



Mathematics (MEI)

Advanced Subsidiary GCE Unit **4752:** Concepts for Advanced Mathematics

Mark Scheme for January 2011

4752

January 2011

SECTION A

1	11.4 o.e.	2	M1 for 12/3 + 12/4 + 12/5 + 12/6 o.e.	M0 unless four terms summed
2	$\frac{1}{2}x^6 + 4x^{\frac{1}{2}} + c$	4	B1 for $\frac{1}{2}x^6$, M1 for $kx^{\frac{1}{2}}$, A1 for $k = 4$ or $\frac{4}{1}$, B1 for $+ c$ dependent on at least one power increased	allow $\frac{3}{6} x^6$ isw,
3	$\frac{1}{2} \times 1.5 \times (0.6 + 0.7 + 2(2.3 + 3.1 + 2.8 + 1.8))$ = 15.975 rounded to 2 s.f. or more	M2	M1 if one error or M2 for sum of 5 unsimplified individual trapezia: 2.175, 4.05, 4.425, 3.45, 1.875	basic shape of formula must be correct. Must be 5 strips. M0 if pair of brackets omitted or $h = 7.5$ or 1. allow recovery of brackets omitted to obtain correct answer. M0 for other than 5 trapezia isw only if 15.975 clearly identified as cross-sectional area
4	(i) (3, 15)	B2	B1 for each coordinate	s.c. B0 for (3, 5)
4	(ii) (1.5, 5)	B2	B1 for each coordinate	s.c. B0 for (3, 5)
5	$ar = 6 \text{ and } ar^{4} = -48$ r = -2 tenth term = 1536 $\frac{-3(1-(-2)^{n})}{1-(-2)} \text{ o.e.}$ $(-2)^{n} - 1$	M1 M1 A1 M1	B2 for $r = -2$ www B3 for 1536 www allow M1 for $a = 6$ ÷their r and substitution in GP formula with their a and r c.a.o.	ignore incorrect lettering such as d =-2 condone the omission of the brackets round "-2" in the numerator and / or the denominator

PMT

January 2011

6	a+2d = 24 and $a + 9d = 3$	M1 A1		
	d = -3; a = 30	A1	if M0, B2 for either, B3 for both	do not award B2 or B3 if values clearly obtained fortuitously
	$S_{50} - S_{20}$	M1	ft their s and h	S = 2175, $S = 20$
			It their a and a ;	$S_{50} = -2175; S_{20} = 30$ $u_{21} = 30 - 20 \times 3 = -30$
	-2205 cao	A1	M1 for $S_{30} = 2 (u_{21} + u_{50})$ o.e.	$u_{50} = 30 - 49 \times 3 = -117$
			B2 for -2205 www	
7	(i) $17 \log_{10} x \text{ or } \log_{10} x^{17}$	B2	M1 for $5\log_{10} x$ or $12 \log_{10} x$ or $\log_{10} x^{12}$	condone omission of base
			as part of the first step	
7	(ii) <i>-b</i>	B2	M1 for $\log_a 1 = 0$ or $\log_a a = 1$ soi	allow 0 - <i>b</i>
8	substitution of $\sin^2 \theta = 1 - \cos^2 \theta$	M1	soi	
-	$-5\cos^2\theta = \cos\theta$	A1	or better	
	$\theta = 90$ and 270,	A1		if the 4 correct values are presented, ignore any extra
	102	A1	accept 101.5() and 258.(46)	values which are outside the required range, but apply
	258	A1	rounded to 3 or more sf;	a penalty of minus 1 for extra values in the range
			if M0. allow B1 for both of 90 and 270	
	101 and 259	SC	and B1 for 102 and B1 for 258 (to 3 or	if given in radians deduct 1 mark from total awarded
		1	more sf) $(0.5 \text{ or } 102 \text{ and } 22 \text{ for } 200 \text{ (}0.5 \text{ or } 102 o$	(1.57, 1.77, 4.51, 4.71)
		1		(1.57, 1.77, 7.51, 7.71)

Mark Scheme

2

4752

DI/	Т
L IVI	1

4752			Mark Scheme	January 2011
9	area sector = $\frac{1}{2} \times r^2 \times \frac{\pi}{6} \left[= \frac{\pi r^2}{12} \right]$	M1	soi	
	area triangle = $\frac{1}{2} \times a^2 \times \sin \frac{\pi}{6} \left[= \frac{a^2}{4} \right]$	M1	soi	allow sin30
	$\frac{1}{2a^2} \times \frac{1}{2} = \frac{1}{2} \times r^2 \times \frac{\pi}{6} \times \frac{1}{2}$	M1	soi	no follow through marks available
	$\frac{a^2}{4} = \frac{\pi r^2}{24}$ o.e. and completion to given answer	A1		at least one correct intermediate step required, and no wrong working to obtain given answer

