

**MARK SCHEME for the October/November 2011 question paper  
for the guidance of teachers**

**0581 MATHEMATICS**

**0581/41**

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

| Qu.     | Answers                    | Mark | Part Marks  |
|---------|----------------------------|------|---|
| 1       | (a) (i) 4950               | 2    | M1 for $9000 \times 0.55$ oe  |
|         | (ii) 9 : 11                | 1    | Accept 1 : 1.22 or 0.818 : 1<br>After 4050 in (a)(i) allow SC1 for 11 : 9 etc   |
| (b)     | 1504                       | 1    |   |
|         | 564                        | 1    |   |
|         | 188                        | 1    | After 0 scored M1 for $2256 \div (8 + 3 + 1)$ soi   |
| (c) (i) | 6847.99 or 6848 or 6850    | 3    | M2 for $15000 \times 0.77^3$ oe (6847. (..)ww imp M2)<br>or M1 for $15000 \times 0.77^2$ oe soi (8893.5)<br>After 0 scored SC1 for art 27913 or 27910 or 27900  |
|         | (ii) 54.3 (54.33 to 54.35) | 3ft  | ft their $(15000 - \text{their (c)(i)})/15000 \times 100$ to 3sf<br>or better <b>but not</b> for negative answer or from 4650 in (c)(i) leading to 69%<br>M2 for $1 - 0.77^3$ (0.543..) or their $(15000 - \text{their (c)(i)})/15000 (\times 100)$<br>or SC2ft their (c)(i)/15000 $\times 100$ correctly evaluated (45.65 to 45.67 or 45.7)<br>or M1 for $0.77^3$ (0.4565..) or their (c)(i)/15000 |

