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**MATHEMATICS**

**0580/41**

Paper 4 (Extended)

**May/June 2017**

MARK SCHEME

Maximum Mark: 130

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**Published**

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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               |
| nfww | not from wrong working     |
| soi  | seen or implied            |

| Question | Answer                      | Marks | Part marks  |
|----------|-----------------------------|-------|---|
| 1(a)(i)  | 275.31                      | 2     | <b>M1</b> for $90 \times 23.15 + 1885 \times 13.5$ oe   |
| 1(a)(ii) | 3202                        | 3     | <b>M2</b> for $\frac{198.16 - 90 \times 0.245}{0.055}$ oe<br><br><b>M1</b> for $90 \times 0.245$ or $90 \times 24.5$ oe   |
| 1(b)     | 17.[0] or 17.00 to 17.01    | 2     | <b>M1</b> for $13.5 \times \left(1 + \frac{8}{100}\right)^3$  |
| 1(c)(i)  | 40                          | 3     | <b>M2</b> for $\frac{7.7 - 5.5}{5.5} [\times 100]$ oe or $\frac{7.7}{5.5} \times 100$<br>or <b>M1</b> for $\frac{7.7}{5.5}$ oe  |
| 1(c)(ii) | 11.9 or 11.86 to 11.87      | 3     | <b>M2</b> for $\sqrt[3]{\frac{7.7}{5.5}}$ oe<br>or <b>M1</b> for $5.5 \times x^3 = 7.7$ oe  |
| 1(d)     | 150 [million] oe            | 2     | <b>M1</b> for $390$ [million] $\div (5 + 2 + 6)$  |
| 1(e)     | 250 nfww                    | 3     | <b>M2</b> for $258.25 \div ((100 + 3.3) \div 100)$<br>or <b>M1</b> for 258.25 associated with 103.3[%]  |
| 2(a)     | $71 < t \leq 72$            | 1     |   |
| 2(b)     | 72.3 or 72.27 to 72.28 nfww | 4     | <b>M1</b> for midpoints soi (condone 1 error or omission)<br><br><b>M1</b> for use of $\sum fx$ with $x$ in correct interval including both boundaries<br><br><b>M1</b> (dep on 2nd <b>M1</b> ) for $\sum fx \div 90$ |
| 2(c)(i)  | 41, 62, 80, 90              | 2     | <b>B1</b> for 2 correct values  |

| Question  | Answer  | Marks | Part marks  |
|-----------|---|-------|---|
| 2(c)(ii)  | Correct curve                                   | 3     | <b>B1FT</b> <i>their</i> (c)(i) for 5 correct heights<br><b>B1</b> for 5 points plotted at upper ends of intervals<br><b>B1FT</b> (dep on at least <b>B1</b> ) for increasing curve or increasing polygon through 5 points<br><br>If zero scored, <b>SC1FT</b> for 4 correct points plotted |
| 2(c)(iii) | 72.1 to 72.4                                    | 1     |   |
| 2(c)(iv)  | 1.9 to 2.2                                      | 2     | <b>M1</b> for $UQ = 73.2$ to $73.4$<br>or $LQ = 71.2$ to $71.3$   |
| 2(d)      | 180 cao nfw                                     | 4     | <b>B3</b> for 50 [m/s] nfw<br>OR<br><b>M3</b> for $\frac{3725 \div 1000}{74.5 \div 3600}$<br>OR<br><br><b>M2</b> for $3725 \div 74.5$<br>or <b>M1</b> for 3725 or 74.5 seen or for $(3715 \text{ to } 3725) \div (74.5 \text{ to } 75.5)$<br><br><b>M1</b> indep for multiply by 3.6 oe     |
| 3(a)(i)   | Image at (5, 1), (7, 1), (7, 4)                 | 2     | <b>B1</b> reflection in $y = 4$ or $x = k$  |
| 3(a)(ii)  | Image at (-1, 1), (-4, 1), (-1, 3)              | 2     | <b>B1</b> correct size and correct orientation<br>wrong position<br>or for rotation $90^\circ$ clockwise around (0, 0)  |
| 3(a)(iii) | Image at (2, -4), (4, -4), (2, -1)              | 2     | <b>B1</b> for translation by $\begin{pmatrix} 1 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -5 \end{pmatrix}$  |
| 3(b)      | Enlargement                                     | 1     |   |
|           | [sf] – 0.5 oe                                   | 1     |   |
|           | (5, 5)  | 1     |   |
| 3(c)      | $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ | 2     | <b>B1</b> for one correct column or row   |
| 3(d)(i)   | (4, 2)  | 2     | <b>M1</b> for $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} 4 \\ 1 \end{pmatrix}$ oe  |

