

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE O Level

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## MARK SCHEME for the November 2005 question paper

### 4024 MATHEMATICS

4024/02

Paper 2 maximum raw mark 100

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1	<p>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</p> <p>(a) <math>ABC = 90^\circ</math> with reason</p> <p>(b) (i) <math>\sin OAB = 6/13</math> (= 0.4615...) or <math>OAB = 27.48</math> or seen (leads to <math>OAB = 27.3</math>) AG</p> <p>(ii) <math>\frac{15}{\tan 27.5}</math> 28.8 to 28.9 (cm)</p> <p>(iii) <math>2(\text{their } AC)\sin 27.5</math> or <math>2 \times 15 \cos 27.5</math> or <math>EPC = 2[90 - 27.5]</math> (= 125) and <math>\sqrt{15^2 + 15^2 - 2 \times 15 \times 15 \cos(\text{their } 125)}</math> (M2) 26.55 to 26.65 (cm)</p>	B1	1	
		B1	1	
		M1		
		A1	2	
		M2		
		A1	3	7
2	<p>(a) <math>t = 2 \frac{1}{3}</math>, 2.33 or better After B0, allow B1 for <math>t = 7/3</math> or 2.3 or 3 or for <math>3t = 7</math> seen</p> <p>(b) <math>x = -2.5</math> or <math>-2 \frac{1}{2}</math> and <math>y = 17</math> After B0, allow B1 for one value found with no errors or allow M1 for correct method to eliminate one variable (reaching such as <math>4y = k</math>, <math>ky = 68</math>, <math>8x = k</math> or <math>kx = -20</math>)</p> <p>(c) <math>(y + 2)(y - 2)</math> sol <math>(3y + 2)(y + 2)</math> sol  <math>3y + 2</math> obtained with no errors seen <math>y - 2</math></p> <p>(d) Collect terms e.g. <math>2x + gx = 2f - 3h</math> Factorise e.g. <math>x(2 + g) = 2f - 3h</math> <math>\frac{2f - 3h}{2 + g}</math></p>	B2	2	
		B2	2	
		B1		
		B1		
		B1	3	
		M1		
		M1		
		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
<hr/>			
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 =) $2\sqrt{\quad}$	B1		
(ii) (Mode =) $1\sqrt{\quad}$	B1		
(iii) (Mean =) $1.92$ or $48/25$ or	B1	3	
(c) $\frac{\quad}{5k}$ , $0.2$ or $20\%$	B1	1	
(d) $\frac{\quad}{25k}$ , $0.04$ or $4\%$ After B0, allow B1 for $\frac{\quad}{50k}$ , $0.02$ or $2\%$ or $\frac{\quad}{625}$ , $0.0384$ or $3.84\%$	B2	2	
(e) Uses $2 \times 6$ cars or total number of cars (48) $\frac{\quad}{4k}$ , $0.25$ or $25\%$	M1		
$4k$	A1	2	(i)

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<p>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)]</p> <p>(ii) Lists 8 different ways          or justifies it is 5 ways with 10 cents first + 3 ways with 20 cents first</p> <p>(b) (i) <math>a = 13</math>  <math>b = 21</math> or 8 + their (i) ✓</p> <p>(ii) <math>z = x + y</math> oe</p>	<p>B1          B1 2          B1          B2 ✓ 3          B1 1</p>			<p>6</p>
<p>6 (a) <math>\frac{24}{x}</math></p> <p>(b) <math>\frac{24}{x+0.5}</math> oe</p> <p>(c) <math>\frac{24}{x} - \frac{24}{x+0.5} = \pm 2</math> ✓ soi oe, but must contain <math>x</math> in 2 terms</p> <p>Correct method to remove fractions,          e.g. <math>24(x+0.5) - 24x = \pm 2x(x+0.5)</math> ✓ oe          (but must have contained <math>x</math> in 2 different denominators)</p> <p>Obtain <math>2x^2 + k - 12 = 0</math> AG</p> <p>(d) <b>Formula</b> For numerical <math>\frac{p \pm \sqrt{q}}{r}</math>, (not <math>\pm p</math>) seen or used,          Allow B1 for <math>p = -1</math> and <math>r = 4</math>          and B1 for <math>q = 97</math> or <math>\sqrt{q} = 9.84\dots</math> soi</p> <p><b>Complete square</b> Allow B1 for <math>(x + \frac{1}{4})^2</math> or <math>(x + \frac{1}{4})</math> oe soi          and B1 for <math>97/16</math> or square roots such as <math>2.46\dots</math> or <math>9.84\dots</math></p> <p style="text-align: center;">4</p> <p><b>Final answers</b> 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</p> <p>(e) Time = <math>\frac{24}{2.212}</math> (-10.8...)          their 2.212</p> <p>10 minutes 50 to 52 seconds</p>	<p>B1 1          B1 1          M1 ✓          M1 ✓          A1 3          B1          B1          B2 4          M1          A1 2</p>			<p>11</p>

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7 (a) (i) $\frac{1}{2} \times 0.6^2 (= 0.5655)$ seen 1.520 to 1.530 (m <sup>2</sup> )	M1 A1	2	
(ii) <del>2</del> $2.2(2.5+3.6)$ (= 26.84) oe soi Their 26.84 - their (i) - <del>1.9</del> $0.9$ (= 23.604...) Rounding to 23.6 (m <sup>2</sup> ) AG	M1 A1	2	
(b) (i) Increased area = <del>23.6</del> $\times 1.12$ oe (=26.43... or 26.44)  Number of tiles = $\frac{\text{their } 26.4}{0.25^2}$  = 422 to 424	M1 indep M1		
(ii) Number of boxes = $\frac{\text{their } 423}{20}$ (leading to 22)  Cost = \$ 330 cao	M1 A1	3 2	
(iii) Division by 120 soi  $\frac{20}{120} \times 15$ or $\frac{100}{120} \times 15$ (so)	M1 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°	BI	1
(ii)	$72^2 + 60^2 \pm 2 \times 72 \times 60 \cos 75$ oe soi Correct formula, simplification and a square root taken, seen or implied by subsequent values	M1	
	80.85 to 80.95 (m)	M1	
	After A0, allow A1 for 6547 or 11020 or 104.9 seen, (dep on first M1)	A2	4
(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) ↗	BI ↗	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		12

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9 (a) $\sqrt{5^2 + 12^2}$ or seen [leading to 13 AG ]		M1	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 <sup>2</sup> )		A1	4	
(ii) $\frac{1}{2} \pi \times 5^2 \times 12$ so $(= 100\pi = 314.2)$		M1		
$4\pi \times 5^2$ so $(= 250\pi / 5 = 261.8)$	indep	M1		
575.5 to 576.5 (cm <sup>3</sup> )		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) $[4.65$ or $4.80]$ 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)	$\vec{DC} = \vec{a}$	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