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| <p>2</p> | <p>(a) 0, 1, 2, 3</p> <p>(b) <math>\frac{x-2}{x-5}</math> www final answer</p> <p>(c) (i) <math>5(x+1) + 2(x-3) = 3(x+1)(x-3)</math><br/>oe<br/><math>x^2 - 3x + x - 3</math> or better seen<br/><math>3x^2 - 13x - 8 = 0</math></p> <p>(ii) <math>\frac{-(-13) \pm \sqrt{(-13)^2 - 4(3)(-8)}}{2(3)}</math></p> <p>4.88 and -0.55 cao</p> | <p>3 Additional values count as errors<br/><b>B2</b> for one error/omission or <b>B1</b> for two errors/omissions<br/>After <b>B0</b>,<br/><b>M2</b> for <math>-1 &lt; x \leq 3.5</math> seen, allow <math>7/2</math> for 3.5 or <b>M1</b> for <math>-1 &lt; x</math> or <math>x \leq 3.5</math> or <math>x = -1</math> and <math>x = 3.5</math><br/>Allow <b>M2</b> for <math>0 \leq x &lt; 4</math> or <b>M1</b> for <math>x \geq 0</math> or <math>x &lt; 4</math></p> <p>4 <b>M3</b> for <math>\frac{(x+5)(x-2)}{(x+5)(x-5)}</math><br/>or <b>M2</b> for <math>(x+5)(x-2)</math> seen<br/>or <b>M1</b> for <math>(x+a)(x+b)</math> where <math>ab = -10</math> or <math>a + b = 3</math><br/>and <b>M1</b> for <math>(x+5)(x-5)</math> seen</p> <p><b>M1</b> Allow if still over common denominator</p> <p><b>B1</b> Allow <math>x^2 - 2x - 3</math> seen or <math>3x^2 - 9x + 3x - 9</math> or better seen</p> <p><b>E1</b> With no errors seen and brackets correctly expanded on both sides</p> <p><b>B1</b> In square root <b>B1</b> for <math>(-13)^2 - 4(3)(-8)</math> or better (265)</p> <p>If in form <math>\frac{p + \sqrt{q}}{r}</math> or <math>\frac{p - \sqrt{q}}{r}</math>,</p> <p><b>B1</b> for <math>-(-13)</math> and <math>2(3)</math> or better</p> <p><b>B1B1</b> <b>SC1</b> for 4.88 and -0.55 seen or -0.5 and 4.9 or -0.546... and 4.879 to 4.880</p> |
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| <p>3</p> | <p>(a) (i) <math>1.6 &lt; h \leq 1.7</math></p> <p>(ii) <math>\{1.35 \times 4 + 1.45 \times 13 + 1.55 \times 33 + 1.65 \times 45 + 1.75 \times 19 + 1.85 \times 6\} \div 120</math></p> <p>1.62 or 1.616 to 1.617</p> <p>(b) (i) <math>\frac{6}{120}</math> oe</p> <p>(ii) <math>\frac{2147}{2380}</math> oe (0.902(1..))</p> <p>(c) (i) 95, 120</p> <p>(ii) Plots 7 points correctly exact or in correct square</p> <p>Curve or lines through 7 points</p> <p>(d) (i) 1.61 to 1.63</p> <p>(ii) 1.555 to 1.57</p> | <p>1 Condone alt. notation used for class</p> <p>M3 (194/120)</p> <p>M1 for mid-values soi (allow one slip) and M1 for use of <math>\sum fx</math> with <math>x</math> in correct interval (allow one more slip) and M1 depend on 2nd M for dividing by 120</p> <p>A1 www4</p> <p>1 Accept dec/% to 3 sf or better but not ratio isw cancelling/conversion (also for (ii))</p> <p>3 M2 for <math>\frac{k}{120} \times \frac{k-1}{119}</math> where <math>\frac{k}{120}</math> is 1 – their (b)(i) or if <math>k = 114</math> or M1 for 1 – their (b)(i) or for 114/120 seen After 0 scored SC2 for ans 1/476 oe or SC1 for <math>6/120 \times 5/119</math></p> <p>1</p> <p>P2ft P1ft for 5 or 6 correct plots</p> <p>C1ft ft their <b>increasing</b> curve within 1 mm of points</p> <p>1ft ft their 60th reading on inc. curve to nearest 0.01</p> <p>1ft ft their 36th reading on inc. curve</p>  |
| <p>4</p> | <p>(a) (i) <math>2.7 \times \frac{20}{12}</math> oe = 4.5</p> <p>(ii) <math>1/3\pi \times 4.5^2 \times 20 - 1/3\pi \times 2.7^2 \times 12</math> or <math>(1 - (3/5)^3) \times 1/3\pi \times 4.5^2 \times 20</math> oe</p> <p>332.3 to 332.6 or 332 or 333</p> <p>(b) (i) <math>8^2 + (4.5 - 2.7)^2</math> oe</p> <p>sq root</p> <p>8.2</p> <p>(ii) 185 or 186 or 185.5 or 185.45 to 185.51</p>   | <p>E2 M1 for (SF =) 20/12 or 12/20 (but not from 2.7/4.5 or 4.5/2.7)</p> <p>M3 M1 for <math>1/3\pi \times 4.5^2 \times 20</math> (424 ... or <math>135\pi</math>) and M1 for <math>1/3\pi \times 2.7^2 \times 12</math> (91.6..or <math>29.16\pi</math>)</p> <p>A1</p> <p>M1 e.g. Alt: <math>20^2 + 4.5^2</math> and <math>12^2 + 2.7^2</math></p> <p>M1 Dep on 1st M1 Alt: 20.5 – 12.3 Other complete correct methods are M2</p> <p>E1 No errors seen</p> <p>5 M4 for <math>\pi \times 4.5 \times 20.5 - \pi \times 2.7 \times 12.3</math> or other complete correct method or M3 for <math>\pi \times 4.5 \times 20.5</math> or <math>\pi \times 2.7 \times 12.3</math> (290 or <math>92.25\pi</math>) (104.3...or <math>33.21\pi</math>) or B2 for (slant height of large cone =) 20.5 or (slant height of removed cone =) 12.3 or M1 for <math>\sqrt{4.5^2 + 20^2}</math> or <math>\sqrt{2.7^2 + 12^2}</math> or <math>12/8 \times 8.2</math> oe or <math>20/8 \times 8.2</math> oe</p> |

