

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

**MARK SCHEME for the May/June 2012 question paper  
for the guidance of teachers**

**0580 MATHEMATICS**

**0580/43**

Paper 4 (Extended), maximum raw mark 130

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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### Abbreviations

|     |                            |
|-----|----------------------------|
| cao | correct answer only        |
| cso | correct solution only      |
| dep | dependent                  |
| ft  | follow through after error |
| isw | ignore subsequent working  |
| oe  | or equivalent              |
| SC  | Special Case               |
| www | without wrong working      |
| art | anything rounding to       |
| soi | seen or implied            |

|                  |  |                        |   |
|------------------|--|------------------------|---|
| <b>1 (a) (i)</b> | [0]5 38 oe   | <b>1</b>               | Allow 5h 38 but not 5h 38mins   |
|                  | <b>(ii)</b> 92.7 [92.72 to 92.73] oe                     | <b>2</b>               | Allow $92\frac{8}{11}$ or $\frac{1020}{11}$<br><b>M1</b> for $850 \div$ their 9 h 10 min in hours oe<br>Allow $850 \div 9.1$ for <b>M1</b>  |
|                  | <b>(b) (i)</b> 204 or 203. 9[0] to 203.91                | <b>3</b>               | <b>M1</b> for $160 \times 255 + 330 \times 190 + 150 \times 180$<br>[130 500]<br><b>M1</b> dep for $\div 640$   |
|                  | <b>(ii)</b> $640 \div (4 + 3 + 1)$<br>$\times 3 [= 240]$ | <b>M1</b><br><b>M1</b> | [Can be in either order or shown together]<br>Accept $240 \div 3 \times (4 + 3 + 1) = 640$ for <b>M2</b>  |
|                  | <b>(iii)</b> 150 www 3                                   | <b>3</b>               | <b>M2</b> for $240 \div 1.6$ oe<br>or <b>M1</b> for recognition of $240 = 100 + 60 \%$  |
|                  | <b>(c)</b> 11 cao www 3                                  | <b>3</b>               | <b>M1</b> for figs 340 or figs $550 \div$ speed [e.g. figs 188, figs 306] – can be spoiled by further work<br>and <b>M1</b> for correct conversion of units to give answer in seconds e.g. speed = 50 m/s<br><b>M's</b> independent |

