

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

**MARK SCHEME for the October/November 2009 question paper
for the guidance of teachers**

0580 MATHEMATICS

0580/04

Paper 4 (Extended), maximum raw mark 130

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Abbreviations

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

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|------------------|---|---|--|
| 1 (a) (i) | 8.4(0) | B2 | B1 for 1.2 or 3.6 seen or SC1 for figs 84 in answer |
| (ii) | $\frac{\text{their(i)}}{20} \times 100$ oe 42 ft www2 | M1 A1ft | ft their 8.4×5 After 0 scored SC1 ft for 58% or $\frac{20 - \text{their(i)}}{20} \times 100$ correctly given |
| (b) | 6 | B2 | M1 for 9 or $8 \div (1 + 8 + 3)$ soi |
| (c) | $\frac{2.4}{2} \times 3$ oe (= 3.6 seen) or their (a) (i) $\div 7 \times 3$ $\frac{3}{12} \times 9$ oe (= 2.25 seen) 1.6(0) cao www3 | M1 M1 A1 | |
| (d) | $\frac{2.40}{1.25}$ oe 1.92 www2 | M1 A1 | Implied by figs 192 [11] |

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| 2 (a) (i) | Reflection (M), $x = 1$ | B1,B1 | If extra transformations given in part (a) then zero scored |
| (ii) | Rotation (R) 180 (centre) (1, 0) | B1 B1 B1 | Must be "rotation". Allow half turn for 180. Allow other clear forms of (1, 0) |
| (iii) | Enlargement (E) (centre) (6, 4) (scale factor) 3 | B1 B1 B1 | Must be "enlargement" Allow other clear forms of (6, 4) e.g. vector Accept 3 : 1 or 1 : 3 |
| (iv) | Shear (H) y -axis invariant oe (factor) -1 | B1 B1 B1 | Must be "shear" Allow other explanation for invariant but not "parallel to" isw after y -axis invariant seen |

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| (b) (i) | $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ | B2 | B1 for correct right-hand column in 2 by 2 matrix |
| (ii) | $\begin{pmatrix} 1 & 0 \\ -1ft & 1 \end{pmatrix}$ | B2ft | Ft only their factor in (a) (iv) provided not zero B1ft for left-hand column in 2 by 2 matrix provided shear factor is not zero or SC1 for $\begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$ if not ft |

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| 3 (a) (i) | 1 | B1 | Penalty of -1 in question if any answers given as decimals or percentages (to 3sf) alone, but isw cancelling/conversion after correct answer |
| (ii) | $\frac{3}{6}$ oe | B1 | |
| (b) (i) | $\frac{2}{30}$ oe www2 | B2 | M1 for $\frac{2}{6} \times \frac{1}{5}$ |
| (ii) | 6-12 and 12-6 and 7-11 and 11-7 soi $k \times \frac{1}{6} \times \frac{1}{5}$ for $k = \text{integer}$ $\frac{4}{30}$ oe www3 | M1 M1 A1 | Evidence of all pairs adding up to 18 but no extras e.g. $4/6 \times 1/6$ Without seeing the first M, $\frac{4}{6} \times \frac{1}{5}$ oe scores M2 , $\frac{2}{6} \times \frac{1}{5}$ oe scores M1 |
| (iii) | $\frac{4}{6} \times \frac{2}{5}$ $\frac{8}{30}$ oe www2 | M1 A1 | |
| (c) | $\frac{2}{6} + \frac{4}{6} \times \frac{2}{5}$ oe $\frac{18}{30}$ oe cao www2 | M1 A1 | $\frac{2}{6}$ + their (b) (iii) |
| (d) | 4 | B2 | M1 for $(1 + 1 + 6 + 7 + 11 + 12 + x) \div 7 = 6$ or better |