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|---|--|---|---|
| 5 | <p>(a) 1, -1, 3.5</p> <p>(b) 10 correct points plotted</p> <p>Smooth curve through at least 8 points and correct shape</p> <p>(c) (i) -2.2 to -2.1<br/>-0.65 to -0.45<br/>2.5 to 2.7</p> <p>(ii) (<math>k &lt;</math>) -4 to -3.7<br/><br/>(<math>k &gt;</math>) 1.7 to 2</p> <p>(d) (i) Ruled line gradient 3 and <math>y</math>-intercept -2 over the range -1 to 3.5</p> <p>(ii) (<math>a =</math>) -12, (<math>b =</math>) 2</p> <p>(iii) 0.1 to 0.2 and 3.3 to 3.4 cao</p>  | <p>1,1,1</p> <p>P3ft</p> <p>C1ft</p> <p>1ft</p> <p>1ft</p> <p>1ft</p> <p>1ft</p> <p>3</p> <p>1,1</p> <p>1,1</p>               | <p>P2ft for 8 or 9 correct<br/>P1ft for 6 or 7 correct<br/>Allow points to be implied from curve</p> <p>Correct cubic shape, not ruled</p> <p>Correct or ft their <math>x</math> values</p> <p>If ft and more than 3 solns then 2 marks maximum</p> <p>Correct or ft their graph for <math>y</math> values at max and min</p> <p>After 0 scored SC1 for both correct but reversed</p> <p>B2 for correct but freehand or short or M1 for a ruled line of gradient 3 or passes through (0, -2) (but not <math>y = -2</math>)</p> <p>After 0, M1 for <math>x^3 - 6x - 6x - 2 + 4 (=0)</math> or better</p> |
| 6 | <p>(a) <math>120^2 + 95^2 - 2 \times 120 \times 95 \times \cos 77</math><br/>135.26 ... or 135.3</p> <p>(b) <math>(\sin B) = \frac{\text{their } 135 \times \sin 26}{79}</math><br/><br/>48.5 to 48.7 isw<br/>131 or 131.3 to 131.5 www4</p> <p>(c) (Angle <math>A =</math>) 22.5 to 22.7<br/><br/>'Path' / 79 = sin (their <math>A</math>) oe<br/>30.2 to 30.5 www3</p> <p>(d) <math>\frac{1}{2} \times 120 \times 95 \times \sin 77</math> oe<br/><br/>Their area <math>\div 180</math><br/>30.8 to 30.9<br/><br/>30</p> | <p>M2</p> <p>E2</p> <p>M2</p> <p>A1</p> <p>B1ft</p> <p>B1ft</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>B1ft</p> | <p>M1 for implicit version</p> <p>A1 for 18295 to 18297</p> <p>M1 for <math>\frac{\sin B}{\text{their } 135} = \frac{\sin 26}{79}</math> oe</p> <p>ft for 180 - their 48.5 to 48.7 dep on sine rule or sine used</p> <p>ft 154 - their (b), also accept angle <math>B = 67.3</math> to 67.5 (ft their (b) - 64)</p> <p>Dep on B1 and their <math>A &lt; 90</math> eg <math>79 \cos 67.4</math></p> <p>(5554)</p> <p>Dep on area attempt</p> <p>ft their 30.8 to 30.9 truncated dep on at least M1 earned<br/>After M2 answer 30 www scores A1B1<br/>Answer 30 ww scores 0</p>                           |

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| 7 (a) | (a) (i) Reflection only<br>$y = -2$                       | B1 | Spoilt if extras  |
|       | (ii) Enlargement only<br>$\frac{1}{2}$<br>(1, 4)          | B1 | Spoilt if extras  |
|       | (iii) Rotation only<br>90° clockwise oe<br>Around (1, -3) | B1 | Spoilt if extras  |
|       | (b) (i) Triangle at (-4, 4), (-1, 4), (-1, 5)             | 2  | B1 for translation of $\begin{pmatrix} -5 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 2 \end{pmatrix}$<br><br>After B0, SC1 for translation of 5 small squares to the left and 2 small squares up  |
|       | (ii) Triangle at (4, 4), (1, 4), (4, 6)                   | 3  | B1 for each of (4, 4) or (4, 6) plotted<br>If no/wrong plots allow SC2 for 3 correct coordinates shown in working or SC1 for any 2 correct coordinates shown<br><br>or M1 for $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} 1 & 4 & 4 \\ 2 & 2 & 3 \end{pmatrix}$ shown |
|       | (c) Stretch only<br>(Factor) 2<br>x-axis oe invariant     | B1 | Spoilt if extras  |