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|  |  |   |  |
|--|--|---|--|
| <p><b>2 (a)</b></p> <p><math>[\sin =] \frac{10 \sin 95}{12}</math><br/>56.1 (56.11 to 56.12) www 3</p> <p><b>(b)</b></p> <p><math>12^2 + 17^2 - 2 \times 12 \times 17 \cos 30</math> oe<br/>8.93 [8.925....] www 4</p> <p><b>(c) (i)</b></p> <p>126 or 126.1 (126.11 to 126.12)</p> <p><b>(ii)</b></p> <p>306 or 306.1 (306.11 to 306.12)</p> <p><b>(d)</b></p> <p><math>[\sin =] \frac{17 \sin 30}{\text{their}(b)}</math> oe or<br/><math>[\cos =] \frac{12^2 + (\text{their}(b))^2 - 17^2}{2 \times 12 \times \text{their}(b)}</math> oe<br/>180 – 95 – their (a)</p> <p>137 [136.5 to 136.9] www 4</p> |  | <p><b>M2</b></p> <p><b>A1</b></p> <p><b>M2</b></p> <p><b>A2</b></p> <p><b>1ft</b></p> <p><b>1ft</b></p> <p><b>M2</b></p> <p><b>M1</b></p> <p><b>M1</b></p> <p><b>A1</b></p> | <p><b>M1</b> for correct implicit equation</p> <p><b>M1</b> for correct implicit equation<br/><b>A1</b> for 79.66 to 79.67 or 79.7</p> <p>ft their (a) + 70 [provided less than 360]</p> <p>ft 180 + their (c)(i) [provided less than 360]</p> <p><b>M1</b> for correct implicit equation<br/>[107.7 to 107.9 or 108 or 72 or 72.1 to 72.3]</p> <p>e.g. 28.88 to 28.9 seen – may be on diagram<br/><u>Alt methods possible</u><br/>e.g. <math>[\sin ABC =] \frac{12 \sin 30}{\text{their}(b)}</math> [42.2...] gets <b>M1</b><br/>then 360 – 95 – 30 – their (a) – their 42.2 gets <b>M2</b> dep on previous <b>M1</b></p> <p>isw reflex angle 223 or 223.1 to 223.5 after correct answer seen</p> |
| <p><b>3 (a)</b></p> <p>Triangle with vertices (6, 4), (9, 4), (9, 6)</p> <p><b>(b)</b></p> <p>Triangle with vertices (11, 1), (8, 1), (8, 3)</p> <p><b>(c) (i)</b></p> <p>Rotation<br/>90° [anticlockwise] oe<br/>[centre] (0, 0) oe</p> <p><b>(ii)</b></p> <p><math>\begin{pmatrix} 0 &amp; -1 \\ 1 &amp; 0 \end{pmatrix}</math></p> <p><b>(d) (i)</b></p> <p>Triangle with vertices (1, 3), (4, 3), (4, 9)</p> <p><b>(ii)</b></p> <p><math>\begin{pmatrix} 1 &amp; 0 \\ 0 &amp; 3 \end{pmatrix}</math></p>   |  | <p><b>2</b></p> <p><b>2</b></p> <p><b>1</b></p> <p><b>1</b></p> <p><b>1</b></p> <p><b>2</b></p> <p><b>2</b></p> <p><b>2</b></p> <p><b>2</b></p>                             | <p>Ignore labels and condone good freehand in parts (a), (b) and (d)(i)</p> <p><b>SC1</b> for translation <math>\begin{pmatrix} 5 \\ k \end{pmatrix}</math> or <math>\begin{pmatrix} k \\ 3 \end{pmatrix}</math></p> <p><b>SC1</b> for reflection in <math>y = 6</math></p> <p>If other transformations in addition, then 0, 0, 0<br/>e.g. O, origin</p> <p><b>B1</b> each column</p> <p><b>SC1</b> for (1, 3) and (4, 3), or (4, 9)</p> <p><b>B1</b> right-hand column or <math>\begin{pmatrix} 3 &amp; 0 \\ 0 &amp; 1 \end{pmatrix}</math></p>   |

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|   |         |  |     |   |
|---|---------|--|-----|---|
| 4 | (a) (i) | Median = 2    www 2                      | 2   | M1 for identifying mid-value [e.g. List with indication or 10 <sup>th</sup> and 11 <sup>th</sup> seen in working] or 10.5 soi   |
|   |         | Mode = 3                                 | 1   |   |
|   | (ii)    | 54    www 2                              | 2   | M1 for $3 \div 20 \times 360$ oe  |
|   | (b)     | 184    www 4                             | 4   | M1 for 175, 185, 195    soi<br>M1 for $5 \times a + 12 \times b + 3 \times c$ where $a, b, c$ are in correct interval, including boundaries [3680]<br>M1 (dep on 2 <sup>nd</sup> M) $\div 20$               |
| 5 | (a) (i) | 980 (979.6 to 980.3....)    www 4        | 4   | M3 for $(\pi \times 8^2 \times 6) - \left(2 \times \frac{4}{3} \times \pi \times 3^3\right)$<br>Or M1 for $\pi \times 8^2 \times 6$<br>and M1 for $\left[2 \times \frac{4}{3}\right] \times \pi \times 3^3$ |
|   | (ii)    | 0.98[0] (0.9796 to 0.9803...)            | 1ft | ft their (i) $\div 1000$ but not in terms of $\pi$  |
|   | (b)     | 1.2[0] (1.195 to 1.196)                  | 2ft | ft their (a)(i) $\times 1.22 \div 1000$<br>or their (a)(ii) $\times 1.22$<br>SC1ft for figs 12[0] or 1195 to 1196<br>Apply ft to SC   |
|   | (c)     | 4.88 or 4.87 (4.871 to 4.878..)<br>www 2 | 2ft | ft their (a)(i) $\div \pi 8^2$ provided their (a)(i) is not $384 \pi$ or 1206...<br>M1 for their (a)(i) $\div \pi 8^2$  |

