

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

**MARK SCHEME for the May/June 2009 question paper**  
**for the guidance of teachers**

**4024 MATHEMATICS**

**4024/02**

Paper 2, maximum raw mark 100

This mark scheme is published as an aid to teachers and candidates, 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, which would have considered the acceptability of alternative answers.

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|   |     |       |                                                                                                                                              |          |     |                                                                                                                                                |
|---|-----|-------|----------------------------------------------------------------------------------------------------------------------------------------------|----------|-----|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | (a) |       | $\frac{4a^2 + 9}{6a}$ final answer                                                                                                           | B1       | 1   |                                                                                                                                                |
|   | (b) |       | $5b(b - 2)$ final answer                                                                                                                     | B1       | 1   | Condone missing final bracket<br>After $0 + 0$ give sc1 for <u>both</u><br>correct forms seen.                                                 |
|   | (c) | (i)   | (6, 2)                                                                                                                                       | B1       | 1   | Condone missing brackets                                                                                                                       |
|   |     | (ii)  | $\sqrt{(\pm 4)^2 + (\pm 10)^2}$<br>10.7 to 10.8                                                                                              | M1<br>A1 | 2   | Accept $2\sqrt{29}$                                                                                                                            |
|   | (d) |       | For numerical $\frac{p \pm (or + or -)\sqrt{q}}{r}$<br>$p = -11$ and $r = 6$ (or $2 \times 3$ )<br>$q = 205$ or $\sqrt{q} = 14.3$ to $14.32$ | B1<br>B1 |     | Completing the square<br>B1 for $\frac{-11}{6}$ ; B1 for $\sqrt{\frac{205}{36}}$ oe<br>dep. on correct formula s.o.i or<br><u>used</u>         |
|   |     |       | 0.55<br>-4.22                                                                                                                                | B1<br>B1 | 4   | If final B0 + B0 then<br>sc1 for 0.5 to 0.6 AND -4.2 to<br>-4.22; or for any two answers<br>given to 2 d.p.                                    |
|   |     |       |                                                                                                                                              |          | [9] |                                                                                                                                                |
|   |     |       |                                                                                                                                              |          |     |                                                                                                                                                |
| 2 | (a) | (i)   | Figs 378/the product of at least 2 of 20,<br>24, 7 and 60                                                                                    | M1       |     |                                                                                                                                                |
|   |     |       | \$31.25                                                                                                                                      | A1       | 2   | Accept \$31.2 $\rightarrow$ \$31.3<br>\$0.000 031 2 $\rightarrow$ \$0.000 031 3<br>million;                                                    |
|   |     | (ii)  | $\frac{945 - 378}{378} \times 100$ or $\frac{945}{378} \times 100$<br>150% cao                                                               | M1<br>A1 | 2   | Accept $\frac{78.125 - 31.25}{31.25} \times 100$                                                                                               |
|   |     | (iii) | 2:5 or $m = 2$ , $n = 5$                                                                                                                     | B2       | 2   | sc1 for partial simplification<br>seen.<br>126:315, 54:135, 42:105, 18:45,<br>14:35, 6:15; or for $\frac{2}{5}$ , or 1:2.5,<br>or 5:2 or 2m:5m |
|   | (b) |       | $\frac{480}{0.6} \times \left(\frac{2}{100} = 16\right)$<br>16 cao                                                                           | M1<br>A1 | 2   | sc1 for 9.6(euros) or (\$800<br>seen.                                                                                                          |
|   |     |       |                                                                                                                                              |          | [8] |                                                                                                                                                |

