UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2006 question paper

4024 MATHEMATICS

4024/02 Paper 2, maximum raw mark 100

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

The grade thresholds for various grades are published in the report on the examination for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2006 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

1 (a) (i) $5(x+2)(x-2)$ seen — B2 2 2

After B0, allow B1 for partial factorisation, e.g. $5(x^2-4)$ or $(5x+10)(x-2)$ or $(x+2)(x-2)$ seen etc

(ii) Final answer $\frac{x-2}{2(x-1)}$ oe including $\frac{x-2}{2x-2}$ asc — B2 2 2

After B0, allow B1 for $\frac{\text{Their (a)(i)}}{10(x-1)(x+2)}$ soi or $\frac{5x-10}{10x-10}$ oe nww or quadratic factors of denominator including $(x-1)(x+2)$

(b) $\frac{4(y+5)-3(y-3)}{(y-3)(y+5)}$ oe soi — M1

If denominator in this form, inner brackets essential
If not in this form, accept quadratic expression with y^2 and -15

Final answer $\frac{y+29}{(y-3)(y+5)}$ oe — A2 3 2

After M1 A0, allow A1 for correct simplified numerator and denominator seen, not necessarily at the same stage

(c) **Final answer** $(g=)\ \frac{4\pi^2 L}{T^2}$ oe **cao** — B3

Correct final answer involving an expression divided by fraction — SCB2

or, in either order, Square their equation ft — M1

and Clears fraction, $(gT^2 = 4\pi^2 L)$ ft — indep — M1 3 3 **10**

---

2 (a) (i) **Final answer** (9 , 6) or $x = 9,\ y = 6$ — B1 1 1

(ii) $\frac{3}{4}$ or $\frac{6}{8}$ or (0).75 — B1 1 1

(iii) (±) 10 — B1 1 1

(b) (i) **Final answer** (-12 , 2) or $x = -12,\ y = 2$ Condone brackets missing — B2 2 2

After B0, allow B1 for $\begin{pmatrix}-8\\5\end{pmatrix}+\begin{pmatrix}-4\\-3\end{pmatrix}$ oe or $\begin{pmatrix}-12\\2\end{pmatrix}$

(ii) Trapezium — indep — B1 1 1 **6**

3

(a) $91^2 = 53^2 + 64^2 \pm 2 \times 53 \times 64 \cos(P)$ oe soi — M1

(cos P =) $\frac{53^2 + 64^2 - 91^2}{2 \times 53 \times 64}$ oe soi $\left(= \frac{-1376}{6784}\right)$ (= - 0.2028) — M1

(P =) 101.65° to 101.75° — A1 3 2

If only one or both of other angles alone found,

allow M1 for $53^2 = 64^2 + 91^2 \pm 2 \times 64 \times 91 \cos(Q)$ or $64^2 = 53^2 + 91^2 \pm 2 \times 53 \times 91 \cos(R)$

and A1 for (Q=)34.75° to 34.85° or (R=) 43.45° to 43.55°

Long methods : Allow M2 A1

(b) $\sin S = \frac{53 \sin 68}{74}$ (= 0.66406) — M1

S = 41.55° to 41.65° — A1

P = 70.35 to 70.45° or 112 – their S ft (dep on M1) — A1 3 2

Long methods : Allow M2 A1

(c) ½ × 53 × 74 sin (their P) — M1

1845 to 1855 (m^2) cao — A1 2 2 **8**

---

4 (a) (XBY =) 150° — B1 1 1

(b) XAD = XBY (= 150) — B1

XA = XB **and** AD (= BC) = BY — B1

Conclusion drawn and at least one reason shown SAS needed if too many facts dep — B1 3 -