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|   |         |                          |   |  |
|---|---------|--------------------------|---|--|
| 6 | (a) (i) | 180                      | 1 |  |
|   | (ii)    | 20                       | 1 |  |
|   | (b)     | 220                      | 1 |  |
|   | (c) (i) | $\frac{170}{240}$ oe isw | 1 | Allow 0.708, 0.7083... or % equivalents  |
|   | (ii)    | $\frac{150}{240}$ oe isw | 1 | Allow 0.625 or % equivalents   |
|   | (d)     |                          |   | <b>Penalise once for first correct none 4 dp dec answer to at least 3sf or correct fraction answer in parts (d) and (e)</b>  |
|   | (i)     | 0.5617                   | 2 | Accept 56.1715%, do not accept 0.562 ww<br><b>M1</b> for $\frac{180}{240} \times \frac{179}{239}$ [0.56171 to 0.56172], $\frac{537}{956}$ oe   |
|   | (ii)    | 0.3766                   | 3 | Accept 37.6569%<br><b>M2</b> for $2 \times \frac{180}{240} \times \frac{60}{239}$ oe [0.37656 to 0.37657]<br>$\frac{90}{239}$ oe<br>Or <b>M1</b> for one correct product seen, implied by 0.18828... or 0.1883 |
|   | (e)     | 0.6937                   | 3 | Accept 69.3669%, do not accept 0.694 ww<br><b>M2</b> for $\frac{150}{180} \times \frac{149}{179}$ [0.69366 to 0.69367]<br>$\frac{745}{1074}$ oe<br>or <b>M1</b> for $\frac{150}{180}$ oe soi                   |

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|----------------|--|-------------------------------------|--|
| <b>7 (a)</b>   | 1, ....., 11.3[1..], 16  | <b>3</b>                            | <b>B1</b> each   |
| <b>(b)</b>     | 9 points plotted<br><br>Smooth curve through at least 8 points and exponential shape | <b>P3ft</b><br><br><b>C1ft</b>      | <b>P2ft</b> for 7 or 8, <b>P1ft</b> for 5 or 6.<br><br>ft only if correct shape and covers the domain $0 < x < 4$      |
| <b>(c)</b>     | $2.3 < x < 2.35$   | <b>1</b>                            |  |
| <b>(d)</b>     | $0.4 < x < 0.5$ ,<br>$3.25 < x < 3.35$   | <b>M1</b><br><b>A1</b><br><b>A1</b> | $y = 3x$ ruled to cut curve at all possible points.  |
| <b>(e)</b>     | Reasonable tangent with gradient 3<br><br>(their $x$ , their $y$ )                   | <b>M2</b><br><br><b>A1</b>          | Or <b>M1</b> for any tangent<br><br>Dep on <b>M2</b> . Their point of contact  |
| <b>8 (a)</b>   | $u = 24$<br>$v = 92$<br>$w = 184$  | <b>2</b><br><b>1</b><br><b>1ft</b>  | <b>SC1</b> for angle $DBA = 88$ or $u = \text{angle } CDY$<br><br>ft $2 \times$ their $v$<br>Allow all seen in diagram |
| <b>(b)</b>     | 10.8   | <b>2</b>                            | <b>M1</b> for area factor of $3^2$ soi e.g. dividing by 9  |
| <b>(c) (i)</b> | 18   | <b>2</b>                            | <b>M1</b> for $4x + x = 90$ or better  |
| <b>(ii)</b>    | 72   | <b>2ft</b>                          | ft $90 - \text{their } x$ or $4 \times \text{their } x$  |
| <b>(iii)</b>   | 54   | <b>1</b>                            | <b>M1</b> for angle $K$ or $I = 90 - \text{their } x$ or $4 \times \text{their } x$<br>Allow all seen in diagram       |