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| 4 (a) (i) | Accurate triangle with 2 arcs seen, 2 mm accuracy for lines AC and BC | B2 | SC1 if accurate but no arcs or one arc or if AC and BC are wrong way round with arcs |
| (ii) | Accurate bisector of angle ACB , 2° accuracy and both pairs of arcs shown (accept equidistant marks on edges for 1 st set of arcs) + must meet AB | B2ft | Ft their triangle SC1ft if accurate but no/one pair of arcs or short with arcs In both (ii) and (iii) isw |
| (iii) | Accurate perpendicular bisector of AD 2 mm accuracy at mid-point and 2° for right angle and shows both sets of arcs + must meet AC | B2ft | ft their D , which must be on AB SC1ft if accurate but no/one pair of arcs or short with arcs |
| (iv) | Correct region shaded cao | B1 | Dependent on correct triangle, accurate bisectors of angle ACB and side AD with correct D |
| (b) (i) | $(\cos C) = \frac{140^2 + 180^2 - 240^2}{2 \times 140 \times 180}$ oe - 0.111(1)...or better or 96.37 to 96.38 | M2 E1 | $(-5600/50400$ or $-14/126)$ Allow use of 7, 9 and 12 M1 for correct implicit statement Verification using 96.4 scores M2 max Accept $-\frac{1}{9}$ but not a non-reduced fraction |
| (ii) | $0.5 \times 140 \times 180 \sin$ (their 96.4) oe 12521 to 12523 or 12 500 or 12520 cao www2 | M1 A1 | $(s = 280)$, allow use of 7, 9 (31.3...) |
| (iii) | $(\sin B =) \frac{140 \sin(\text{their } 96.4)}{240}$ oe 35.4 or 35.42 to 35.44 cao www3 | M2 A1 | Allow use of 7, 12 M1 for correct implicit statement SC2 for correct answer by other method |

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| 5 (a) (i) | $(x + 3)(2x + 5) - x(x + 4) = 59$ oe $2x^2 + 6x + 5x + 15 - x^2 - 4x = 59$ oe $x^2 + 7x - 44 = 0$ | M1 A1 E1 | Implies M1 (allow $11x$ for $6x + 5x$) Correct conclusion – no errors or omissions |
| (ii) | $(x + 11)(x - 4)$ | B2 | SC1 any other $(x + a)(x + b)$ where $a \times b = -44$ or $a + b = 7$ |
| (iii) | -11, 4 www ft | B1ft | Strict ft dep on at least SC1 in (ii) allow recovery if new working seen |
| (iv) | $\tan = \frac{(\text{their } + \text{ve root}) + 3}{2(\text{their } + \text{ve root}) + 5}$ oe 28.3 (00...) ft www2 | M1 A1ft | Could be alt trig method oe M1 where trig function is explicit ft one of their positive roots $(27.4^\circ (27.40 - 27.41)$ from $x = 11)$ |

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| (b) (i) | $\frac{2x+5}{x+4} = \frac{x+3}{x} \quad \text{oe}$ $x^2 + 4x + 3x + 12 = 2x^2 + 5x$ $x^2 - 2x - 12 = 0$ | M1 A1 E1 | Must be seen. Allow ratio or correct products Correct expansion of brackets seen (allow $7x$ for $4x + 3x$) Correct conclusion – no errors or omissions M1 must be seen |
| (ii) | $\frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-12)}}{2(1)}$ or $(x-1)^2 - 12 = 1$ (B1) and $x-1 = \pm\sqrt{13}$ (B1) – 2.61, 4.61 final answers www4 | B1,B1 B1,B1 | In square root B1 for $(-2)^2 - 4(1)(-12)$ or better If in form $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$, B1 for $-(-2)$ and $2(1)$ or better If B0, SC1 for -2.6 and 4.6 or both answers correct to 2 or more dps rot $-2.6055\dots, 4.6055\dots$ |
| (iii) | 26.4 (26.42.... to 26.44....) ft | B1ft | ft $4 \times$ a positive root + 8 |

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| 6 (a) (i) | –16 | B1 | |
| (ii) | 18 to 19 | B1 | |
| (b) (i) | –4.3 to –4.2, 1.5 to 1.6 | B1,B1 | |
| (ii) | –4.5 to –4.4 , 1.3 to 1.4 | B1,B1 | |
| (iii) | –4.5 to –4.4 $< x < 1.3$ to 1.4 ft | B1ft | Ft their (ii) . Allow clear worded explanations and condone \leq signs |
| (c) | $-\frac{30}{7}$ oe isw conversion | B2 | Accept $-4\frac{2}{7}, 30/-7$ M1 for $30/7$ oe fract, isw conversion or for $-30/7$ oe soi |
| (d) | Ruled line passing within 2 mm of $(-5, 30)$ and $(2, 0)$ | B2 | B1 for ruled line parallel to $g(x)$. By eye (21° to 25° to horizontal if in doubt) allow broken line |
| (e) (i) | Ruled horizontal line through $(-3, -27)$ | B1 | No daylight, not chord (allow broken) |
| (ii) | $y = -27$ | B1 | |
| (f) | Ruled lines $x = -3, x = -2, y = 40$ Region enclosed by lines $x = -3, x = -2, y = 40$ and $y = g(x)$ | B1 B1 | Long enough to be boundary of region – allow broken or solid ruled lines Allow any clear indication |