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|   |     |          |                                                                                                                                             |                |           |                                                                                                                                                                      |
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| 3 | (a) | (i)      | $\tan x = \frac{11}{4}$<br>70 to 70.02                                                                                                      | M1<br>A1       | 2         | For any <u>complete</u> methods allow appropriate M and A marks.<br>sc1 for 19.9 to 20                                                                               |
|   |     | (ii) (a) | $\sin 28 = \frac{4}{PX}$ or $\frac{PX}{(\sin 90)} = \frac{4}{\sin 28}$<br>8.5 to 8.525                                                      | M1<br>A1       | 2         | GRADIAN ANSWERS<br>(i) 77.80<br>sc1 for 22.2 or 12.2<br>(ii) (a) 9.39 ...<br>(b) 8.50 (leading to 2.5)<br>or 7.77 ... from Sine Rule (leading to 3.23)<br>-----<br>- |
|   |     | (b)      | $d = \frac{4}{\tan 28}$ , or $PX \cos 28$ , or $\frac{4 \sin 62}{\sin 28}$<br>or $\sqrt{PX^2 - 4^2}$<br>7.5 to 7.6<br>11 – d (= 3.4 to 3.5) | M1<br>A1<br>M1 | 3         |                                                                                                                                                                      |
|   |     | (b)      | $r^3 = \frac{96}{\frac{4}{3}\pi}$ or 22.9 ...<br>2.84 to 2.841                                                                              | M1<br>A1       | 2<br>[9]  |                                                                                                                                                                      |
| 4 | (a) | (i) (a)  | 3 (lines of symmetry)                                                                                                                       | B1             | 1         | AG. Allow if 140° calculated, but not if quoted.<br><br>The second B mark implies the first.                                                                         |
|   |     | (b)      | order 3                                                                                                                                     | B1             | 1         |                                                                                                                                                                      |
|   |     | (ii) (a) | Use of $(9 - 2) \times 180$ etc.                                                                                                            | M1             | 1         |                                                                                                                                                                      |
|   |     | (b)      | $6x + 3y = 1260$ oe<br>$y = 420 - 2x$ oe isw                                                                                                | B1<br>B1       | 2         |                                                                                                                                                                      |
|   | (b) | (c)      | Sensible attempt at solving for x or y<br>$x = 136$                                                                                         | M1<br>A1       | 2         |                                                                                                                                                                      |
|   |     | (i)      | $\angle FEB = 114^\circ$                                                                                                                    | B1             | 1         |                                                                                                                                                                      |
|   |     | (ii)     | $\angle BEA = 42^\circ$                                                                                                                     | B1             | 1         |                                                                                                                                                                      |
|   |     | (iii)    | $\angle AGD = 63^\circ$                                                                                                                     | B1             | 1<br>[10] |                                                                                                                                                                      |
| 5 | (a) | (i) (a)  | $\frac{1}{50}$ , 0.02 cao                                                                                                                   | B1             | 1         | Accept negatives<br><br><br><br>$\sqrt{4 + \frac{1}{2}}$ (their 5)                                                                                                   |
|   |     | (b)      | $\frac{1}{2} \times (8 + 4) \times 200$ oe<br>1200 m                                                                                        | M1<br>A1       | 2         |                                                                                                                                                                      |
|   |     | (c)      | 5 m/s                                                                                                                                       | B1             | 1         |                                                                                                                                                                      |
|   |     | (ii)     | $150u = \frac{1}{2} \times 13 \times 150 (= 975)$ oe<br>$u = 6\frac{1}{2}$                                                                  | M1<br>A1       | 2         |                                                                                                                                                                      |

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|   |     |          |                                                                                                                                    |                |           |                                                                                                                                                                                                                                                                                                                                                           |
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|   | (b) | (i)      | 195 m                                                                                                                              | B1             | 1         |                                                                                                                                                                                                                                                                                                                                                           |
|   |     | (ii)     | 24.5 or (25.4 to 25.5) seen<br>$\frac{\text{Distance}}{\text{Time}}$<br>7.64 to 7.65                                               | B1<br>M1<br>A1 | 3         | N.B. $\frac{190}{25} = 7.6$ scores the M1 only                                                                                                                                                                                                                                                                                                            |
|   |     |          |                                                                                                                                    |                | [10]      |                                                                                                                                                                                                                                                                                                                                                           |
| 6 | (a) |          | $p = 11$<br>$q = 30$<br>$r = 60$<br>$s = 6$<br><br>all four                                                                        | B2             | 2         | sc1 for 2 or 3 correct                                                                                                                                                                                                                                                                                                                                    |
|   | (b) |          | $x = 2n + 1$ oe<br>$y = n(n + 1)$ oe<br>$z = 2n(n + 1)$ oe $\sqrt{2 \times y}$                                                     | B1<br>B1<br>B1 | 3         | In (b), accept any unsimplified form but $-1$ , once, if not given explicitly                                                                                                                                                                                                                                                                             |
|   | (c) |          | 102                                                                                                                                | B1             | 1<br>[6]  |                                                                                                                                                                                                                                                                                                                                                           |
| 7 | (a) | (i)      | $\frac{2}{5}$ oe fraction                                                                                                          | B1             | 1         | Not 40%; 0.4                                                                                                                                                                                                                                                                                                                                              |
|   |     | (ii) (a) | $h = 25$                                                                                                                           | B1             | 1         |                                                                                                                                                                                                                                                                                                                                                           |
|   |     | (b)      | $2(50 \times 15 + 60 \times 15) + 50 \times 60$<br>$6300 \text{ cm}^2$                                                             | M1<br>A1       | 2         | sc1 for 3300 or for $9300 \text{ cm}^2$                                                                                                                                                                                                                                                                                                                   |
|   | (b) | (i)      | $\frac{220}{360} \times 2\pi \times 9 \times 35$<br>1208 to 1210                                                                   | M1<br>A1       | 2         |                                                                                                                                                                                                                                                                                                                                                           |
|   |     | (ii)     | $\frac{220}{360} \times \pi \times 9^2 (= 155.50 \dots)$<br>$\frac{1}{2} \times 9^2 \times \sin 140 (= 26.03 \dots)$<br>181 to 182 | M1<br>M1<br>A2 | 4         | POSSIBLE GRAD ANSWERS<br>(ii) 188 to 188.3<br>from $\frac{1}{2} \times 9^2 \times \sin 140 (= 32.7 \dots)$ ;<br>177 to 178<br>from $81 \times \sin 70 \times \sin 20 (= 22.3 \dots)$<br>(iii) 4.9 from $\cos 70$ ; 6.2 from $\sin 20$<br>sc1 for 4.08 ... or for 2.7 ...<br>-----<br>-<br>If A0, then<br>sc1 for 155 to 156 seen or for 25.9 to 26.1 seen |
|   |     | (iii)    | $d = 9 - 9\cos 70$<br>$= 5.92$ to $5.93$                                                                                           | M1<br>A1       | 2<br>[12] | }<br>} sc1 for 3.07 to 3.08 seen                                                                                                                                                                                                                                                                                                                          |

