

GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit 4752: Concepts for Advanced Mathematics

Mark Scheme for June 2011

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SECTION A

1	$\frac{1}{2}x^4 + 3x$	M1	accept unsimplified	ignore + c
	F[5] - F[2]	M1	at least one term correctly integrated,	condone omission of brackets
	[=327.5-14]		may be implied by A1	
	=313.5 o.e.	A1		313.5 unsupported scores 0
2	$0.05, 2000, 1.25 \times 10^{-6}$ or	B2	B1 for two correct	
	$\frac{1}{20}$, 2000, $\frac{1}{800000}$ o.e.			
	divergent	B1	allow "alternate terms tend to zero and to infinity" o.e.	do <i>not</i> allow "oscillating", "getting bigger and smaller", "getting further apart"
3	(i) <i>m</i> =	M1		no marks for use of Chain Rule or any other attempt to
	$\frac{\sqrt{1+2\times4.1} - \sqrt{1+2\times4}}{4.1-4}$ s.o.i			differentiate
	4.1-4 s.o.1	3.54		
	grad = $\frac{\sqrt{9.2} - \sqrt{9}}{4.1 - 4}$ s.o.i	M1		SC2 for 0.33 appearing only embedded in equation
	$grad = \frac{\sqrt{3.2 - \sqrt{3}}}{\sqrt{1 - \sqrt{3}}}$ s.o.i	A 1		of chord
	0.3315 cao	A1		
3	(ii) selection of value in (4, 4.1) and 4	M1		allow selection of 4 and value in (3.9, 4)
	or of two values in [3.9, 4.1] centred	1111		and wasternon or value in (e12, 1)
	on 4			
	answer closer to 1/3 than 0.3315()	A1		
4	$6 = ab \text{ and } 3.6 = ab^2$	M1	$\log 6 = \log a + \log b \text{ and }$	
			$\log 3.6 = \log a + \log b^2$	
	$a = 10, \ b = 0.6 \text{ c.a.o.}$	A2	A1 each;	
			if M0 then B3 for both, B1 for one	

5	$\left[\frac{dy}{dx} = \right] 32x^{3} \text{ c.a.o.}$ substitution of $x = \frac{1}{2}$ in their $\frac{dy}{dx}$ grad normal = $\frac{-1}{their4}$	M1 M1 M1	[= 4]	must see kx^3 their 4 must be obtained by calculus
	when $x = \frac{1}{2}$, $y = 4\frac{1}{2}$ o.e. $y - 4\frac{1}{2} = -\frac{1}{4}(x - \frac{1}{2})$ i.s.w	B1 A1	$y = -\frac{1}{4}x + 4\frac{5}{8}$ o.e.	
6	$\frac{dy}{dx} = 6x^{\frac{1}{2}} - 2$ $y = kx^{\frac{3}{2}} - 2x + c \text{ o.e.}$ $y = 4x^{\frac{3}{2}} - 2x + c \text{ o.e.}$	M2 A1	M1 for $k x^{\frac{3}{2}}$ and M1 for $-2x + c$	$x^{\frac{1}{6}}$ is a mistake, not a misread " $y =$ " need not be stated at this point, but must be seen at some point for full marks
	correct substitution of $x = 9$ and $y = 4$ in their equation of curve $y = 4x^{\frac{3}{2}} - 2x - 86$	M1 dep A1	dependent on at least M1 already awarded allow A1 for $c = -86$ i.s.w. if simplified equation for y seen earlier	must see "+ c"

7	$\frac{\sin \theta}{\cos \theta} = 2\sin \theta$ $2\cos \theta - 1 = 0 \text{ and } \sin \theta = 0$ $[\theta =] 0, 180, 360,$ $[\theta =] 60, 300$ if 4 marks awarded, lose 1 mark for extra values in the range, ignore extra values outside the range	M1 A1 B1 B1	may be implied by $2\cos\theta - 1 = 0$ or better	or, if to advantage of candidate B4 for all 5 correct B3 for 4 correct B2 for 3 correct B1 for 2 correct if extra value(s) in range, deduct one mark from total do not award if values embedded in trial and improvement approach
8	$\log p = \log s + \log t$ $\log p = \log s + n \log t$ $[n =] \frac{\log p - \log s}{\log t} \text{ or } \frac{\log \left(\frac{p}{s}\right)}{\log t}$ [base not required]	M1 M1 A1	or $\frac{p}{s} = t^n$ $n \log t = \log \left(\frac{p}{s}\right)$ as final answer (i.e. penalise further incorrect simplification)	or A2 for $ [n =]\log_t \left(\frac{p}{s}\right) [\text{base } t \text{ needed }] \text{ following first M1} $
	$\log 16^{\frac{1}{2}}$ or $[-] \log 5^2$ s.o.i. $\log (4 \times 75)$ or $\log \frac{75}{25}$ s.o.i. x = 12 www	A1	$x = \frac{4 \times 75}{25} $ implies M1M1	if $a = 10$ assumed, $x = 12$ c.a.o. scores B3 www no follow through
	$t_1 = -\sin\theta$ $t_2 = \sin\theta$	B1 B1	www www	e.g. $\sin(\theta + 360) = \sin \theta + \sin 360 = \sin \theta$ B0

