June 2004

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 75

SYLLABUS/COMPONENT: 9709/01

MATHEMATICS
Paper 1 (Pure 1)

UNIVERSITY of CAMBRIDGE
International Examinations

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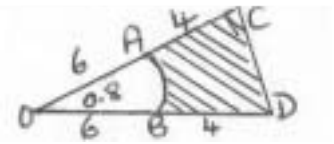
1. (i) $a/(1-r) = 256$ and $a = 64$ $\rightarrow r = ¾$	M1 A1 [2]	Use of correct formula Correct only
(ii) $S_{10} = 64(1-0.75^{10})\ (1-0.75)$ $\rightarrow S_{10} = 242$	M1 A1 [2]	Use of correct formula – 0.75^{10} not 0.75^{9} Correct only
2. $\int_0^1 \sqrt{3x+1}\,dx = (3x+1)^{1.5} \div 1.5$	B1	MI for $(3x+1)^{1.5} \div 1.5$
then 3	M1	For division by 3
$\rightarrow$ [ ] at 1 – [ ] at 0	M1	Must attempt [ ] at x=0 (not assume it is 0) and be using an integrated function
$\rightarrow$ 16/9 – 2/9 = 14/9 or 1.56	A1 [4]	Fraction or decimal. (1.56+C loses this A1)
3. (i) $\sin^2\theta + 3\sin\theta\cos\theta = 4\cos^2\theta$ divides by $\cos^2\theta$ $\rightarrow \tan^2\theta + 3\tan\theta = 4$	M1 A1 [2]	Knowing to divide by $\cos^2\theta$ Correct quadratic (not nec = 0)
(ii) Solution $\tan\theta = 1$ or $\tan\theta = -4$ $\rightarrow \theta = 45°$ or $104.0°$	M1 A1 A1 [3]	Correct solution of quadratic = 0 Correct only for each one.
4. (i) Coeff of x^3 = 6C3 x 2^3 =160	B1 B1 B1 [3]	B1 for 6C3 B1 for 2^3 B1 for 160
(ii) Term in x^2 = 6C2 x 2^2 = 60	B1	B1 for 60 (could be given in (i))
reqd coeff = 1 x (i) – 3 x 60 $\rightarrow$ –20	M1 A1 [3]	Needs to consider 2 terms co
5. 		
(i) Area of sector = ½ 6^2 0.8 (14.4) Area of triangle = ½.10^2.sin0.8 (35.9) $\rightarrow$ Shaded area = 21.5	M1 M1 A1 [3]	Use of $½r^2\theta$ with radians Use of ½absinC or ½ bh with trig Correct only
(ii) Arc length = 6 x 0.8 (4.8) CD (by cos rule) or 2 x 10sin0.4 (7.8) $\rightarrow$ Perimeter = 8 + 4.8 + 7.8 = 20.6	M1 M1 A1 A1 [4]	Use of $s=r\theta$ with radians Any correct method – allow if in (i) Correct only

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6. (i) eliminates x (or y) completely	M1	Needs x or y removed completely
→ $x^2+x-6=0$ or $y^2-17y+66=0$	A1	Correct only (no need for = 0)
Solution of quadratic = 0	DM1	Equation must = 0.
→ (2, 6) and (–3, 11)	A1 [4]	Everything ok.
(ii) Midpoint = (–½, 8½)	B1 √	For his two points in (i)
Gradient of line = –1		Use of y-step x-step (beware fortuitous)
Gradient of perpendicular = 1	M1	Use of $m_1m_2 = -1$
→ y – 8½ = 1 (x + ½) (or y = x + 9)	M1 A1 [4]	Any form – needs the M marks.
7. (i) Differentiate $y=18/x \rightarrow -18x^{-2}$	M1	Any attempt at differentiation
Gradient of tangent = –½	A1	For –½
Gradient of normal = 2	DM1	Use of $m_1m_2 = -1$
Eqn of normal y–3 = 2(x–6) (y=2x–9)	DM1	Correct method for eqn of line
If y = 0, x = 4½	A1 [5]	Ans given – beware fortuitous answers.
(ii) Vol = $\pi \int \frac{324}{x^2} dx = \pi\left[-324x^{-1}\right]$.	M1 A1	Use of $\int y^2 dx$ for M. correct(needs π) for A
Uses value at x=6 – value at x= 4.5	DM1	Use of 6 and 4.5
$-54\pi - -72\pi = 18\pi$	A1 [4]	Beware fortuitous answers (ans given)
8. (i) $2h + 2r + \pi r = 8$	M1	Reasonable attempt at linking 4 lengths + correct formula for ½C or C.
→ $h = 4 - r - \frac{1}{2}\pi r$ 	A1 [2]	Co in any form with h subject.
(ii) $A=2rh+\frac{1}{2}\pi r^2 \rightarrow A = r(8-2r-\pi r) + \frac{1}{2}\pi r^2$	M1	Adds rectangle + ½xcircle (eqn on own ok)
→ $A = 8r - 2r^2 - \frac{1}{2}\pi r^2$	A1 [2]	Co beware fortuitous answers (ans given)
(iii) $dA/dr = 8 - 4r - \pi r$	M1 A1	Knowing to differentiate + some attempt
= 0 when r = 1.12 (or $8/(4+\pi)$)	DM1 A1 [4]	Setting his dA/dr to 0. Decimal or exact ok.
(iv) $d^2A/dr^2 = -4 - \pi$	M1	Looks at 2nd differential or other valid complete method.
This is negative → Maximum	A1 [2]	Correct deduction but needs d^2A/dr^2 correct.

