GCE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics A
Unit MAP5

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Key to Mark Scheme

M ..... mark is for ..... method
m ..... mark is dependent on one or more M marks and is for ..... method
A ..... mark is dependent on M or m marks and is for ..... accuracy
B ..... mark is independent of M or m marks and is for ..... method and accuracy
E ..... mark is for ..... explanation
√ **or ft or F** ..... follow through from previous incorrect result
CAO ..... correct answer only
AWFW ..... anything which falls within
AWRT ..... anything which rounds to
AG ..... answer given
SC ..... special case
OE ..... or equivalent
A2,1 ..... 2 or 1 (or 0) accuracy marks
-*x* EE ..... deduct *x* marks for each error
NMS ..... no method shown
PI ..... possibly implied
SCA ..... substantially correct approach
c ..... candidate
SF ..... significant figure(s)
DP ..... decimal place(s)

Abbreviations used in Marking

MC – *x* ..... deducted *x* marks for mis-copy
MR – *x* ..... deducted *x* marks for mis-read
ISW ..... ignored subsequent working
BOD ..... given benefit of doubt
WR ..... work replaced by candidate
FB ..... formulae booklet

Application of Mark Scheme

No method shown:
Correct answer without working ..... mark as in scheme
Incorrect answer without working ..... zero marks unless specified otherwise

More than one method/choice of solution:

2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete and 1 partial attempt, neither crossed out	award credit for the complete solution only

Crossed out work — do not mark unless it has not been replaced

Alternative solution using a correct or partially correct method — award method and accuracy marks as appropriate

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MAP5

Q	Solution	Marks	Total	Comments
1(a)	$\frac{4}{x(x+4)} = \frac{1}{x} - \frac{1}{x+4}$	M1A1		Whole Q depends on the PFs
	$I = \ln x - \ln(x+4)(+c)$	A1F	3	ft incorrect PFs
(b)(i)	$I = [\ln x - \ln(x+4)]_0^1$	B1		attempt to put in limits
	$\ln x \to -\infty$ as $x \to 0 \therefore$ no finite limit	E1	2	
(ii)	$\frac{x}{x+4} \to 1$ as $x \to \infty$	E1		a clear explanation is required
	$\therefore I = \ln 1 - \ln \frac{1}{5}$	M1		substitution of limits
	$= \ln 5$	A1F	3	O.E; no ln 1 in answer
	Total		**8**	
2	$\cos^k x = \left(1 - \frac{x^2}{2} \ldots\right)^k$	M1		
	$= 1 - \frac{kx^2}{2} \ldots$	A1		ignore higher powers of x
	$\lim_{x \to 0} \frac{1 - \left(1 - \frac{kx^2}{2}\right)}{x^2} = 4$	M1		award only if some function of k appears
	$k = 8$	A1F	4	
	Total		**4**	

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MAP5 (Cont)

Q	Solution	Marks	Total	Comments
3(a)	$y_1 = 1 + h(1 + 1 - 3)$	M1		
	$= 1 - h$	A1	2	
(b)(i)	$x_1 = 1 + h$	B1		
	$y_2 = 1 + 2h\left((1+h)^2 + (1-h)^2 - 3\right)$	M1A1F		M0 if x_1 used throughout M1 if some function of h is used (including 1)
	$= 1 - 2h + 4h^3$	A1	4	AG
(ii)	$h = 0.05$	B1		B0 if $h = 0.1$
	$y(1.1) = y_2 = 1 - 2 \times 0.05 + 4 \times 0.05^3$ $= 0.9005$	B1F	2	Would have to accept to 3 sig fig ft $h = 0.1$ (giving 0.804)
	Total		**8**	
4	$2 = r + r\cos\theta$	M1		
	$= r + x$	B1		i.e. $x = r\cos\theta$ used relevantly
	$2 - x = r$	A1		
	$(2-x)^2 = x^2 + y^2$	M1		For relevant use of $r = \sqrt{x^2 + y^2}$
	$4 - 4x + x^2 = x^2 + y^2$	A1		
	$y^2 = 4(1 - x)$	A1F	6	Or $y^2 = 4 - 4x$ o.e. ft simple arithmetical errors only
	Total		**6**	