| Question  | Answer   | Marks     | Part marks  |
|-----------|--|-----------|---|
| 3(d)(ii)  | $(-4, 2)$  | <b>3</b>  | <b>M2</b> for $\begin{pmatrix} -1 & 0 \\ 0 & 2 \end{pmatrix}$ or $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} -4 \\ 1 \end{pmatrix}$<br>or <b>M1</b> for $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \begin{bmatrix} 4 \\ 1 \end{bmatrix}$<br>or $\begin{pmatrix} -4 \\ 1 \end{pmatrix}$ |
| 3(d)(iii) | $\frac{1}{2} \begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$ oe isw                  | <b>3</b>  | <b>M2</b> for $\det = 2$ soi or $k \begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$ soi<br>or <b>M1</b> for recognition that <b>Q</b> is inverse matrix of <b>G</b><br>or <b>GQ = I</b> or <b>QG = I</b>   |
| 4(a)      | $-1.6$ to $-1.4$   | <b>1</b>  |   |
| 4(b)      | $-0.5$   | <b>1</b>  |   |
| 4(c)      | $k > -4$   | <b>2</b>  | <b>B1</b> for identifying the $-4$<br>or for horizontal line drawn $y = -4$   |
| 4(d)      | $y = x - 5$ ruled<br>and<br>$-2.3$ to $-2.1$<br>$-1.2$ to $-1.1$<br>$1.3$ to $1.4$ | <b>3</b>  | <b>B2</b> for correct line and 2 correct values or<br>no line and 3 correct values<br>or <b>B1</b> for no line and 2 correct values<br>or <b>B1</b> for correct line  |
| 4(e)      | Tangent ruled at $x = 1$   | <b>B1</b> | No daylight at point of contact. Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = 0.8$ and $1.2$   |
|           | $-6$ to $-4$   | <b>2</b>  | Dep on <b>B1</b> or close attempt at tangent at $x = 1$<br><b>M1</b> for rise/run for <i>their</i> tangent at $x = 1$   |
| 5(a)(i)   | 50890 or 50893 to 50900.4  | <b>2</b>  | <b>M1</b> for $\pi \times 18^2 \times 50$   |