(c) AXD = BXY soi — B1

Convincingly shows DXY = 60° (= AXB) **AG** dep — B1 2 -

(d) States DX =XY — B1

Correctly concludes triangle DXY is equilateral dep — B1 2 - **8**

or DY = DX and/or XY with a reason — B1

triangle is equilateral dep — B1

(c)(d) together ΔDCY congruent to Δ ADX and/or Δ BXY — B1

DY = DX and/or XY dep — B1

ΔDCY is equilateral dep — B1

Angle DXY =60° dep — B1

Numerical values used for other angles cannot gain credit

---

5 (a) (i)	($) 825	B1	1	1	
(ii)	(£) 625	B1	1	1	
(iii)	$\frac{792 \times 1.44}{1.65}$	M1			
	691.2 (euros)	A1	2	2	
(b) (i)	($) 16 200	B1	1	1	
(ii)	(Their 16 200) × 1.08 × 1.08 oe soi	M1			
	($) 18 895.68 [Accept 18 896, 18895.7, 18895 or 18900] ft	A1	2	2	
(iii)	Figures $\frac{\text{Their (b)(ii) - 15 000}}{15\,000}$ (× 100) or $\frac{\text{Their 1200 + 1296 + 1399.68}}{15\,000}$	M1			
	25.95 to 26.05 (%) [Accept 26] ft	A1	2	2	
	or 125.95 to 126.05 (%)	SC B1			
(c)	Use of $\frac{12 \text{ or } 100}{112}$ soi	M1			
	($) 41 500	A1	2	2	**11**

---

6 (a)	**Formula** For numerical $\frac{p \pm \sqrt{q}}{r}$, (not ± p), seen or used,				
	Allow B1 for p = - 12 and r = 14 **and** B1 for q = 452 or √q = 21.2..soi	B1 + B1			
	Complete square Allow B1 for $(a + 6/7)^2$ or $(a + 6/7)$ oe soi				
	and B1 for 113/49 or square roots such as 1.5185..or 10.63../7				
	Final answers Allow B1 for each of 0.66 and - 2.38 nww	B2	4	2	
	or allow B1 for **both** 0.661. and -2.375.. seen or 0.66 and -2.38 seen				(1)
(b)					
(i)	$4x + 6y = 816$ **seen** (leading to $2x + 3y = 408$)	B1	1	-	
(ii)	$3x + 5y = 654$ oe seen	B1	1	1	
(iii)	$x = 78$ **and** $y = 84$	B3	3	3	**9**
	After B0, allow B2 for one correct answer found with no wrong working				
	After B0, allow M1 for correct method to eliminate one variable				
	After $5x + 3y = 654$ in (ii), allow SC B2 for both $x = 82$ **and** $y = 81.3$ or better				

---

7 (a)	$2\pi \times 30^2$	$(= 1800\pi)$	$(=5655)$	soi		M1		
	$2\pi \times 30 \times 70$	$(=4200\pi)$	$(=13194)$	soi	indep	M1		
	Their 1800π + their $4200\pi + \pi \times 30^2$			(provided all areas)	indep	M1		
	21 650 to 21 750 (cm^2)					A1	4	3
	Note Use of $3\pi 30^2$ may be taken as $2\pi 30^2 + \pi 30^2$, **unless** contradicted by the addition of extra $\pi 30^2$, when M0, M1, M1,A0 possible							
(b) (i)	$\frac{2}{3}\pi \times 30^3$	$(= 18000\pi)$	$(= 56549)$			M1		
	Their $18000\pi + \pi \times 30^2 \times 70$	$(=81\,000\pi)$	$(=254469)$	(both volumes)	indep	M1		
	254 to 255 (litres)	cao				A1	3	2
(ii)	$\frac{\text{Their (b)(i)}}{3}$	$(= 84.8..)$				M1		
	1 minute 24.5seconds to 1 minute 25.5 seconds			cao		A1	2	2
(iii)	(Length =) Figures $\frac{\text{Their (b)(i)}}{[\frac{1}{2}(0.4 + 0.6) \times 0.3]}$					M1		
	Correct conversion of units (using 1000)				indep	M1		
	1.690 to 1.700 **m** or 169.0 to 170.0 **cm** [Unit essential in this case]				cao	A1	3	3	**12**