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9. $\overrightarrow{OA}=\begin{pmatrix}1\\3\\-1\end{pmatrix},\overrightarrow{OB}=\begin{pmatrix}3\\-1\\3\end{pmatrix},\overrightarrow{OC}=\begin{pmatrix}4\\2\\p\end{pmatrix},\overrightarrow{OD}=\begin{pmatrix}-1\\0\\q\end{pmatrix}$		Condone notation throughout. Allow column vectors or **i**,**j**,**k** throughout
(i) $\overrightarrow{AB}$ = **b**–**a** = 2**i** – 4**j** + 4**k**	M1	Use of **b–a,** rather than **b+a or a–b**
Unit vector = (2**i** – 4**j** + 4**k**) $\sqrt{(2^2+4^2+4^2)}$	M1	Dividing by the modulus of "his" $\overrightarrow{AB}$
= ± (2**i** –4**j** + 4**k**) 6	A1 [3]	Co (allow – for candidates using **a–b**)
(ii) $\overrightarrow{OA}.\overrightarrow{OC}$ = 4 + 6 – p = 0 for 90° → p = 10	M1 DM1 A1 [3]	Use of $x_1x_2 + y_1y_2 + z_1z_2$ Setting to 0 + attempt to solve co
(iii) $(–2)^2 + 3^2 + (q+1)^2 = 7^2$	M1	Correct method for length with **±d–a, d+a**
→ $(q+1)^2 = 36$ or $q^2 + 2q = 35$	A1	Correct quadratic equation
q = 5 and q = –7	DM1 A1 or B1 B1 [4]	Correct method of solution. Both correct. Or B1 for each if $(q+1)^2=36$, q=5 only.
10. f: x ↦ x^2–2x, g : x ↦ 2x+3		
(i) $x^2 – 2x – 15 = 0$	M1	Equation set to 0 and solved.
End-points –3 and 5	A1	Correct end-points, however used
→ x < –3 and x > 5	A1 [3]	Co-inequalities – not ≤ or ≥
(ii) Uses dy/dx = 2x–2 = 0 or $(x–1)^2 – 1$	M1	Any valid complete method for x value
Minimum at x = 1 or correct form	A1	Correct only
Range of y is f(x) ≥ –1	A1	Correct for his value of "x" – must be ≥
No inverse since not 1 : 1 (or equivalent)	B1 [4]	Any valid statement.
(iii) gf(x) = $2(x^2 – 2x) + 3$ $(2x^2 – 4x +3)$	M1	Must be gf not fg – for unsimplified ans.
$b^2 – 4ac = 16 – 24 = –8$ → –ve	M1	Used on quadratic=0, even if fg used.
→ No real solutions.	A1 [3]	Must be using gf and correct assumption and statement needed.
[or gf(x)=0 ⟶ f(x)=–3/2. Imposs from (ii)]		
(iv) y = 2x + 3 correct line on diagram	B2,1,0 [2]	3 things needed –B1 if one missing. • g correct,
Either inverse as mirror image in y=x or $y = g^{-1}(x) = ½ (x–3)$ drawn		• g^{-1} correct – not parallel to g • y=x drawn or statement re symmetry
DM1 for quadratic equation. Equation must be set to 0. Formula ⟶ must be correct and correctly used – allow for numerical errors though in b^2 and –4ac. Factors ⟶ attempt to find 2 brackets. Each bracket then solved to 0.		

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