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|   |     |       |                                                                                                                                                                                                   |                                          |             |                                                                              |
|---|-----|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------|------------------------------------------------------------------------------|
| 8 | (a) | (i)   | $PQ = (x + 2) \text{ m}$                                                                                                                                                                          |                                          |             | If <b>AB</b> used instead of $x$ , $-1$ once                                 |
|   |     | (ii)  | $BC = \frac{168}{x}$                                                                                                                                                                              |                                          |             |                                                                              |
|   |     | (iii) | $QR = \frac{168}{x} + 11 \sqrt{BC} + 11$ all 3<br>(condone $10 + 1$ for 11)                                                                                                                       | <b>B2</b>                                | 2           | sc1 for 1 or 2 correct                                                       |
|   |     | (b)   | Area = $(x + 2) \left( \frac{168}{x} + 11 \right) - 168$ or<br>$\sqrt{PQ} \times QR - 168$ as an expression in $x$<br>correct working to $22 + 11x + \frac{336}{x}$                               | <b>M1</b>                                |             | or $(x + 2) + 10(x + 2) + 2 \times \frac{168}{x}$ oe                         |
|   |     |       |                                                                                                                                                                                                   | <b>A1</b>                                | 2           | Answer given                                                                 |
|   |     |       |                                                                                                                                                                                                   |                                          |             |                                                                              |
|   |     | (c)   | $p = 158 \text{ to } 158 \frac{1}{3}$                                                                                                                                                             | <b>B1</b>                                | 1           |                                                                              |
|   |     | (d)   | Correct scales                                                                                                                                                                                    | <b>S1</b>                                |             | Condone reversed axes, if labelled                                           |
|   |     |       | 7 correct plots (ignore $x = 9$ ) within 1 mm                                                                                                                                                     | <b>P1</b>                                |             | Accept if curve goes through correct points                                  |
|   |     |       | Smooth curve                                                                                                                                                                                      | <b>C1</b>                                | 3           | Not grossly thick; no straight lines<br>Ignore curve for $x < 3$ and $x > 8$ |
|   | (f) | (i)   | $143 \leq \text{answer} < 144$                                                                                                                                                                    | <b>B1</b>                                | 1           |                                                                              |
|   |     | (ii)  | 7.4 to 7.6                                                                                                                                                                                        | <b>B1</b>                                | 1           |                                                                              |
|   |     |       |                                                                                                                                                                                                   |                                          | <b>[12]</b> |                                                                              |
|   |     | (e)   | Clear attempt to draw tangent at (4, 150)<br>gradient = $-6$ to $-12$                                                                                                                             | <b>T1</b><br><b>G1</b>                   | 2           | Accept "integer" fractions                                                   |
|   |     |       |                                                                                                                                                                                                   |                                          |             |                                                                              |
|   |     |       |                                                                                                                                                                                                   |                                          |             |                                                                              |
| 9 | (a) | (i)   | $\frac{AD}{\sin 38} = \frac{17}{\sin 114}$<br>$AD = 17 \times \frac{\sin 38}{\sin 114}$<br>11.4 to 11.5                                                                                           | <b>M1</b><br><b>M1 dep.</b><br><b>A1</b> | 3           | -----<br>GRADIAN ANSWERS<br>(i) 9.7 to 9.8<br>(ii) 140.9 to 141              |
|   |     | (ii)  | $17^2 = 9^2 + 10^2 \pm (2) \times 9 \times 10 \cos x$ }<br>or $\cos x = \pm [(9^2 + 10^2 - 17^2)/(2) \times 9 \times 10]$ }<br>$\cos C = \frac{10^2 + 9^2 - 17^2}{2 \times 9 \times 10} = (-0.6)$ | <b>M1</b><br><b>A1</b>                   |             |                                                                              |
|   |     |       | 126 to 127                                                                                                                                                                                        | <b>A1</b>                                | 3           |                                                                              |
|   |     |       |                                                                                                                                                                                                   |                                          |             |                                                                              |

