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Paper 4 (Extended)

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MARK SCHEME

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Abbreviations

| | |
|-----|----------------------------|
| cao | correct answer only |
| dep | dependent |
| FT | follow through after error |
| isw | ignore subsequent working |
| oe | or equivalent |
| SC | Special Case |
| nfw | not from wrong working |
| soi | seen or implied |

| Question | Answer | Marks | Partial marks |
|----------|-----------------------------|-------|---|
| 1(a) | 2915 | 2 | M1 for $10\,494 \div (13 + 5)$ oe |
| 1(b) | 1056 | 2 | M1 for $384 \div (10 - 6)$ oe |
| 1(c)(i) | 52.2 or 52.17... | 2 | M1 for $20 \div 23$ or 20×60 or $23 \div 60$ isw If zero scored, SC1 for answer 52.6 (from use of 0.38) |
| 1(c)(ii) | 63[.0] or 63.03 to 63.05... | 5 | M4 for $\frac{\text{their } 52.17... - 32}{32} \times 100$ oe or M3 for $\frac{\text{their } 52.17... - 32}{32}$ oe or $\frac{\text{their } 52.17...}{32} \times 100$ oe OR B2 for $\frac{5}{8}$ [hours] oe or 37.5 [minutes] or M1 for $20 \div 32$ or better and M2 for $\frac{\text{their } 37.5 - 23}{23} \times 100$ oe or M1 for $\frac{\text{their } 37.5 - 23}{23}$ or $\frac{\text{their } 37.5}{23} \times 100$ |
| 1(d) | 0.06 final answer nfw | 3 | M1 for $11.99 \div 0.9276$ or 12.99×0.9276 A1 for 12.93 or 12.925 to 12.926 |
| 1(e) | 9750 | 3 | M2 for $7605 \div \left(1 - \frac{22}{100}\right)$ oe or M1 for $(100 - 22)[\%]$ correctly associated with 7605 seen |

| Question | Answer | Marks | Partial marks |
|----------|---|-------|--|
| 2(a) | 122 | 4 | <p>B3 for 238 or 61 or 58 correctly identified in working or on diagram or B2 for 952 seen or 74 or 119 or 29 correctly identified in working or on diagram OR Method 1 using sum of interior angles M1 for $(8 - 2) \times 180$ or 1080 isw M1 for <i>their</i> $1080 - 4 \times 32$ M1 for $360 - \textit{their} 952 \div 4$ OR Method 2 using isosceles triangles and square M1 for $(180 - 32) \div 2$ or for 90 M1 for <i>their</i> $74 \times 2 + 90$ or $90 - \textit{their} 74$ M1 for $360 - \textit{their} 74 \times 2 + 90$ or $90 + 2(90 - \textit{their} 74)$ OR Method 3 using four kites joined to centre M1 for $360 \div 4$ M1 for $(360 - (\textit{their} 90 + 32)) \div 2$ M1 for $2(180 - \textit{their} 119)$ OR Method 4 using square around outside M1 for $90 - 32$ M1 for $(90 - 32) \div 2$ M1 for $180 - 2(\textit{their} 29)$</p> |
| 2(b) | 105 | 3 | <p>M2 for $360 = 2 \times y + (2y - 60)$ oe or $2(180 - y) = 2y - 60$ oe or B1 identifying in working or on diagram a relevant angle in terms of y</p> |
| 3(a) | -2.75 or $-2\frac{3}{4}$ | 2 | M1 for $11x - 3x = -7 - 15$ or better |
| 3(b)(i) | $(x + 11)(x - 2)$ final answer | 2 | M1 for $(x + a)(x + b)$ where $ab = -22$ or $a + b = 9$ |
| 3(b)(ii) | -11 and 2 final answer | 1 | |
| 3(c) | $[x] = \frac{2a}{2-y}$ or $\frac{-2a}{y-2}$ nfw final answer | 4 | <p>M1 for clearing the x term in the denominator M1 for correctly removing the bracket (expand or divide by 2) M1 for factorising to obtain single x term M1 for <i>their</i> factor and division Incorrect answer scores 3 out of 4 maximum</p> |
| 3(d) | $\frac{x}{x+6}$ nfw final answer | 3 | <p>M1 for $x(x - 6)$ M1 for $(x + 6)(x - 6)$</p> |