Section A Total: 36

SECTION B

11	(i) $200 - 2\pi r^2 = 2\pi rh$ $h = \frac{200 - 2\pi r^2}{2\pi r}$ o.e.	M1 M1	$100 = \pi r^2 + \pi r h$ $100r = \pi r^3 + \pi r^2 h$	sc3 for complete argument working backwards: $V = 100r - \pi r^3$ $\pi r^2 h = 100r - \pi r^3$ $\pi r h = 100 - \pi r^2$
	substitution of correct <i>h</i> into $V = \pi r^2 h$	M1	$100r = \pi r^3 + V$	$ 100 = \pi r h + \pi r^2 200 = A = 2\pi r h + 2\pi r^2 $
	$V = 100r - \pi r^3$ convincingly obtained	A1	$V = 100r - \pi r^3$	
			or	sc0 if argument is incomplete
			$\mathbf{M1} \text{ for } h = \frac{V}{\pi r^2}$	
			M1 for $200 = 2\pi r^2 + 2\pi r \times \frac{V}{\pi r^2}$	
			M1 for $200 = 2\pi r^2 + 2\frac{V}{r}$	
			A1 for $V = 100r - \pi r^3$ convincingly obtained	
11	(ii) $\frac{dV}{dr} = 100 - 3\pi r^2$	B2	B1 for each term	allow 9.42() r^2 or better if decimalised
	(ii) $\frac{dV}{dr} = 100 - 3\pi r^2$ $\frac{d^2V}{dr^2} = -6\pi r$	B1		-18.8() r or better if decimalised

11	(iii) their $\frac{dV}{dr} = 0$ s.o.i.	M1	must contain r as the only variable	
	r = 3.26 c.a.o.	A2	A1 for $r = (\pm)\sqrt{\frac{100}{3\pi}}$; may be implied	
			by 3.25	
	V = 217 c.a.o.	A1	deduct 1 mark only in this part if answers not given to 3 sf,	there must be evidence of use of calculus

12	(i)(A) 390	B2	M1 for $500 - 11 \times 10$	
12	(i)(B) $S_{24} = \frac{24}{2} (2 \times 500 + (24 - 1) \times -10)$ o.e. i.s.w.	B2	nothing simpler than $12(1000 + 23 \times -10)$ or $\frac{24}{2}(1000 - 230)$ or $12(2 \times 500 - 230)$	condone omission of final bracket or "(23)-10" if recovered in later work
			if B2 not awarded, then M1 for use of a.p. formula for S_{24} with $n = 24$, $a = 500$ and $d = -10$	if they write the sum out, all the terms must be listed for 2 marks
	or $S_{24} = \frac{24}{2} (500 + 270)$ o.e. i.s.w. [=9240] (answer given)		or M1 for $l = 270$ s.o.i.	$12 \times (1000 - 230)$ or 12×770 on its own do not score
12	(ii)(A) 368.33() or 368.34	B2	M1 for 460×0.98^{11}	
12	(ii)(B) $J_{20} = 310$ $M_{20} = 313.36(), 313.4, 313.3,$ 313.37 or 313 $J_{19} = 320$ $M_{19} = 319.76(), 319.8 \text{ or } 319.7$	В3	B3 for all 4 values correct or B2 for 3 values correct or B1 for 2 values correct	values which are clearly wrongly attributed do not score
12	(ii)(C) 8837 to 8837.06	B2	M1 for $S_{24} = \frac{460(1 - 0.98^{24})}{1 - 0.98}$ o.e.	
12	(ii)(D) $\frac{a(1-0.98^{24})}{(1-0.98)} = 9240$ o.e. 480.97 to 480.98	M1 A1	f.t. their power of 24 from (ii)C	

13	(i) arc AC = 2.1×1.8	M1	$\frac{103}{360} \times 2\pi \times 2.1$	103° or better
	= 3.78 c.a.o.	A1	300	3.78 must be seen but may be embedded in area formula
	area = their 3.78×5.5 = 20.79 or 20.8 i.s.w.	M1 dep* A1	dependent on first M1	Tormula
13	(ii) BD = $2.1 \cos (\pi - 1.8)$ or $2.1\cos 1.3(4159)$ or $2.1\sin 0.2(292)$ r.o.t to 1 d.p. or	M2	M1 for $\cos(\pi - 1.8) = \frac{BD}{2.1}$ o.e.	M2 for BD = 2.1 cos 76.8675° or 2.1sin13.1324rounded to 2 or more sf
	more			or M2 for CD = 2.045 r.o.t. to 3 s.f. or better and BD = $\sqrt{(2.1^2 - 2.045^2)}$
	= 0.48	A1	allow any answer which rounds to 0.48	, , , , , , , , , , , , , , , , , , ,
13	(iii) sector area = 3.969	M2	M1 for $\frac{1}{2} \times 2.1^2 \times 1.8$	or equivalent with degrees for first two Ms N.B. $5.5 \times 3.969 = 21.8295$ so allow M2 for 21.8295
	triangle area $= 0.487$ to 0.491	M2	M1 for	may be sin 1.8 instead of sin $(\pi - 1.8)$
			$1/2 \times 2.1 \times \text{their } 0.48 \times \sin (\pi - 1.8)$ or $1/2 \times \text{their } 0.48 \times 2.045 \text{ r.o.t. to } 3 \text{ s.f. or better}$	N.B. $5.5 \times \text{area} = 2.6785$ to 2.7005 so allow M2 for a value in this range
	24.5	A1	allow any answer which rounds to 24.5	

Section B Total: 36