8 (a) (i)	21 , 28	B1	1	1	
(ii)	$\frac{1}{2} \times 7 \times (7 + 1) = 28$ ($= T_7$) or better seen	B1	1	-	
(iii)	5050	B1	1	1	
(iv)	25 250 or 5 × their (iii) ft	B1	1	1	
(v)	Attempts to use T_{500} - their (iv) (provided their (iv) < their T_{500})	M1			
	100 000	A1	2	1	
(b) (i)	$S_6 = 56$	B1			
	$S_7 = 84$	B1	2	2	
	After B0 + B0, allow M1 for correct expansion of either or both expressions				
(ii)	$(7 \times (7 + 1) \times (7 + 2)) \div 6 = 84$ ($= S_7$) or better seen	B1	1	-	
(iii)	1540 seen	B1	1	1	
(c) (i)	$S_4 - S_3 = (1 \times 4 + 2 \times 3 + 3 \times 2 + 4 \times 1) - (1 \times 3 + 2 \times 2 + 3 \times 1)$				
	$= 4 + 3 + 2 + 1 (= T_4)$ seen	B1	1	-	
	20 – 10 =10 is enough to score				
(ii)	$S_{n+1} - S_n = (n + 1) + n + (n - 1) + \ldots + 2 + 1 = T_{n+1}$ justified	B1	1	-	**12**
	If algebraic methods used, mark strictly, expecting at least one step seen				

9

(a) $\sqrt{\{104^2 - 100^2\}}$ **or** 28.56... oe seen [leading to 28.6 **AG**] B1 1 -

(b) (i) 25° B1 1 1

(ii) (FN =) 100 tan (their 25) (= 46.63..) M1

(FB =) Their [46.63 - (28.56.. or 28.6)] dep M1

18.00 to 18.10 (m) [Expect at least 3 sig figs here] A1 3 3

Alternative methods : M2 A1

(c) (i) $CN = \sqrt{\{100^2 + 60^2\}}$ **or** $BC = \sqrt{\{104^2 + 60^2\}}$ M1

$= 116.6....$ soi **or** $= 120.06....$ soi A1

$\tan BCN = \frac{\text{Their } 28.6}{\text{Their CN}}$ **or** $\sin BCN = \frac{\text{Their } 28.6}{\text{Their BC}}$ M1

13.70° to 13.80° cao A1 4 3

Alternative methods : still M1 A1 M1 A1

(ii) $BD = \frac{\text{(Their } 28.6)}{\sin 10}$ (= 164 to 165) M1

$\cos DBA = \frac{104}{\text{Their BD}}$ (= 0.63.....) dep M1

50.75° to 50.85° cao A1 3 2 **12**

or $DN = \frac{\text{(Their } 28.6)}{\tan 10}$ (= 162.198)

and $DA = \sqrt{\{\text{their } 162.198^2 - 100^2\}}$ (=127.7) M1

$\tan DBA = \frac{\text{their } 127.7}{104}$ dep M1

50.75° to 50.85° A1

Alternative methods : M2 A1

10 Condone inaccuracies of up to 1 mm in plotting and drawing.

If plots are not visible, allow P marks if curve passes within 1 mm of correct plot.

Both P and dep C marks can be recovered following a grossly wrong plot if the plot is ignored and the curve passes within 1 mm of the correct point.

Lined or plain paper used : no penalty, but extend tolerances to 2 mm.

Penalties , only to be applied to any P or C marks earned :

Wrong scale(s) : - 1 once

Interchanged axes : no penalty if labelled, - 1 otherwise

Non-uniform scale(s) : - 2 after marking as generously as possible

(a) 8(.03) B1 1 1

Ignore graph for $x < 1$ and for $x > 6$ throughout rest of question

(b) All 7 points plotted ft (P1 for at least 5 of these ft) P2

Smooth curve, not grossly thick , through all plotted points, of which at least 5 are correct C1 3 -

(c)

1.35 to 1.45 B1

3.55 to 3.70 B1 2 2

(d) Drawing tangent at x = 4 and estimating $\frac{\text{change in y}}{\text{change in x}}$ M1

1.20 to 1.40 A1 2 -

Accept $\frac{\text{integer}}{\text{integer}}$ if in range for A1

(e) (i) Ruled straight line within 1 mm of both (1 , 3.5) and (5 , 5.5) L2 2 -

After L0, allow L1 for a good freehand line through these points,

or a ruled line that would pass within 1 mm of the points if longer,

or a ruled line that is long enough and passes within 2 mm of the points

(ii)

1.45 to 1.55 **and** 4.55 to 4.65 X1 1 1

(iii) $2x^3 - 5x^2 - 30x + 50 \quad (= 0)$ or any equivalent **equation** E1 1 1 **12**

Accept $a = -5$, $b = -30$ and $c = 50$