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|    |     |                                                                                                                                                                                                                                                                                                       |                                      |                                   |                                                                                                                           |
|----|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------|
|    | (b) | (i) (a) $\overrightarrow{OQ} = \mathbf{p} + \mathbf{q}$<br>(b) $\overrightarrow{RS} = \mathbf{p} - \mathbf{q}$ ✓ (a) – 2q<br>(c) $\overrightarrow{OS} = 2\mathbf{p} + 2\mathbf{q}$ ✓ 2 × (a)<br>(d) $\overrightarrow{OT} = 4\mathbf{p}$<br><br>(ii) (O, P and T are) collinear oe<br>$OT = 4OP$ oe    | B1<br>B1<br>B1<br>B1<br><br>B1<br>B1 | 1<br>1<br>1<br>1<br><br>2<br>[12] | In (b) (i), –1, once, for unsimplified answers<br><br>Marks in (ii) are dep on a correct (i) (d)                          |
| 10 | (a) | Correct scales and axes<br>Correct bases (width + position)<br>Heights (2), 10, 8, 7, 4, 2                                                                                                                                                                                                            | S1<br>B1<br>H1                       | 3                                 | Condone reversed axes if clearly labelled                                                                                 |
|    | (b) | $7 < t \leq 9$                                                                                                                                                                                                                                                                                        | B1                                   | 1                                 |                                                                                                                           |
|    | (c) | $(4 \times 2) + (10 \times 3.5) + (8 \times 4.5) + (14 \times 6) + (8 \times 8) + (6 \times 10.5)$<br>(= 290)<br>÷ 50<br>5.8                                                                                                                                                                          | M1<br><br>M1<br>A1                   | 3                                 | 8, 35, 36, 84, 64, 63<br>Condone up to 3 slips<br><br>Indep of first M                                                    |
|    | (d) | (i) 0<br><br>(ii) $\frac{14}{25}$ oe 0.56                                                                                                                                                                                                                                                             | B1<br><br>B1                         | 1<br><br>1                        | Condone $\frac{0}{50}$ , none, nil                                                                                        |
|    | (e) | (i) $\frac{54}{175} (= \frac{14}{25} \times \frac{27}{49})$ (0.308 to 0.309)<br><br>(ii) $\frac{88}{175} (= 2 \times \frac{14}{25} \times \frac{22}{49})$ (0.502 to 0.503)                                                                                                                            | B1<br><br>B2                         | 1<br><br>2<br>[12]                | In (e), –1, once, for any answer not in lowest terms, or in decimal form<br><br>sc1 for $\frac{44}{175}$ (0.251 to 0.252) |
| 11 | (a) | (i) $\begin{pmatrix} -3 & 9 \\ -3 & 2x \end{pmatrix}$<br><br>(ii) $\mathbf{AB} = \begin{pmatrix} 1 & 0 \\ -1 + \frac{x}{3} & 1 \end{pmatrix}$ or $\mathbf{BA} = \begin{pmatrix} 1 & 3-x \\ 0 & 1 \end{pmatrix}$<br>or $\mathbf{B}^{-1} = \begin{pmatrix} 0 & 3 \\ -1 & 3 \end{pmatrix}$ oe<br>$x = 3$ | B2<br><br>B1<br><br>B1 dep.          | 2<br><br>2                        | sc1 for 3 correct elements<br><br>e.g. $3 \begin{pmatrix} 0 & 1 \\ -\frac{1}{3} & 1 \end{pmatrix}$ , (0.33 or better)     |

|               |                                       |                 |              |
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|  |     |           |                                                                                                                                |           |        |                                                                   |                                                                 |
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|  | (b) | (i) (a)   | SF = −2                                                                                                                        | B1        | 1      | B1 for each coord. sc1 for $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$ |                                                                 |
|  |     | (b)       | Centre is (1, 2)                                                                                                               | B2        | 2      |                                                                   |                                                                 |
|  |     | (ii)      | Shear,<br>x-axis inv., SF = 2                                                                                                  | B1<br>B1  | 2      |                                                                   | Mention of a 2 <sup>nd</sup> transformation<br>loses both marks |
|  |     | (iii) (a) | $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} k \\ 2 \end{pmatrix} = \begin{pmatrix} k + 4 \\ 2 \end{pmatrix}$ |           |        |                                                                   |                                                                 |
|  |     | (b)       | k = 4<br>ET(L) = E((8, 2)) = (−13, 2)                                                                                          | MA1<br>B2 | 1<br>2 |                                                                   |                                                                 |
|  |     |           |                                                                                                                                |           | [12]   |                                                                   |                                                                 |