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MAP5 (Cont)

Q	Solution	Marks	Total	Comments
5(a)	$\text{IF} = \text{e}^{-\int \frac{1}{x+1}\text{d}x} = \text{e}^{-\ln(x+1)}$	M1A1		
	$= \frac{1}{x+1}$	A1	3	
(b)	$\frac{\text{d}}{\text{d}x}\left(\frac{y}{x+1}\right) = \frac{x^2}{x+1}$	M1A1		
	$= \frac{1}{x+1} + x - 1$	M1A1F		
	$\frac{y}{x+1} = \frac{x^2}{2} - x + \ln(x+1) + c$	A1F		Allow if c missing
				Or by substituting $u = x+1$
				in this case $\int\left(u - 2 + \frac{1}{u}\right)\text{d}u$ M1A1
	$c = 2$	A1F	6	$\frac{(x+1)^2}{2} - 2(x+1) + h(x+1) + c$ A1
	$y = (x+1)\left(\frac{x^2}{2} - x + \ln(x+1) + 2\right)$			$c = 3.5$ A1
(c)	$\lim_{x\to -1} y = 0$ since $(x+1)\ln(x+1) \to 0$ as $x \to -1$	E1	1	Must have proper explanation.
	Total		**10**	
6(a)	$R_1 + R_2 = \frac{1}{2}\int_{-(\pi-\alpha)}^{\alpha} 4(1-\cos\theta)^2\,\text{d}\theta$	M1A1		M1 for use of formula A1 for correct limits (appearing at any point)
	$(1-\cos\theta)^2 = 1 - 2\cos\theta + \cos^2\theta$	A1		
	$\cos^2\theta = \frac{1+\cos 2\theta}{2}$ used	M1		
	$\text{I} = \left[3\theta - 4\sin\theta + \frac{\sin 2\theta}{2}\right]$	A1F		
	$a = 3,\ b = -8$	A1A1	7	CAO
(b)	$OA = 2(1-\cos\alpha)$	B1		
	$OB = 2(1-\cos(-\pi+\alpha))$	B1		Could use $\pi + \alpha$
	$AB = 4$	B1	3	
	Total		**10**	

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MAP5 (Cont)

Q	Solution	Marks	Total	Comments
7(a)	$\frac{du}{dx} = \frac{d^2y}{dx^2} - k\frac{dy}{dx}$	M1A1		
	$\frac{d^2y}{dx^2} - k\frac{dy}{dx} - k\left(\frac{dy}{dx} - ky\right) = 12xe^{kx}$	M1		M1 for everything in $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ or in $\frac{du}{dx}$, u and y
	$\frac{du}{dx} - ku = 12xe^{kx}$	A1	4	AG
(b)	IF is $e^{\int -k dx} = e^{-kx}$	B1		**Alternative method** CF $u = Ae^{kx}$ B1 PI $u = Bx^2e^{kx}$ M1 $\frac{du}{dx} = kBx^2e^{kx} + 2xBe^{kx}$ m1A1 $B = 6$ A1
	$\frac{d}{dx}\left(ue^{-kx}\right) = 12x$	M1A1		
	$ue^{-kx} = 6x^2 + A$	A1		A0 if A missing
	$u = \left(6x^2 + A\right)e^{kx}$	A1F	5	f.t. A missing
(c)	$\frac{dy}{dx} - ky = \left(6x^2 + A\right)e^{kx}$	M1		If attempt is made using *C.F.* and *P.I.* *C.F.* $y = (A + Bx)e^{kx}$ B1 *P.I.* $y = Cx^3e^{kx}$ M1 completely correct A1 total 3/5
	IF is e^{-kx}	B1		
	$\frac{d}{dx}\left(ye^{-kx}\right) = 6x^2 + A$	A1		
	$ye^{-kx} = 2x^3 + Ax + B$	A1		
	$y = (2x^3 + Ax + B)e^{kx}$	A1	5	6
	Total		**14**	
	Total		**60**	

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