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| 9  | (a) (i) | $-\frac{1}{3}$ oe   | 2                      | <b>B1</b> for $f(2) = -3$ soi   |
|    | (ii)    | -7  | 1                      |   |
|    | (b)     | $\frac{x-2}{x}$ final answer www  | 2                      | <b>M1</b> for $1 - \frac{2}{x}$ seen  |
|    | (c)     | $y-1 = x^3$ or $x = y^3 + 1$<br>$x = \sqrt[3]{y-1}$ or $x-1 = y^3$<br><br>$\sqrt[3]{x-1}$ oe final answer www2                                | <b>M1</b><br><b>A1</b> | i.e. two correct steps<br>For <b>M1</b> , accept a correct reverse flowchart<br>After 0 scored allow <b>SC1</b> for $\sqrt[3]{x-1}$ seen then spoil   |
|    | (d)     | $A, F, D$   | 3                      | <b>B1</b> each  |
|    | (e)     | 29  | 2                      | <b>M1</b> for $x = k(2)$ or $\sqrt[5]{x+3} = 2$ (Variable can be $y$ in second method)  |
| 10 | (a)     | 1.3[0]  | 3                      | <b>M2</b> for $(31.7[0] - 7) \div (12 + 7)$ or better<br>Or <b>M1</b> for $12x + 7(x + 1) = 31.7[0]$ or better<br>or $31.7[0] - 7$ or better)   |
|    | (b) (i) | $\frac{36}{y} - \frac{36}{y+1} = 25$ oe<br>$36(y+1) - 36y = 25y(y+1)$ oe<br>$36y + 36 - 36y = 25y^2 + 25y$ oe }<br><br>$25y^2 + 25y - 36 = 0$ | <b>M2</b><br><b>E1</b> | <b>SC1</b> for $\frac{36}{y}$ oe or $\frac{36}{y+1}$ oe seen<br>Accept both all over $y(y+1)$<br>Must see at least one of these lines before E mark<br><br>Final line reached without any errors or omissions |
|    | (ii)    | $(5y+9)(5y-4)$  | 2                      | Accept $(25y-20)(y+1.8)$ oe<br><b>SC1</b> for $(5y+m)(5y+n)$ where $mn = -36$ or $m+n = 5$  |
|    | (iii)   | -1.8 oe, 0.8 oe   | 1ft                    | ft only <b>SC1</b> from (b)(ii)   |
|    | (iv)    | 2.6[0]  | 1ft                    | ft $2 \times$ positive root from (b)(iii) +1<br>Dep on pos and neg root in (b)(iii)   |

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|----------------|--|----------------------------------|--|
| <b>11 (a)</b>  | 33, 41<br>16 $\pi$ , 25 $\pi$<br>20 $\pi$ , 30 $\pi$ | <b>1</b><br><b>1</b><br><b>2</b> | <b>B1</b> each   |
| <b>(b) (i)</b> | 8n + 1 oe final answer                               | <b>2</b>                         | e.g. 9 + 8(n - 1), condone n = 8n + 1<br><b>SC1</b> for 8n + k                                       |
| <b>(ii)</b>    | 137 www2   | <b>2</b>                         | <b>M1</b> for their (b)(i) = 1097  |
| <b>(c) (i)</b> | n <sup>2</sup> $\pi$ oe final answer                 | <b>1</b>                         |  |
| <b>(ii)</b>    | 9n <sup>2</sup> $\pi$ oe final answer                | <b>1</b>                         | Allow (3n) <sup>2</sup> $\pi$  |
| <b>(d)</b>     | n(n + 1) $\pi$ oe final answer                       | <b>2</b>                         | <b>SC1</b> for a quadratic expression<br>e.g. n(n + 1), n <sup>2</sup> + 5, n <sup>2</sup> + n $\pi$ |