Section A Total: 36

4752

January 2011

(i) eqn of AB is y = 3x + 1 o.e. SC3 for verifying that A, B and C are collinear and **M1** 10 that C also lies on the curve or equiv in y: $y = 4\left(\frac{y-1}{3}\right)^2$ **M1** their "3x + 1" = $4x^2$ **SC2** for verifying that A, B and C are collinear by showing that gradient of AB = AC (for example) or or rearranging and deriving roots y = 4showing C lies on AB or $\frac{1}{4}$ solely verifying that C lies on the curve scores 0 (4x + 1) (x - 1) = 0 o.e. so x = -1/4**M1** condone verification by showing lhs = rhs o.e. at C, x = -1/4, $y = 4 \times (-1/4)^2$ or $3 \times$ **A1** or $y = \frac{1}{4}$ implies $x = \pm \frac{1}{4}$ so at C $x = -\frac{1}{4}$ (-1/4) + 1[=1/4 as required]**M1** 10 (ii) y' = 8x**A1** at A y' = 8eqn of tgt at A $y - 4 = \text{their}^{*}8''(x - 1)$ **M1** ft their gradient gradient must follow from evaluation of \overline{ax} A1 y = 8x - 4condone unsimplified versions of y = 8x - 4NB if m = -2 obtained from given **M1** at C $y' = 8 \times -1/4$ [=-2] dependent on award of first M1 answer or only showing that $(-\frac{1}{4}, \frac{1}{4})$ A1 $y - \frac{1}{4} = -2(x - (-\frac{1}{4}))$ or other SC2 if equation of tangent and curve solved lies on given line $y = -2x - \frac{1}{4}$ then 0 unsimplified equivalent to obtain simultaneously to correctly show repeated root marks. given result. allow correct verification that $(-\frac{1}{4},\frac{1}{4})$ lies on given line (iii) their "8x - 4" = $-2x - \frac{1}{4}$ 10 **M1** or $\frac{y+4}{8} = \frac{y+\frac{1}{4}}{-2}$ o.e. **A1** y = -1 www [x = 3/8]

4

SECTION B

4752			Mark Scheme	January 2011
11	(i) $\frac{x^4}{4} - x^3 - \frac{x^2}{2} + 3x$	M2	M1 if at least two terms correct	ignore + c
	their integral at 3 – their integral at 1 $[=-2.25-1.75]$	M1	dependent on integration attempted	M0 for evaluation of $x^3 - 3x^2 - x + 3$ or of differentiated version
	= -4 isw represents area between curve and x axis between $x = 1$ and 3	A1 B1		B0 for area <i>under</i> or above curve between $x = 1$ and 3
	negative since below <i>x</i> -axis	B1		
11	(ii) $y' = 3x^2 - 6x - 1$ their $y' = 0$ soi	M1 M1	dependent on differentiation attempted	
	$x = \frac{-2 \pm \sqrt{b^2 - 4ac}}{2a}$ with $a = 3, b = -6$ and $c = -1$ isw	M1	or $3(x-1)^2 - 4 = 0$ or better	no follow through; NB $\frac{6 \pm \sqrt{48}}{6}$ or better stated without
	$x = \frac{6 \pm \sqrt{48}}{6}$ or better as final answer	A1	eg A1 for $1 \pm \frac{2}{3}\sqrt{3}$	working implies use of correct method
	$\frac{6-\sqrt{48}}{5} < x < \frac{6+\sqrt{48}}{5}$ or ft their	B1	allow \leq instead of $<$	A0 for incorrect simplification, eg $1 \pm \sqrt{48}$
	6 6 final answer			allow B1 if <i>both</i> inequalities are stated separately and it's clear that both apply allow B1 if the terms and the signs are in reverse order
12	(i) 50% of 25 000 is 12 500 and the population [in 2005] is 12 000 [so consistent]	B1	or 12 000 is 48% of 25 000 so less than 50% [so consistent]	
12	(ii) $\log_{10} P = \log_{10} a - kt$ or $\log_{10} \overline{a} = -kt$ o.e. www	B2	condone omission of base; M1 for $\log_{10} P = \log_{10} a + \log_{10} 10^{-kt}$ or better www	

PMT

4752			Mark Scheme	January 2011
12	(iii) 4.27, 4.21, 4.13, 4.08 plots ruled line of best fit drawn	B1 B1 B1	accept 4.273, 4.2108, 4.130, 4.079 rounded to 2 or more dp 1 mm tolerance ft their values if at least 4 correct values are correctly plotted	f.t. if at least two calculated values correct must have at least one point on or above and at least one point on or below the line and must cover $0 \le t \le 25$
12	(iv) $a = 25000$ to 25400 $0.01 \le k \le 0.014$ $P = a \times 10^{-kt}$ or $P = 10^{\log a - kt}$ with values in acceptable ranges	B1 B2 B1	allow $10^{4.4.}$ M1 for $-k = \Delta x$ using values from table or graph; condone $+k$ B0 if left in logarithmic form	M1 for a correct first step in solving a pair of valid equations in either form A1 for k A1 for a A1 for $P = a \times 10^{-kt}$
12	(v) $P = a \times 10^{-35k}$ 8600 to 9000 comparing their value with 9375 o.e. and reaching the correct conclusion for their value	M1 A1 A1	T heir <i>a</i> and <i>k</i> f.t.	allow $\log P = \log a - 35k$

PMT

Section B Total: 36