| Question | Answer | Marks | Partial marks |
|----------|--|-----------|---|
| 4(a) | 10, 7 | 2 | B1 for each value |
| 4(b) | Correct curve | 4 | B3 FT for 10 or 11 correct points B2 FT for 8 or 9 correct points B1 FT for 6 or 7 correct points FT <i>their</i> table |
| 4(c) | -1.7 to -1.55 | 1 | FT <i>their</i> graph if one answer |
| 4(d) | Tangent ruled at $x = 3.5$ | B1 | No daylight between tangent and curve at point of contact |
| | 6.5 to 11 | B2 | dep on tangent drawn or close attempt at tangent at $x = 3.5$ M1 for rise/run also dep on tangent or close attempt at $x = 3.5$ |
| 4(e) | line $y = 2x + 10$ ruled <u>AND</u> -1.3 to -1.1 1 4.1 to 4.25 | 4 | B3 for correct line (could be short) and 1 correct value or B2 for correct line (could be short) or B1 for $[y =] 2x + 10$ seen If zero scored, SC1 for no/wrong line and 3 correct values |
| 5(a) | 54, 76, 96 | 3 | B1 for each |
| 5(b) | 187 or 186.8 to 186.9 nfw | 4 | M1 for 155, 175, 185, 200, 225 soi M1 for Σfm with <i>their</i> frequencies from (a) $155 \times \textit{their} 54 + 175 \times \textit{their} 76 + 185 \times \textit{their} 96 + 200 \times 92 + 225 \times 42$ M1 (dep on second M1) for <i>their</i> $\Sigma fm \div 360$ |
| 6(a) | 18 22 $4n + 2$ oe 17 26 $n^2 + 1$ oe | 6 | B2 for 18, 22, 17, 26 or B1 for two or three correct values AND B2 for $4n + 2$ oe or B1 for $4n + k$ oe or $pn + 2$ ($p \neq 0$) AND B2 for $n^2 + 1$ oe or B1 for $n^2 + k$ oe |
| 6(b) | 242 | 1 | FT <i>their</i> $4n + 2$ provided a linear expression |
| 6(c) | 15 | 1 | |
| 6(d) | 3 | 2 | M1 for $2 \times 1^2 + 2 \times 1 + q = 7$ oe |

| Question | Answer | Marks | Partial marks |
|----------|---|-----------|---|
| 7(a) | -7 | 1 | |
| 7(b) | $\frac{4}{64}$ or better | 2 | M1 for $g(4^3)$ soi or $\frac{4}{4^x}$ or better |
| 7(c) | $\frac{3-x}{2}$ oe final answer | 2 | M1 for $x = 3 - 2y$ or $2x = 3 - y$ or $\frac{y}{2} = \frac{3}{2} - x$ or $\frac{y-3}{-2}$ oe as final answer |
| 7(d) | 4^{3-2x} | M1 | |
| | Correctly interprets the indices | M1 | Dep on previous M1 e.g. $4^3 \times 4^{-2x}$ or $4^3 \times \frac{1}{4^{2x}}$ or $\frac{4^3}{4^{2x}}$ |
| | $\frac{64}{16^x}$ nfw | A1 | Correct completion with no errors |
| 7(e) | 1.5 | 2 | B1 for $4^x = 8$ or better |
| 8(a) | $\pi \times \frac{5}{2} \times l + \frac{4}{2} \times \pi \times \left(\frac{5}{2}\right)^2 = \frac{115\pi}{4}$ oe or $\frac{115\pi}{4} - \frac{4}{2} \times \pi \times \left(\frac{5}{2}\right)^2 = \pi \times \frac{5}{2} \times l$ oe | M2 | M1 for $\pi \times \frac{5}{2} \times l$ or $\frac{4}{2} \times \pi \times \left(\frac{5}{2}\right)^2$ |
| | $\frac{5\pi l}{2} = \frac{65\pi}{4}$ oe or $[l =] \left(\frac{115\pi}{4} - 2 \times \pi \times 2.5^2 \right) \div 2.5\pi$ oe | B1 | nfw oe both terms must be written in terms of π nfw or correct complete method for l with decimals |
| | $[l =] \frac{65\pi \times 2}{4 \times 5\pi}$ or $\frac{65\pi}{10\pi}$ oe = 6.5 | A1 | Correct calculation with no errors and B1 earned |
| 8(b) | 6 | 3 | M2 for $\sqrt{6.5^2 - 2.5^2}$ or M1 for $h^2 + 2.5^2 = 6.5^2$ If zero scored, SC2dep for answer 4.15[3]... |