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| <p><b>8</b></p> | <p>(a) (i) There are up to 5 large coaches oe</p> <p>(ii) <math>50x + 30y \geq 300</math> oe</p> <p>(b)</p> <p><math>x = 5</math> ruled</p> <p><math>x + y = 10</math> ruled</p> <p><math>5x + 3y = 30</math> ruled</p> <p>Correct region indicated cao</p> <p>(c) (i) 5<br/>2</p> <p>(ii) 2950</p>  | <p><b>1</b></p> <p><b>E2</b></p> <p><b>L1</b></p> <p><b>L1</b></p> <p><b>L2</b></p> <p><b>R1</b></p> <p><b>1</b></p> <p><b>1</b></p> <p><b>1ft</b></p> | <p>E.g. can't hire more than 5 large coaches<br/>The maximum is 5 large coaches<br/>The large coaches are less than or equal to 5</p> <p>No errors<br/>Allow in words provided clear<br/>e.g. 50 in large coaches and 30 in small coaches must equal 300 seats or more<br/><b>M1</b> for associating 50 with <math>x</math> or large coaches and 30 with <math>y</math> or small coaches</p> <p>Freehand lines –1 pen once.<br/>All lines must be long enough to make full boundary of their region accept dashed or solid lines</p> <p><b>L1</b> for ruled line with intercepts at (0, 10) or (6, 0) within 2mm by eye at intercepts (extend if line is short)</p> <p>Allow if slight inaccuracy(s) in diagonal lines<br/>Allow any clear indication of region</p> <p>After 5 and 2 in working ignore attempts to calculate costs</p> <p>ft their <math>5 \times 450 +</math> their <math>2 \times 350</math> provided positive integers</p> |
| <p><b>9</b></p> | <p>(a) (i) <math>2 \times 3 \times 3 \times 7</math> oe</p> <p>(ii) 18</p> <p>(iii) 504</p> <p>(b) 3.028 or 3.029 cao</p> <p>(c) <math>\pi r^2</math> their <math>h =</math> their <math>V</math></p> <p><math>(r^2 =) \frac{\text{their } V}{\pi \times \text{their } h}</math></p> <p>Sq root</p> <p>Selects 555 or 554.99.. and 11.5</p> <p>3.919 cao</p> | <p><b>2</b></p> <p><b>1</b></p> <p><b>2</b></p> <p><b>4</b></p> <p><b>M1</b></p> <p><b>M1</b></p> <p><b>M1</b></p> <p><b>B1</b></p> <p><b>A1</b></p>   | <p><b>M1</b> for prime factors of 2,3,3,7 shown condone 1('s) shown as well for method only</p> <p><b>M1</b> for other multiples of 504 or <math>2 \times 2 \times 2 \times 3 \times 3 \times 7</math> oe shown<br/>If (ii) and (iii) both correct but reversed allow <b>SC1</b></p> <p><b>B3</b> for 3.0289(85...)<br/>or <b>M1</b> for their 105/their 34 (their 105 in range 104 to 106 and their 34 in range 33 to 35)<br/>and <b>B1</b> for 104.5 or 34.5 or 34.499.. selected</p> <p>Where <math>V</math> is in range 540 to 560 and <math>h</math> is in range 11 to 13</p> <p>Implies previous method (15.36 implies <b>M2</b>)<br/>If using 545 and 12.5 then 13.88 (leading to 3.73)<br/>If using 550 and 12 then 14.59 (leading to 3.82)</p> <p>Dep on <b>M2</b>, can be implied from answers</p> <p>Indep</p> <p>If trials then 5 or 0</p>  |