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| <p>1 (a)</p> <p>12.7 m</p> <p>(b)</p> <p>(c)</p>         | <p><math>\sqrt{15^2 - 8^2}</math></p> <p><math>15^2 + 11^2 \pm 2 \times 15 \times 11 \cos 55^\circ</math> soi</p> <p>Correct formula, simplification and square root taken soi</p> <p>156(.7...) or 535(.2...) soi</p> <p>12.5 m</p> <p><math>\cos \hat{A}DB = \frac{8}{15}</math> oe</p> <p><math>\hat{A}DB = 57.8^\circ</math> soi</p> <p><math>67.2^\circ</math> or <math>(125^\circ - \text{their } \hat{A}DB)</math> ✓</p>  | <p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p> |
| <p>2 (a)</p> <p>(b)</p>                                  | <p><math>p = 17 \quad q = 36 \quad r = 125</math> (B1 each)</p> <p><math>s = 178</math> or their <math>(p + q + r)</math> v</p> <p><math>x = 3n + 2</math> oe <math>y = (n + 1)^2</math> oe <math>z = n^3</math> oe (B1 each)</p> <p><math>t = n^3 + n^2 + 5n + 3</math> oe or their <math>(x + y + z)</math> v</p>  | <p>B3</p> <p>B1</p> <p>B3</p> <p>B18</p>  |
| <p>3 (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p> | <p><math>20^\circ</math></p> <p><math>105^\circ</math></p> <p><math>55^\circ</math> or <math>180 - \text{their (a)} - \text{their (b)}</math> v</p> <p><math>55^\circ</math></p> <p>(allow B1 for any indication <math>\hat{E}CB = 75^\circ</math>)</p> <p><math>30^\circ</math> or <math>85 - \text{their (d)}</math> v or <math>50 - \text{their (a)}</math> v</p> <p>(allow B1 for indication <math>\hat{B}AC = \hat{B}EC</math> or <math>\hat{A}BE = \hat{A}CE</math>)</p> | <p>B1</p> <p>B1</p> <p>B1</p> <p>B2</p> <p>B2</p>   |

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| <p>4 (a)</p> <p>(b)(i)</p> <p>(ii)</p> <p>(iii)</p> <p>(iv)</p> | <p>Final answer <math>t = \frac{mv - mu}{F}</math> oe</p> <p>(allow M1 for reaching <math>m(v - u)</math> or <math>mv - mu = Ft</math> oe)</p> <p><math>43 = c + 50d</math> and <math>49 = c + 80d</math> oe</p> <p><math>c = 33</math> and <math>d = 0.2</math> or <math>\frac{1}{5}</math></p> <p>(allow B2 for one correct www<br/>or M1 for correct elimination of one variable)</p> <p><math>40 = \text{their } c + m \times \text{their } d</math> soi</p> <p>35 cao</p> <p>Statement such as “Length of unloaded string”</p>  | <p>B2</p> <p>B1</p> <p>B3</p> <p>M1</p> <p>A1</p> <p>B1</p>  |
| <p>5 (a)(i)</p> <p>(ii)</p> <p>(b)</p> <p>(c)</p>               | <p>Fig <math>(\pi \times 24^2 \times 125)</math> soi</p> <p>226 litres cao</p> <p>(allow A1 for 226 000 seen)</p> <p>Fig <math>\{2\pi \times 24 \times 125 + (2 \times) \pi \times 24^2\}</math> soi</p> <p>Division by <math>100^2</math> soi or works in metres</p> <p><math>2.07 \text{ m}^2</math> cao</p> <p>fig <math>\frac{48\,000}{150 \times 20}</math> soi</p> <p>16 cm</p> <p>(Drop =) fig <math>\frac{20\,000}{\pi \times 24^2}</math> or fig <math>\frac{20\,000}{20 \times 150}</math></p> <p>Divides their drop by 2.5 or <math>\frac{20\,000}{2.5}</math> soi</p> <p>4.42 cm/h cao</p> | <p>M1</p> <p>A2</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>indep</p> <p>M1</p> <p>A1</p> |

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| <p>6 (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p>     | <p>Triangle A correctly plotted</p> <p>Triangle B with vertices at (10, 1), (12, 1) and (10, -2)</p> <p>Triangle C with vertices at (-3, 1), (-3, -1) and (-6, 1)<br/>(allow B1 for 2 vertices correct or vertices at (9, 7), (12, 7) and (9, 9))</p> <p>Triangle D with vertices at (1, 4), (1, 2) and (-2, 4)<br/>(allow B1 for 2 vertices correct or vertices at (0, -3), (0, -5), (-3, -3))</p> <p>Shear<br/>Factor 2 or with matrix <math>\begin{pmatrix} 1 &amp; 2 \\ 0 &amp; 1 \end{pmatrix}</math></p> <p>[In (b), (c), (d) allow <math>\surd</math> from earlier mistakes]</p>  | <p>B1</p> <p>B1</p> <p>B2</p> <p>B2</p> <p>M1<br/>A1</p>  |
| <p>7 (a)</p> <p>(b)(i)</p> <p>(ii)</p> <p>(c)</p> <p>(d)</p> | <p><math>\frac{200(x+4) - 200x}{x(x+4)}</math> oe</p> <p>Final answer <math>\frac{800}{x(x+4)}</math> oe</p> <p><math>\frac{200}{x}</math></p> <p><math>\frac{200}{x+4}</math> or (their (i) - 5) seen</p> <p>their <math>\left(\frac{200}{x}\right)</math> - their <math>\frac{200}{x+4} = \pm 5</math> or <math>(x+4)</math> [their (i) - 5] = 200 oe</p> <p>Correct derivation of <math>x^2 + 4x - 160 = 0</math> <b>AG</b></p> <p><math>\frac{-4 \pm \sqrt{656}}{2}</math></p> <p>(allow B1 for -4 and 2 and B1 for <math>\sqrt{656}</math> or 25.6...)</p> <p>10.81 and -14.81 (B1 each)<br/>(allow B1 for both 10.8(...) and -14.8(...) seen)</p> <p><math>\frac{40}{\text{their } 10.81} + \frac{120}{4 + \text{their } 10.81}</math> (dep on (their 10.81) &gt; 0)</p> <p>11.8 litres cao (but accept 11 800 cm<sup>3</sup>)</p> | <p>M1</p> <p>A1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>B2</p> <p>B2</p> <p>M1</p> <p>A1</p> |