| Question | Answer | Marks | Partial marks |
|----------|---------------------------|-------|---|
| 8(c) | 72[.0...] or 71.99... nfw | 4 | <p>M3 for $\frac{\pi}{3} \times \left(\frac{5}{2}\right)^2 \times \text{their } 6 + \frac{1}{2} \times \frac{4\pi}{3} \times \left(\frac{5}{2}\right)^3$ oe</p> <p>or M1 for $\frac{\pi}{3} \times \left(\frac{5}{2}\right)^2 \times \text{their } 6$ oe</p> <p>and M1 for $\frac{1}{2} \times \frac{4\pi}{3} \times \left(\frac{5}{2}\right)^3$ oe</p> <p>If zero scored, SC3dep for $\frac{\pi}{3} \times (5)^2 \times \text{their } 4.15 + \frac{1}{2} \times \frac{4\pi}{3} \times (5)^3$ oe or SC1dep for $\frac{\pi}{3} \times (5)^2 \times \text{their } 4.15$ oe SC1dep for $\frac{1}{2} \times \frac{4\pi}{3} \times (5)^3$ oe</p> |
| 8(d) | 53.7 or 53.65 to 53.67 | 3 | <p>M1 for figs (<i>their (c)</i>) $\times 19.3 \times 38.62$ or better</p> <p>M1 for $\div 1000$ soi</p> |
| 9(a)(i) | 52 | 2 | M1 for $(1 - 0.35) \times 80$ oe |
| 9(a)(ii) | 84 | 1 | |
| 9(b)(i) | $\frac{27}{729}$ oe | 2 | M1 for $\frac{3}{9} \times \frac{3}{9} \times \frac{3}{9}$ |
| 9(b)(ii) | $\frac{144}{729}$ oe | 3 | <p>M2 for $\frac{2}{9} \times \frac{3}{9} \times \frac{4}{9} \times 6$ oe</p> <p>or M1 for $\frac{2}{9} \times \frac{3}{9} \times \frac{4}{9}$ oe isw</p> |
| 9(c) | $\frac{42}{60}$ oe | 4 | <p>M3 for $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3} + \frac{3}{5} \times \frac{2}{4} \times \frac{2}{3} \times 3$ oe</p> <p>or M2 for $\frac{3}{5} \times \frac{2}{4} \times \frac{2}{3} \times 3$ oe</p> <p>or for $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3} + \left(\frac{3}{5} \times \frac{2}{4} \times \frac{2}{3}\right) [\times 2]$</p> <p>or M1 for $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3}$ or $\frac{3}{5} \times \frac{2}{4} \times \frac{2}{3}$ oe isw</p> <p>or for PPG, PGP, GPP and PPP selected soi</p> |

| Question | Answer | Marks | Partial marks |
|-----------|--|-------------|---|
| 10(a) | $12.5^2 = x^2 + 8.5^2 - 2 \times x \times 8.5 \cos 60$ oe isw | M2 | M1 for $\cos 60 = \frac{x^2 + 8.5^2 - 12.5^2}{2 \times x \times 8.5}$ |
| | $156.25 = x^2 + 72.25 - 8.5x$ | A1 | or better |
| | $2x^2 - 17x - 168 = 0$ | A1 | with no errors or omissions |
| 10(b) | $\frac{[- -]17 \pm \sqrt{([- -]17)^2 - 4(2)(-168)}}{2 \times 2}$ | 2 | B1 for $\sqrt{([- -]17)^2 - 4(2)(-168)}$ or better seen and if in form $\frac{p + or - \sqrt{q}}{r}$ B1 for $p = [- -] 17$ and $r = 2 \times 2$ |
| | 14.35, -5.85 final answers | 1, 1 | SC1 for 14.352 to 14.353 and -5.853 to -5.852 seen or 14.3 or 14.4 and -5.8 or -5.9 as final answers or -14.35 and 5.85 as final answers or 14.35 and -5.85 seen in working |
| 10(c) | 12.2 or 12.17... nfw | 3 | M2 for $\frac{\text{their } 14.35 \times \sin 46}{\sin 58}$ or M1 for $\frac{\sin 46}{CD} = \frac{\sin 58}{\text{their } 14.35}$ |
| 10(d) | 138 or 137.5 to 137.8 nfw | 3 | M1 for $0.5 \times \text{their } 14.35 \times 8.5 \sin 60$ M1 for $0.5 \times \text{their } 14.35 \times \text{their } 12.2 \times \sin 76$ |
| 11(a)(i) | $\begin{pmatrix} 1 & -18 \\ 6 & 13 \end{pmatrix}$ | 2 | M1 for two or three correct elements |
| 11(a)(ii) | $\frac{1}{11} \begin{pmatrix} 4 & 3 \\ -1 & 2 \end{pmatrix}$ or better isw | 2 | M1 for $\det = 11$ or $[k] \begin{pmatrix} 4 & 3 \\ -1 & 2 \end{pmatrix}$ isw |
| 11(b) | Reflection | 1 | |
| | y-axis oe | 1 | |
| 11(c) | $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ | 2 | B1 for one correct column or row |

| Question | Answer | Marks | Partial marks |
|-----------|---|-------|---|
| 11(d)(i) | $\frac{1}{7}(4\mathbf{a} + 3\mathbf{b})$ or $\frac{4}{7}\mathbf{a} + \frac{3}{7}\mathbf{b}$ | 3 | M2 for correct unsimplified answer seen or $\overline{AP} = \frac{3}{7}(\mathbf{b} - \mathbf{a})$ oe or $\overline{BP} = \frac{4}{7}(\mathbf{a} - \mathbf{b})$ oe or M1 for $\overline{AB} = \mathbf{b} - \mathbf{a}$ or $\overline{BA} = \mathbf{a} - \mathbf{b}$ or correct route for \overline{OP} |
| 11(d)(ii) | $[m =] \frac{7}{3}$ $[k =] \frac{4}{3}$ | 2 | B1 for each value or M1 for $\frac{m}{7}(4\mathbf{a} + 3\mathbf{b}) = \mathbf{b} + k\mathbf{a}$ oe |