MEI

Mathematics in Education and Industry

MEI STRUCTURED MATHEMATICS

CONCEPTS OF ADVANCED MATHEMATICS, C2

Practice Paper C2-D

MARK SHEME

Qu		Answer	Mark	Comment
Section A				
1	**(i)**	$\frac{x^4}{4} - x^2 + c$	M1 A1 **2**	
	(ii)	$\int_0^2 (x^3 - 2x)\,dx = \left[\frac{x^4}{4} - x^2\right]_0^2 = \frac{16}{4} - 4 = 0$ Therefore Area above = Area below	M1 A1 E1 **3**	Alternatively show: $\int_0^{\sqrt{2}} = \int_{\sqrt{2}}^2$
2	**(i)**	11 000	B1 **1**	
	(ii)	$10^{3k} = \frac{24000}{11000} = 2.182$ $\Rightarrow 3k = \log 2.182 \Rightarrow k = 0.11$	M1 M1 A1 **3**	Correct process for solution
3	**(i)**	$\log_{10} \frac{(x+4)(x+16)}{x^2}$	B1 B1 **2**	Numerator Denominator
	(ii)	Substitute $x = 4$ gives $\log_{10} \frac{(x+4)(x+16)}{x^2} = \log_{10} \frac{8 \times 20}{16} = \log_{10} 10 = 1$	M1 E1 **2**	
4		Cancellation of $\cos\theta \Rightarrow \cos\theta \frac{\sin\theta}{\cos\theta} = \sin\theta$ $\Rightarrow \theta = 60^\circ, 120^\circ$	M1 A1 A1 **3**	
5	**(i)**	Curve drawn is a reflection in the x-axis $(a, 0)$, $(-a, 0)$, $(0, -b)$	M1 A1 **2**	
	(ii)	Curve drawn is a reflection in the y- axis $(-a, 0)$, $(a, 0)$, $(0, b)$	M1 A1 A1 **3**	
6		Use of sine rule with 46° $\frac{180}{\sin 46^0} = \frac{\text{JB}}{\sin 78^0}$ JB = 244.76 Use of right angled triangle e.g. $\sin 56^0 = \frac{\text{width}}{244.76}$ width = 203 m	M1 A1 A1 M1 A1 **5**	Alternatively work with JA

7	**(i)**	-1, -4, -1, -4 Periodic	B1 B1 **2**	
	(ii)	$1, 1\frac{1}{2}, 1\frac{3}{4}, ...$ Convergent to 2	B1 B1 **2**	
	(iii)	0,1, 4, 25,………… Divergent	B1 **1**	
8	**(i)**	$A = \frac{1}{2}r^2\theta = 18 \times 1.8 = 32.4$	M1 A1 **2**	
	(ii)	Area triangle $= \frac{1}{2}r^2 \sin\theta = 18 \times \sin 1.8 = 17.53$ $\Rightarrow$ Area segment $= 32.4 - 17.53 = 14.87$	M1 A1 A1 **3**	

Section B				
9	**(i)**	$y = x^3 - 6x^2 + 9x + c$ Substitute $x = 2,\ y = -2 \Rightarrow c = -4$ $\Rightarrow y = x^3 - 6x^2 + 9x - 4$	M1 A1 A1 A1 M1 A1 **5**	Integration For c
	(ii)	Factorising Gives $y = (x-1)^2(x-4)$ Double root at x = 1 indicates touching x-axis. so A is (1, 0) B is (4, 0)	M1 A1 B1 B1 **4**	
	(iii)	At C (0, 4), $\frac{dy}{dx} = 9$ At B (4, 0) $\frac{dy}{dx} = 3 \times 16 - 12 \times 4 + 9 = 9$ So tangents are parallel so the normal of one is perpendicular to the tangent of the other.	B1 M1 E1 **3**	

10	**(i)**	$\frac{dy}{dx} = 2x - \frac{16}{x^2}$	M1 A1 **2**	
	(ii)	$\frac{dy}{dx} = 0$ when $2x - \frac{16}{x^2} = 0 \Rightarrow x^3 = 8$ $\Rightarrow x = 2,\ y = 12$	M1 A1 **2**	
	(iii)	$\frac{d^2y}{dx^2} = 2 + \frac{32}{x^3}$ When $x = 2,\ \frac{d^2y}{dx^2} > 0$ i.e. minimum.	M1 A1 E1 **3**	
	(iv)	Values of y are: 12, 12.65, 14.33, 16.82, 20 $A = \frac{1}{2} \times 0.5 \times \left(12 + 2\left(12.65 + 14.33 + 16.82\right) + 20\right)$ $= 29.9$	B1 M1 A1 **3**	
	(v)	Over-estimates because the curve is concave.	B1 B1 **2**	
11	**(i)**	£28 000, £31 360, £35 123.20 ratio = 1.12	B1 B1 **2**	
	(ii)	$28000(1.12)^9$ = 77646.21	M1 A1 **2**	
	(iii)	Use of $\frac{a(r^n - 1)}{r - 1}$ $= \frac{28000(1.12^{10} - 1)}{1.12 - 1}$ = 491 364.58	M1 A1 A1 **3**	
	(iv)	Use of $\frac{n}{2}\left(2a + (n-1)d\right)$ $= \frac{10}{2}\left(70000 + 9d\right) = 491\ 364.58$ $\Rightarrow d = 3141.44$	M1 A1 M1 A1 A1 **5**	