| Question  | Answer                        | Marks | Part marks   |
|-----------|-------------------------------|-------|--|
| 5(a)(ii)  | 20.5 or 20.52 to 20.534       | 3     | <p><b>B2</b> for answer 29.5 or 29.46 to 29.48<br/>OR<br/><b>M2</b> for <math>(50900 - 30000) \div (\pi \times 18^2)</math> oe</p> <p>or <b>M1</b> for<br/><math>(\text{figs } 50.9 - \text{figs } 30) \div (\pi \times \text{figs } 18^2)</math><br/>or <b>M1</b> for <math>(50900 - 30000) = (\pi \times 18^2)h</math><br/>oe</p> <p>OR<br/><b>alternative method</b><br/><b>M2</b> for <math>50 - \frac{30000}{\pi \times 18^2}</math> oe</p> <p><b>M1</b> for <math>\text{figs } 30 = \pi \times \text{figs } 18^2 \times (50 - h)</math> oe<br/>or for <math>\frac{\text{figs } 30}{\pi \times \text{figs } 18^2}</math> oe</p> <p>OR<br/><b>alternative method</b><br/><b>M2</b> for <math>\frac{(50.9 - 30)}{50.9} \times 50</math> oe<br/>or <b>M1</b> for <math>\frac{(50.9 - 30)}{50.9}</math> or <math>\frac{30}{50.9} \times 50</math> oe<br/>or <b>M1</b> for<br/><math>\frac{(\text{figs } 50.9 - \text{figs } 30)}{\text{figs } 50.9} \times 50</math> oe</p> |
| 5(a)(iii) | 334 nfw                       | 4     | <p><b>M2</b> for <math>\text{figs } 30 \div \frac{2}{3}\pi \times 3.5^3</math> oe<br/>or <b>M1</b> for <math>\frac{1}{2} \times \frac{4}{3}\pi \times 3.5^3</math> oe<br/>and <b>B1</b> for 30 000</p>   |
| 5(b)(i)   | 3.28[6..] or 3.29             | 3     | <p><b>M2</b> for <math>[r^2 = ] \frac{95 \times 3}{8.4\pi}</math> oe<br/>or <b>M1</b> for <math>\frac{1}{3}\pi \times r^2 \times 8.4 [= 95]</math></p>   |
| 5(b)(ii)  | 93.1 to 93.6                  | 4     | <p><b>M3</b> for <math>\pi \times 3.3 \times \sqrt{3.3^2 + 8.4^2}</math><br/>or <b>M2</b> for <math>\sqrt{3.3^2 + 8.4^2}</math><br/>or <b>M1</b> for <math>3.3^2 + 8.4^2</math></p>  |
| 6(a)(i)   | $-7x + 55$ final answer       | 2     | <p><b>M1</b> for <math>8x + 20</math> or <math>-15x + 35</math><br/>or answer <math>-7x + k</math> or <math>kx + 55</math></p>   |
| 6(a)(ii)  | $x^2 - 14x + 49$ final answer | 2     | <p><b>M1</b> for 3 of <math>x^2 - 7x - 7x + 49</math></p>  |

| Question  | Answer                                  | Marks | Part marks   |
|-----------|---|-------|--|
| 6(b)(i)   | -18                                     | 3     | <b>M1</b> for a correct first step ie correctly multiplying by 3 or correctly dividing by 2 or for correctly subtracting 5<br><b>M1</b> for correctly reaching $ax = b$ from <i>their</i> first step   |
| 6(b)(ii)  | 15                                      | 3     | <b>M2</b> for $6x - 4x = 21 + 9$ oe<br>or<br><b>M1</b> for $6x - 21$ or correct division by 3<br>or for correctly reaching $ax = b$ from <i>their</i> first step   |
| 6(b)(iii) | 5 and -5                                | 3     | <b>B2</b> for 5 or -5<br>or <b>M1</b> for $[x^2 = ] (74 + 1) \div 3$ or better   |
| 7(a)      | (-0.5, 3)                               | 2     | <b>B1</b> for one correct value  |
| 7(b)      | $[y = ] -2x + 2$ final answer           | 3     | <b>M1</b> for $\frac{-2-8}{2-3}$ or better<br><b>M1</b> for substitution of (-3, 8) or (2, -2)<br>or <i>their</i> midpoint into $y = mx + c$ with <i>their</i> $m$   |
| 7(c)      | $y = -2x + 7$ oe                        | 2FT   | <b>FT</b> <i>their</i> (b)<br><b>M1</b> for $y = (\text{their}-2)x + k$ ( $k \neq 2$ )<br>or $y = kx + 7$ ( $k \neq 0$ )<br><br>If zero scored, <b>SC1</b> for $(\text{their} - 2)x + 7$   |
| 7(d)      | $x - 2y + 9 = 0$ or $2y - x - 9 = 0$ oe | 4     | <b>B3</b> for any correct equivalent in wrong form<br>Or<br><b>M2</b> for $y = \frac{1}{2}x + k$ oe ( <b>FT</b> negative reciprocal of <i>their</i> gradient in (b))<br>or <b>M1</b> for $\text{grad} = \frac{1}{2}$ ( <b>FT</b> negative reciprocal of <i>their</i> gradient in (b))<br><br><b>M1</b> for substitution of (1, 5) into $y = mx + c$ oe with <i>their</i> $m$ |
| 8(a)(i)   | 290                                     | 2     | <b>M1</b> for $180 + 110$ oe   |
| 8(a)(ii)  | 156.8 or 156.7[9..]                     | 5     | <b>B1FT</b> for $CBA = 10^\circ$ ( <i>their</i> (a) - 280)<br>and <b>B3</b> for [angle $ACB = ]13.2^\circ$<br>or <b>M2</b> for $[\sin C] = \frac{50 \sin(\text{their}10)}{38}$<br>or <b>M1</b> for $\frac{50}{\sin C} = \frac{38}{\sin(\text{their}10)}$ oe  |

