $x \geq 5$ ft and $x \leq 2$	2
	(iii)	$y' = 2x - 7$ $x = 2$ subst in their $y' [= -3]$ $y = -3(x - 2)$ or (2, 0) subst in $y = -3x + c$ NB ans $y = -3x + 6$ given	M1 M1 M1	allow seen in (i); <u>or</u> M1 for $x^2 - 7x + 10 = -3x + 6$ M1 for $(x - 2)^2 = 0$; M1 for double root implies tangent	3
		(iv)	$\int ((x^2 - 7x + 10) - (-3x + 6)) [dx]$ $x^3/3 - 2x^2 + 4x$ or $(x^3/3 - 7x^2/2 + 10x) - (-3x^2/2 + 6x)$ value at 2 [- value at 0] 8/3 o.e.	M2 A1 M1 A1	M1 for $\int (x^2 - 7x + 10) [dx]$ and M1 for $\int (-3x + 6) [dx]$ or for $\frac{1}{2} \times 2 \times 6$ o.e., for integration of quadratic at least, condone one error ft for their integral accept 2.66 or better; condone neg sign
10	(i)	$(x - 2)^2 + (y - 4)^2 = r^2$ correct expansion of LHS subst of 25 for $x^2 + y^2 - 4x - 8y$ or subtraction of given eqn from their correct equation	M1 M1 A1	<u>or</u> for starting with given eqn: M2 for $(x-2)^2 - 4 + (y-4)^2 - 16 = 25$ A1 for $(x - 2)^2 + (y - 4)^2 = 25 + 16 + 4$ or $r^2 = 45$ SC1 for $r^2 = 16 + 4 + 25$ [can earn 3 if f, g, c formula quoted and result justified]	3
		(ii)	$(8 - 2)^2 + (8 - 4)^2$ or 52 $> r^2$ so outside	M1 A1	or square root of this; or M1 for sketch, A1 for accurate drawing; or M1 for showing $y = 1$ or 7 on circle, A1 for 8 not in $[1, 7]$ M1subst (8, 8) into given eqn and LHS=32, A1 > 25 so outside
	(iii)	grad = $\frac{1}{2}$ $(y - 4) =$ their $m(x - 2)$ o.e.	2 1	M1 for grad = $-1/\text{grad PQ}$ B3 for $y = \frac{1}{2}x + 3$ o.e.	3
	(iv)	showing (2, 4) is on $y + 2x = 8$ $y = 8 - 2x$ subst of their y or x from line in eqn for circle attempt to rearrange to zero $5x^2 - 20x - 25 = 0$ or simpler $x = 5$ or -1 $y = -2$ or 10	1 M1 M1 M1 A1 A1 A1	or finding (5, 2) and (-1, 10) and showing dist between them = $2\sqrt{45}$ or $x = (8 - y) / 2$ condone one further error or $5y^2/4 - 10y - 25 = 0$ etc or A1 for each of (5, -2) and (-1, 10), to advantage of cand.	7

Examiner's Report