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| 8 (a)   | Vertical lines at $t = 60, 80, 90, 95, 100, 110$ and $130$<br>Rectangles completed, with heights in ratio $1 : 5 : 14 : 20 : 12 : 2$<br>(allow B1 for 4 or 5 correct heights)  | B1<br>B2 |
| (b)     | Interval $95 < t \leq 100$ indicated   | B1       |
| (c)     | $98 \frac{3}{16}$ oe or $98.2$ or better<br>(allow B2 for 98 or $\frac{7855}{80}$ seen<br>or allow M1 for $\frac{4t_1 + 10t_2 + \dots}{4 + 10 + \dots}$ where $60 \leq t_1 \leq 80$ etc<br>and dep M1 for $t_1 = 70, t_2 = 85, t_3 = 92.5, t_4 = 97.5, t_5 = 105, t_6 = 120$ ) | B3       |
| (d)     | $\frac{7}{40}$ oe  | B1       |
| (e) (i) | $\frac{7}{790}$ cao<br>(allow B1 for equivalents or for $\frac{8 \times 7}{80 \times 79}$ or for $\frac{7}{800}$ )   | B2       |
| (ii)    | $\frac{4}{395}$ oe<br>(allow B1 for $\frac{2 \times 4 \times 8}{80 \times 79}$ or for answer $\frac{2}{395}$ oe)   | B2       |

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|----|---------|---|-----------------------|
| 9  | (a)     | $p = 29(.0)$  | B1                    |
|    | (b)     | All 8 points plotted v<br>(allow P1 for at least 6 correct plots v)<br><br>Smooth curve through all plots of which at least 6 v               | P2<br><br>C1          |
|    | (c) (i) | 1.28 to 1.33  | B1                    |
|    | (ii)    | 13.7 to 13.99   | B1                    |
|    | (d)     | Tangent drawn at $x = 1.5$ and using $\frac{\text{change in } y}{\text{change in } x}$<br><br>$-9(.0)$ to $-12(.0)$                           | M1<br><br>A1          |
|    | (e)     | Ruled straight line through (0, 25) and (4, 13)<br>(allow B1 for short ruled line or good freehand line)                                      | B2                    |
|    | (f) (i) | 1.2(0) to 1.25 and 3.2(0) to 3.28   | B1                    |
|    | (ii)    | $7x^3 - 25x^2 + 25 = 0$ oe<br>(accept $a = 7, b = -25, c = 0, d = 25$ )   | B1                    |
| 10 | (a)     | Reasonable explanation, such as $\frac{1}{5}$ of whole angle at O   | B1                    |
|    | (b)     | $\frac{1}{2} 1.5^2 \sin 72^\circ$ or other complete method for area of triangle<br>$5 \times$ their (area of triangle)<br>$5.35 \text{ cm}^2$ | M1<br>dep<br>M1<br>A1 |
|    | (c) (i) | Reference to angle at centre of circle property, (or other method)  | B1<br>M1              |
|    | (ii)    | $2 \times 1.5 \cos 18^\circ$ or other complete method<br>2.85 cm convincingly obtained <b>AG</b>  | A1<br><br>M1          |
|    | (iii)   | $\frac{1}{2} (\text{their } 2.85)^2 \sin 36^\circ$ or other complete method<br>$2.39 \text{ cm}^2$  | A1<br><br>M1          |
|    | (iv)    | $\frac{36}{360} \pi (\text{their } 2.85)^2$<br><br>$0.162$ to $0.166 \text{ cm}^2$  | A1<br><br>B1          |
|    | (v)     | $6.15$ to $6.19 \text{ cm}^2$ or [their (b) + $5 \times$ their (c)(iv)] v   | B1                    |

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| 11 | (a)(i) | $\mathbf{b} - \mathbf{a}$   | B1       |
|    | (ii)   | $\frac{2}{3}(\mathbf{b} - \mathbf{a})$ oe or $\frac{2}{3}$ (their (i)) v            | B1       |
|    | (iii)  | $\frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$ oe or $\mathbf{a} +$ their(ii) v    | B1       |
|    | (iv)   | $\frac{5}{3}\mathbf{b}$ oe cao  | B1       |
|    | (b)    | $\vec{CD} = \vec{CO} + \vec{OD}$ or $\vec{CD} = \vec{CB} + \vec{BD}$ or better seen | M1       |
|    |        | $\mathbf{b} - \frac{1}{3}\mathbf{a}$ convincingly obtained AG                       | A1       |
|    | (c)    | $\frac{5}{3}\mathbf{b} - \frac{5}{9}\mathbf{a}$                                     | B1       |
|    | (d)(i) | Shows $\vec{ED} = \frac{5}{3}\vec{CD}$ (accept $k = \frac{5}{3}$ )                  | B1       |
|    | (ii)   | Length of ED = $\frac{5}{3}$ length of CD oe<br>E, C and D lie on a straight line   | B1<br>B1 |
|    | (e)    | $\frac{AE}{OE}$ or a correct method seen  | M1       |
|    |        | $\frac{4}{5}$ oe  | A1       |