| Question  | Answer  | Marks        | Part marks   |
|-----------|---|--------------|--|
| 8(a)(iii) | 8.68 or 8.677 to 8.684  | 3            | <b>M2</b> for $[x=]50\sin(\text{their}10)$ oe<br>or <b>M1</b> for $\sin(\text{their}10) = \frac{x}{50}$ oe<br>or <b>M1</b> for a correct right-angled triangle drawn with 50 as hypotenuse   |
| 8(b)(i)   | $x(x - 25) = 2200$  | 1            | and no errors seen   |
| 8(b)(ii)  | $\frac{-(-25) \pm \sqrt{(-25)^2 - 4(1)(-2200)}}{2(1)}$ or<br>better | <b>B2</b>    | <b>B1</b> for $\sqrt{(-25)^2 - 4(1)(-2200)}$ or better<br>or for $\left(x - \frac{25}{2}\right)^2$ oe<br>or <b>B1</b> for $\frac{-(-25) + \sqrt{q}}{2(1)}$ or $\frac{-(-25) - \sqrt{q}}{2(1)}$<br>or both<br>or for $\frac{25}{2} + \text{or} - \sqrt{\left(\frac{25}{2}\right)^2 + 2200}$ |
|           | -36.04 and 61.04 final answer                                       | <b>B1,B1</b> | If <b>B0B0, SC1</b> for values in ranges<br>-36.042 to -36.041 <b>and</b> 61.041 to 61.042<br>seen<br>or for answers -36[.0] or -36.042 to<br>-36.041 <b>and</b> 61[.0] or 61.041 to 61.042<br>or -36.04 <b>and</b> 61.04 seen in working<br>or for -61.04 <b>and</b> 36.04 as final ans   |
| 9(a)(i)   | 5 and 13  | 1            |  |
| 9(a)(ii)  | $8n - 3 = 203$  | <b>M1</b>    | Evaluation of 25th or 26th term with<br>supporting evidence or explanation   |
|           | 25.75 or $25\frac{3}{4}$  | <b>A1</b>    | Second evaluation of 25th or 26th terms<br>with supporting evidence or explanation<br><br>If zero scored, <b>SC1</b> for 25.75 or 197 and<br>205 with partial evidence or explanation  |
| 9(b)(i)   | $6n + 7$ oe final answer  | 2            | <b>B1</b> for $6n + c$ or $kn + 7$ $k \neq 0$  |
| 9(b)(ii)  | $n^2 + n + 2$ oe final answer                                       | 2            | <b>B1</b> for a quadratic expression<br>or second difference = 2   |
| 9(c)      | $[y = ] 10$   | 2            | <b>M1</b> for $5(20 - y) = 50$   |
|           | [First term = ] 14  | 2            | <b>M1</b> for $5(x - \text{their } y) = 20$<br>or for $20 \div 5 + \text{their } y$  |