UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE O Level

MARK SCHEME for the November 2005 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 initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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*.

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

CIE is publishing the mark schemes for the November 2005 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

1	Nonsense in one part may be used to earn M marks in any other part of the question Throughout accept equivalent complete methods and decimal angles without degree sign, but degree sign essential if answer in degrees and minutes				
(a)	ABO = 90° with reason	B1	1		
(b) (i)	sin OAB = 8/13 (= 0.4615..) or OAB = 27.48.. oe seen (leads to OAB = 27.5) **AG**	B1	1		
(ii)	$\frac{15}{\tan 27.5}$	M1			
	28.8 to 28.9 (cm)	A1	2		
(iii)	2(their AC)sin27.5 **or** 2×15cos27.5	M2			
	or EPC = 2[90 – 27.5] (=125)				
	and $\sqrt{(15^2 + 15^2 - 2 \times 15 \times 15 \cos(\text{their } 125))}$ (M2)				
	26.55 to 26.65 (cm)	A1	3		7
2 (a)	(t =) 2 ⅓, 2.33 or better	B2	2		
	After B0, allow B1 for t = 7/3 or 2.3 or 3 or for 3t = 7 seen				
(b)	x = -2.5 or - 2½ **and** y = 17	B2	2		
	After B0, allow B1 for one value found with no errors				
	or allow M1 for correct method to eliminate one variable				
	(reaching such as 4y = k, ky = 68, 8x = k or kx = -20)				
(c)	(y + 2)(y – 2) soi	B1			
	(3y + 2)(y + 2) soi	B1			
	$\frac{3y+2}{y-2}$ obtained with no errors seen	B1	3		
(d)	Collect terms e.g. 2x + gx = 2f – 3h	M1			
	Factorise e.g. x(2 + g) = 2f – 3h	M1			
	$\frac{2f-3h}{2+g}$	A1	3		10

3 (a) (i)	(DCA =) 90° (angle in semicircle)		B1			
(ii)	(DAC =) 34° or 124 – their (i)√ (angle sum of triangle)		B1√			
(iii)	(CBA =) 124° (opposite angles of cyclic quad)		B1			
(iv)	(AEB [=ADB] =) 28° (angles in same segment)		B1	4		
	Lack of reason loses B1 on first occasion only					
(b)	EBD = 28° (alternate angles) Reason needed		B1			
	Deduces BDX or BDA = EBD					
	And hence triangle BDX is isosceles	indep	B1	2		
(c)	(ABE =) 62°		B1	1		
(d)	Convincingly shows X is the centre of the circle		B1	1		8
	e.g. Deduces triangle ABX is isosceles, so AX = BX = DX					
4 (a)	Correct, labelled, diagram representing 4, 7, 6, 5, 2, 0, 1		B2	2		
	After B0, allow B1 for diagram without labels					
	or labelled diagram with at least 4 values correct					
(b) (i)	(Median =) 2√		B1√			
(ii)	(Mode =) 1√		B1√			
(iii)	(Mean =) 1.92 or 48/25 oe		B1	3		
(c)	$\frac{k}{5k}$, 0.2 or 20%√		B1√	1		
(d)	$\frac{k}{25k}$, 0.04 or 4%		B2	2		
	After B0, allow B1 for $\frac{k}{50k}$, 0.02 or 2% or $\frac{24}{625}$, 0.0384 or 3.84%					
(e)	Uses 2/6 cars or total number of cars (48)		M1			
	$\frac{k}{4k}$, 0.25 or 25%		A1	2		10