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| 7 (a) (i) | $\frac{60}{360} \times \pi \times 2 \times 24$ oe 25.1 (25.12 to 25.14) www2 | M1 A1 | Accept 8π |
| (ii) | $\frac{60}{360} \times \pi \times 24^2$ oe 301 or 302 or 301.4 to 301.7 www2 | M1 A1 | Accept 96π |
| (b) (i) | $\pi d = \text{their (a) (i)}$ oe 4 (3.99 – 4.01) cao www2 | M1 A1 | |
| (ii) | $24^2 - (\text{their radius})^2$ 23.7 (23.66 to 23.67) cao www2 | M1 A1 | Alt trig method for h explicit Accept $\sqrt{560}, 2\sqrt{140}, 4\sqrt{35}$ |
| (iii) | $\frac{1}{3} \times \pi \times (\text{their } r)^2 \times (\text{their } h)$ 394 – 398 cao www2 | M1 A1 | Not for $h = 24$ |
| (c) (i) | 27W | B1 | |
| (ii) | 4W | B1 | If B0, B0 in (c), SC1 for 27 and 4 alone [12] |

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|----------------|--|--|---|
| 8 (a) | $5.5 < t \leq 6$ | B1 | Condone poor notation |
| (b) | 4.25, 4.75, 5.25, 5.75, 6.25, 6.75 $(2 \times 4.25 + 7 \times 4.75 + 8 \times 5.25 + 18 \times 5.75 + 10 \times 6.25 + 5 \times 6.75)$ (= 283.5) $\div 50$ or their $\sum f$ 5.67 www4 | M1 M1 M1 A1 | At least 5 correct mid-values seen $\sum fx$ where x is in the correct interval allow one further slip Depend on second method After M3 allow 5.7 isw conversion to mins/secs and reference to classes |
| (c) (i) | 17, 15 | B1 | |
| (ii) | Rectangular bars of heights 11.3 and 15 Correct widths of 1.5 and 1 – no gaps | B1ft B1ft B1 | ft their 17 divided by 1.5 ft their 15 11.3 plot between 11 and 12 include lines and 15 to be touching the 15 line |
| (iii) | 2.5 cao | B1 | [10] |

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|---------|--|-------------------------------------|--|
| 9 (a) | $3(m-3) + 4(m+4) = -7 \times 12$ $3m - 9 + 4m + 16 = -84$ -13 www4 | M2 A1 A1 | Allow <u>all over</u> 12 at this stage M1 for $3(m-3) + 4(m+4)$ seen Allow <u>all over</u> 12 at this stage May be seen in stages |
| (b) (i) | 0.5 oe | B1 | |
| (ii) | $\frac{3(x+3) - 2(x-1)}{(x-1)(x+3)}$ $\frac{x+11}{(x-1)(x+3)}$ final answer | M1 A1 | If brackets not seen allow $3x + 9 - 2x \pm 2$ as numerator with a correct denominator A1 isw incorrect expansion of denominator if correct brackets seen |
| (iii) | $\frac{x(x+11)}{(x-1)(x+3)} = 1$ ft or $x + 11 = \frac{1}{x} (x-1)(x+3)$ or better ft $x^2 + 11x = x^2 + 3x - x - 3$ $-\frac{1}{3}$ oe cso www3 | M1 M1 A1 | Must clear one denominator correctly Ft their (b)(ii) dep on fraction in (ii) with $(x-1)(x+3)$ oe as denominator Depend on previous M1 - 0.33(33...) |
| (c) | $p(q-1) = t$ oe $pq = t + p$ $\frac{t+p}{p}$ oe final answer www3 | M1 M1 M1 | Multiplying by $(q-1)$ Ft their first step e.g. pq only term on one side Ft their 2 nd step e.g. dividing by p Note: $q-1 = \frac{t}{p}$ is M2 and then $q = \frac{t}{p} + 1$ is M1 |

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|---------|--|------------------------|---|
| 10 (a) | $21 + 23 + 25 + 27 + 29 = 125$ $31 + 33 + 35 + 37 + 39 + 41 = 216$ | B1 B1 | |
| (b) | Cubes | B1 | |
| (c) (i) | n oe | B1 | |
| (ii) | n^3 oe | B1 | |
| (d) | $4^2 - 4 + 1 = 13$ www | E1 | Allow 16 for 4^2 , otherwise all must be seen |
| (e) | $7 \times 43 + 2 + 4 + 6 + 8 + 10 + 12$ | B1 | All must be seen |
| (f) | $n(n-1)$ final answer oe | B1 | |
| (g) | $n(n^2 - n + 1)$ + their (f) $n^3 - n^2 + n + n^2 - n = n^3$ | M1 E1 | All must be seen, no errors or omissions |

[10]