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2002

XVIII

1583

Time allowed

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Percentage

/

%

Maths

**AQA
AS & A LEVEL**

Mark Scheme

3.10 I: Numerical methods

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<p>2</p> $\int_1^3 \frac{1}{\sqrt{1+x^3}} dx$ <table border="1" style="margin-left: 20px;"> <tr> <td style="text-align: center;">x</td> <td style="text-align: center;">y</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0.707(1)</td> </tr> <tr> <td style="text-align: center;">1.5</td> <td style="text-align: center;">0.478(1)</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">0.333(3)</td> </tr> <tr> <td style="text-align: center;">2.5</td> <td style="text-align: center;">0.245(3)</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">0.189(0)</td> </tr> </table> $A = \frac{1}{3} \times 0.5 \left[y(1) + y(3) + 4(y(1.5) + y(2.5)) + 2(y(2)) \right]$ $= 0.743$	x	y	1	0.707(1)	1.5	0.478(1)	2	0.333(3)	2.5	0.245(3)	3	0.189(0)	<p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p>	<p>4</p>	<p>3 correct } SC B1 for all correct expressions but all correct } wrongly evaluated</p> <p>use of Simpson's rule</p>
x	y														
1	0.707(1)														
1.5	0.478(1)														
2	0.333(3)														
2.5	0.245(3)														
3	0.189(0)														
Total		4													

<p>6(a)</p> $f(0.5) = -0.875$ $f(1) = 2$ Change of sign \therefore root	<p>M1</p> <p>A1</p>	<p>2</p>	
<p>(b)</p> $x^3 + 4x - 3 = 0$ $4x = 3 - x^3$ $x = \frac{3 - x^3}{4}$	<p>B1</p>	<p>1</p>	<p>AG</p>
<p>(c)(i)</p> $x_1 = 0.5$ $x_2 = 0.71875 \quad 0.72 \quad \text{AWRT}$ $x_3 = 0.66$	<p>M1</p> <p>A1</p> <p>A1</p>	<p>3</p>	
<p>(ii)</p>	<p>M1</p> <p>A1</p> <p>A1</p>	<p>3</p>	<p>For cobweb, x_1 to curve</p> <p>For x_2</p> <p>All correct</p>
Total		9	



1(a)	$f(2) = -1$ $f(2.1) = +0.161$ change of sign $\therefore 2 < \alpha < 2.1$	M1		both attempted
		A1	2	
(b)	$x^3 - x - 7 = 0$ $x^3 = x + 7$ $x = \sqrt[3]{x+7}$	B1	1	AG
		M1		
		A1		
(c)	$x_1 = 2$ $x_2 = 2.0801\dots$ $x_3 = 2.0862\dots$ $x_4 = 2.09$	M1		AWRT 2.08 AWRT 2.09
		A1		
		A1	3	
		A1		
Total			6	

6(a)	$\therefore \int \ln x = 1(\ln 1.5 + \ln 2.5 + \ln 3.5 + \ln 4.5)$ $= 4.08$	M1		use of 1.5, 2.5, ... ; 3 or 4 correct x values AWFW 4 to 4.2 CAO
		A1		
		A1	3	

(c)	$V = (k) \int \sec^2 x \, dx$ $= (k) [\tan x]_0^1$ $= 4.89$	M1		CAO
		A1		
		A1	3	

1	$x = 1.5, 2.5, 3.5, 4.5$ $y_1 = 0.7115 \quad 0.712$ $y_2 = 0.5218 \quad 0.522$ $y_3 = 0.4439 \quad 0.444$ $y_4 = 0.3993 \quad 0.399$ $A = 1 \times (y_1 + y_2 + y_3 + y_4)$ $= 2.08$	M1		Method x values 3 correct y 's
		A1		
		A1		
		A1	4	
		A1		
Total			4	

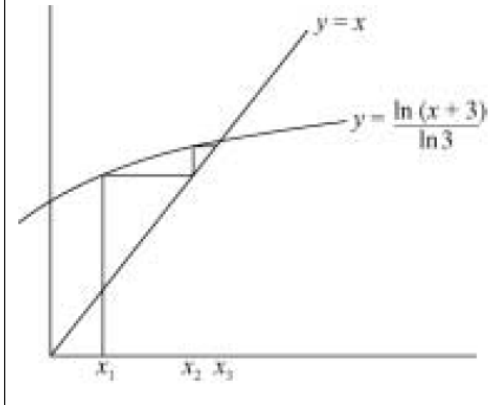


8(a)	$A(-1, \pi)$	B1		
	$B\left(0, \frac{\pi}{2}\right)$	B1	2	
(b)	$\cos^{-1} x - 3x - 1 = 0$			
	$f(0.1) = 0.17$ allow 0.2, 0.1	M1		Or comparing 'sides'
	$f(0.2) = -0.23$ allow -0.2			
	Change of sign \therefore root	A1	2	
(c)	$x_1 = 0.1$	M1		
	$x_2 = 0.1569 = 0.157$	A1		
	$x_3 = 0.1378 = 0.138$			
	$x_4 = 0.144$	A1	3	
Total			7	

(b)	$V = 4(\pi) \int_2^4 (x-1)^3 dx$	M1		$(\pi) \int y^2 dx$
	$= 4\pi \left[\frac{(x-1)^4}{4} \right]_2^4$	M1		$k(x-1)^4 (\pi)$ or in expanded form
	$= \pi(81-1) = 80\pi$	m1		correct substitution of limits into
		A1	4	$k(x-1)^4$
				CAO
(c)	Translate	E1		
	$\begin{pmatrix} 1 \\ 0 \end{pmatrix}$	B1		OE
	Stretch (I) SF 2 (II)	M1		for I and (II or III)
	// y axis (III)	A1	4	for I and II and III

4(a)		y		
	x_0	1	3	B1
	x_1	1.25	3.948(2)	
	x_2	1.5	5.196(2)	B1
	x_3	1.75	6.838(5)	
	x_4	2	9	
	$A = \frac{1}{3} \times \frac{1}{4} (3 + 4 \times 3.9482 + 2 \times 5.1962$			
	$+ 4 \times 6.8385 + 9)$	M1		Simpson's rule
	$= 5.46$	A1	4	CAO
(b)(i)	$f(x) = 3^x - x - 3$			
	$f(0.5) = -1.77$	M1A1	2	change of sign \therefore root
	$f(1.5) = 0.696$			



(ii)	$3^x = x + 3$ $\ln 3^x = \ln(x + 3)$ $x \ln 3 = \ln(x + 3)$ $x = \frac{\ln(x + 3)}{\ln 3}$	M1		correct use of logs
(iii)	$x_1 = 0.5$ $(x_2 = 1.14)$ $x_3 = 1.29 = 1.3$	M1	2	correct with no mistakes; AG
(iv)		M1	2	staircase x_2, x_3 correct and labelled on x -axis
Total			12	