5 (a) (i) Lists 5 different ways	B1				
e.g. on **4017** (1, 1, 1, 1), (2, 1, 1), (1, 2, 1), (1, 1, 2), (2, 2)					
[on **4024**, (10, 10, 10, 10), (20, 10, 10), (10, 20, 10), (10, 10, 20), (20, 20)]					
(ii) Lists 8 different ways					
or justifies it is 5 ways with 10 cents first + 3 ways with 20 cents first	B1	2			
(b) (i) a = 13	B1				
b = 21 or 8 + (their (i)) ∫	B2∫	3			
(ii) z = x + y oe	B1	1			6
6 (a) $\frac{24}{x}$	B1	1			
(b) $\frac{24}{x+0.5}$ oe	B1	1			
(c) $\frac{24}{x} - \frac{24}{x+0.5} = \pm 2$∫ soi oe, but must contain x in 2 terms	M1∫				
Correct method to remove fractions,					
e.g. $24(x + 0.5) - 24x = \pm 2x(x + 0.5)$∫ oe	M1∫				
(but must have contained x in 2 different denominators)					
Obtain $2x^2 + x - 12 = 0$ **AG**	A1	3			
(d) **Formula** For numerical $\frac{p \pm \sqrt{q}}{r}$, (not ± p) seen or used,					
Allow B1 for p = – 1 and r = 4	B1				
and B1 for q = 97 or $\sqrt{q}$ = 9.84... soi	B1				
Complete square Allow B1 for $(x + \frac{1}{4})^2$ or $(x + \frac{1}{4})$ oe soi					
and B1 for 97/16 or square roots such as 2.46.... or $\frac{9.84...}{4}$					
Final answers Allow B1 for each of 2.212 and – 2.712 nww	B2	4			
or allow B1 for **both** 2.21 and – 2.71 seen					
or allow B1 for **both** 2.2122... and – 2.7122... seen					
(e) Time = $\frac{24}{\text{their } 2.212}$ (= 10.8...)	M1				
10 minutes 50 to 52 seconds	A1	2			11

7 (a) (i) ½ π 0.6² (= 0.5655) seen		M1			
1.520 to 1.530 (m²)		A1	2		
(ii) 2×2.2(2.5 + 3.6) (= 26.84) oe soi		M1			
Their 26.84 − their (i) − 1.9×0.9 (= 23.604...)					
Leading to 23.6 (m²) AG		A1	2		
(b) (i) Increased area = 23.6 × 1.12 oe (=26.43.... or 26.44)		M1			
Number of tiles = $\frac{\text{their } 26.4}{0.25^2}$	indep	M1			
= 422 to 424		A1	3		
(ii) Number of boxes = $\frac{\text{their } 423}{20}$ (leading to 22)		M1			
Cost = $330 cao		A1	2		
(iii) Division by 120 soi		M1			
$\frac{20}{120} \times 15$ or $\frac{100}{120} \times 15$ soi		M1			
$2.5		A1	3		12

8 Nonsense in one part may be used to earn M marks in any other part of the question.
Throughout accept equivalent complete methods and decimal angles without degree sign, but degree sign essential if answer is given in degrees and minutes.

(a) (i)	292°	B1	1	
(ii)	$72^2 + 60^2 \pm 2 \times 72 \times 60 \cos 75$ oe soi	M1		
	Correct formula, simplification and a square root taken, seen or implied by subsequent values dep	M1		
	80.85 to 80.95 (m)	A2	4	
	After A0, allow A1 for 6547 or 11020 or 104.9 seen. (dep on first M1)			
(iii)	$\frac{\sin B}{60} = \frac{\sin 75}{\text{their (ii)}}$ soi	M1		
	$\sin ABC = \frac{60 \sin 75}{\text{their (ii)}}$ (= 0.7162...)	M1		
	45.70 to 45.80°	A1	3	
(iv)	157.70 to 158 or (their (i) + their (iii) − 180) ✓	B1✓	1	
(b)	(Height of kite =) 72 tan 24 (=32.05)	M1		
	$\tan \alpha = \frac{\text{their height}}{60}$ (= 0.534...)	M1		
	28.05 to 28.15°	A1	3	12

