

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.

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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)	$ABO = 90^\circ$ with reason	B1	1	
(b) (i)	$\sin OAB = 6/13$ (= 0.4615...) or $OAB = 27.48^\circ$ or $\sin$ (leads to $OAB = 27.5^\circ$) AG	B1	1	
(ii)	$\frac{15}{\tan 27.5}$	M1		
	28.8 to 28.9 (cm)	A1	2	
(iii)	$2(\text{their } AC)\sin 27.5$ or $2 \times 15 \cos 27.5$	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)	$t = 2 \frac{1}{3}$, 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 $-2 \frac{1}{2}$ 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)	$(y+2)(y-2)$ sol	B1		
	$(3y+2)(y+2)$ sol	B1		
	$3y+2$ obtained with no errors seen	B1	3	
	$y-2$			
(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

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

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5 (a) (i) Lists 5 different ways 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))	B1		
(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) $a = 13$ $b = 21$ or 8 + their (i)	B1 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 (but must have contained x in 2 different denominators)	M1		
Obtain $2x^2 + x - 12 = 0$ AG	A1	3	
(d) Formula For numerical $\frac{p \pm \sqrt{q}}{r}$, (not $\pm p$) seen or used, Allow B1 for $p = -1$ and $r = 4$ and B1 for $q = 97$ or $\sqrt{q} = 9.84...$ soi	B1 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 9.84... 4			
Final answers Allow B1 for each of 2.212 and -2.712 nww or allow B1 for both 2.21 and -2.71 seen or allow B1 for both 2.2122... and -2.7122... seen	B2	4	
(e) Time = $\frac{24}{2.212}$ (-10.8...) their 2.212	M1		
10 minutes 50 to 52 seconds	A1	2	11

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7 (a) (i) $\frac{1}{2} \times 0.6^2 (= 0.5655)$ seen 1.520 to 1.530 (m ²)	M1			
	A1	2		
(ii) $2 \times 2.2(2.5 + 3.6) (= 26.84)$ or sol Their 26.84 - their (i) - $1.9 \times 0.9 (= 23.604...)$ Leading to 23.6 (m ²) AG	M1			
	A1	2		
(b) (i) Increased area = 23.6×1.12 or $(= 26.43... \text{ or } 26.44)$	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 21)	M1			
Cost = \$ 330 or	A1	2		
(iii) Division by 120 or	M1			
$\frac{20}{120} \times 15$ or $\frac{100}{120} \times 15$ or	M1			
\$ 2.5	A1	3		12

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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 (n)

A2 4

After A0, allow A1 for 6547 or 11020 or 104.9 seen, (dep on first M1)

(iii) $\frac{\sin B}{60} = \frac{\sin 75}{\text{their (i)}}$ 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

Some possible answers

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

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(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) $y = (x - 2)(100 - 5)$ 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 <u>change in y</u> , ignoring sign change in x	M1		
$- 1.60$ to $- 2.00$ [Ignore support from Calculus]	A1	2	
(f) (i) $[4.65$ to $4.80]$ to $[8.45$ to $8.55]$	R2	2	
After R0, allow R1 for either value			
(ii) 6.20 to 6.40	X1	1	12

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Accept such as $\vec{b} + -\vec{a}$ for $\vec{b} - \vec{a}$ throughout.Only expressions linear in $\vec{a}$ and/or $\vec{b}$ can score.

(a) (i) $\vec{DO} = \vec{a}$

B1

(ii) $\vec{AB} = \vec{b} - \vec{a}$

B1

(iii) $\vec{DB} = \vec{a} + \vec{b}$

B1

3

(b) Triangle OAB is equilateral, so length OA = OB = AB

B1

1

(c) (i) (a) $\vec{AX} = \vec{b}$

B1

(b) $\vec{YX} = 3\vec{b}$

B1

2

(ii) Points lie on a straight line or

B1

1

(d) $\vec{XZ} = -3\vec{a}$

B1

1

(e) $\vec{YZ} = 3\vec{b} - 3\vec{a}$ or $\vec{ZY} = 3\vec{a} - 3\vec{b}$

B1

Deduces $|\vec{XZ}| = |\vec{YX}| = |\vec{YZ}|$,

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