Some possible answers

9 (a)	$\sqrt{13^2 - 12^2}$ (= 5) oe seen [leading to 13 AG]		B1	1		
(b) (i)	$\pi \times 5 \times 13$ soi (= 65π = 204.2)		M1			
	$2\pi 5^2$ soi (= 50π = 157.1)	indep	M1			
	Their 65π + their 50π + $k\pi 5^2$ where k = integer (provided all terms are areas)	indep	M1			
	361.0 to 362.0 (cm²)		A1	4		
(ii)	$\frac{1}{4}\pi 5^2 \times 12$ soi (= 100π = 314.2)		M1			
	$\frac{1}{3}\pi 5^2$ soi (= 250 π /3 = 261.8)	indep	M1			
	575.5 to 576.5 (cm³)		A1	3		
(c)	Figs ($\pi 1.5^2 \times 2$) (= fig(9π /2) = fig 14.14)		M1			
	Correct conversion, (using 1 000 000)	indep	M1			
	Fig $\frac{\text{their } 14.14}{\text{their } 576}$	indep	M1			
	24 500 to 24 600		A1	4		12

10

(a) (i)	$EF = x - 2$			
(ii)	$BC = 100/x$			
(iii)	$FG = [100/x] - 5$ or their (ii) $- 5$ √			
	All three correct	B2	2	
	After B0, allow B1 for any two correct √ answers			
(b)	$y = (x - 2)(\frac{100}{x} - 5)$ convincingly leading to $y = 110 - 5x - \frac{200}{x}$ **AG**	B1	1	
(c)	40(.0)	B1	1	
(d)	All 7 points plotted √ (P1 for at least 5 of these √)	P2		
	Smooth curve, not grossly thick, through all plotted points, of which at least 5 are correct	C1	3	
(e)	Drawing tangent at $x = 8$ and estimating change in y / change in x , ignoring sign	M1		
	-1.60 to -2.00 [Ignore support from Calculus]	A1	2	
(f) (i)	[4.65 to 4.80] to [8.45 to 8.55]	B2	2	
	After B0, allow B1 for either value			
(ii)	6.20 to 6.40	X1	1	12

11					
	Accept such as $\underset{\sim}{b} + -\underset{\sim}{a}$ for $\underset{\sim}{b} - \underset{\sim}{a}$ throughout.				
	Only expressions linear in $\underset{\sim}{a}$ and/or $\underset{\sim}{b}$ can score.				
(a) (i)	$\overrightarrow{DO} = \underset{\sim}{a}$		B1		
(ii)	$\overrightarrow{AB} = \underset{\sim}{b} - \underset{\sim}{a}$		B1		
(iii)	$\overrightarrow{DB} = \underset{\sim}{a} + \underset{\sim}{b}$		B1	3	
(b)	Triangle OAB is equilateral, so length OA = OB = AB		B1	1	
(c) (i) (a)	$\overrightarrow{AX} = \underset{\sim}{b}$		B1		
(b)	$\overrightarrow{YX} = 3\underset{\sim}{b}$		B1	2	
(ii)	Points lie on a straight line oe		B1	1	
(d)	$\overrightarrow{XZ} = -3\underset{\sim}{a}$		B1	1	
(e)	$\overrightarrow{YZ} = 3\underset{\sim}{b} - 3\underset{\sim}{a}$ or $\overrightarrow{ZY} = 3\underset{\sim}{a} - 3\underset{\sim}{b}$		B1		
	Deduces $\lvert\overrightarrow{XZ}\rvert = \lvert\overrightarrow{YX}\rvert = \lvert\overrightarrow{YZ}\rvert$,				
	So sides are equal and hence triangle equilateral	dep	B1	2	
	Alternative : States XZ parallel OA and YX parallel OB so X 60°		(B1)		
	And length XZ = length YX so equilateral	dep	(B1)		
(f)	$\frac{1}{9}$		M1		
	After 0/2, allow B1 for 1 to 9, 1:9, 9, $\left(\frac{1}{3}\right)^2$ or $\left(\frac{a}{3a}\right)^2$ seen		B2	2	12