

**MARK SCHEME for the October/November 2013 series**

**0444 MATHEMATICS (US)**

**0444/41**

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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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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
- soi seen or implied

	Correct answer		Part marks
<b>1</b>	<b>(a) (i)</b> $\frac{2}{5}$ cao	<b>1</b>	
	<b>(ii)</b> 3 : 2 cao	<b>1</b>	
	<b>(b) (i)</b> 1.22	<b>2</b>	<b>M1</b> for $86.38 - 28 \times 1.56$
	<b>(ii)</b> 1.3[0] nfw	<b>3</b>	<b>M2</b> for $1.56 \div 1.2$ oe <b>or M1</b> for $1.56 = 120\%$ soi
	<b>(c)</b> 33.6[0]	<b>2</b>	<b>M1</b> for $(667 - 314.2) \div 10.5$ oe
<b>2</b>	<b>(a) (i)</b> 204 or 204.2 to 204.23	<b>2</b>	<b>M1</b> for $\pi \times 5 \times 13$ implied by answer in range 204.1 to 204.3
	<b>(ii)</b> 12 cao	<b>3</b>	<b>M2</b> for $\sqrt{13^2 - 5^2}$ or states 5, 12, 13 triangle <b>or M1</b> for $13^2 = 5^2 + h^2$ or better
	<b>(iii)</b> 314 or 314.1 to 314.2	<b>2</b>	<b>M1</b> for $\frac{1}{3} \times \pi \times 5^2 \times$ <i>their (a)(ii)</i> implied by answer in range 314 to 314.3
	<b>(iv)</b> $3.14 \times 10^{-4}$ or 3.141 to $3.142 \times 10^{-4}$	<b>2FT</b>	<b>FT</b> <i>their (a)(iii)</i> $\div 100^3$ correctly evaluated and given in standard form to 3 sig figs or better <b>or M1 FT</b> for <i>their (iii)</i> $\div 100^3$  <b>or SC1</b> for conversion of <i>their</i> $m^3$ into standard form only if negative power
	<b>(b)</b> 138 or 138.3 to 138.5	<b>4</b>	<b>M3</b> for $\frac{10\pi}{26\pi} \times 360$ oe or $\frac{\pi \times 5 \times 13}{\pi \times 13^2}$ or <i>their (a)(i)</i> $\times 360$ oe <b>or M2</b> for a correct fraction without $\times 360$  <b>or M1</b> for $\pi \times 2 \times 13$ [81.6 to 81.8] seen or $\pi \times 13^2$ [530.6 to 531.2] seen

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3	(a)	45.[0] or 45.01 to 45.02 nfw	4	M2 for $55^2 + 70^2 - 2.55.70 \cos 40$ or M1 for correct implicit equation A1 for 2026. ....
	(b)	84.9 or 84.90 to 84.92	4	B1 for angle $BDC = 40$ soi  M2 for $\frac{70 \sin(\text{their } 40)}{\sin 32}$ or M1 for correct implicit equation
	(c) (i)	4060 or 4063 to 4064 nfw	3	M2 for $\frac{1}{2}(55 \times 70 \sin 40) +$ oe $\frac{1}{2}(70 \times \text{their (b)} \sin (180 - \text{their } 40 - 32))$
	(ii)	1020 or 1015 to 1016	2FT	FT their (c)(i) $\div 4$ oe correctly evaluated or M1 their (c)(i) $\div$ figs 4 oe
(d)	35.4 or 35.35... nfw	2	M1 for $\sin 40 = \frac{\text{distance}}{55}$ or better  or for $\frac{1}{2}(55 \times 70 \sin 40) = (70 \times \text{distance}) \div 2$ or better	
4	(a) (i)	Correct reflection to (4, 8) (2, 9) (4, 9)	2	SC1 for reflection in line $x = 5$ or reflection in $y = k$ Ignore additional triangles
	(ii)	Correct rotation to (4, 2), (4, 3) (6, 3)	2	SC1 for rotation $180^\circ$ with incorrect centre Ignore additional triangles
	(iii)	Enlargement to (2, 4) (10, 4) (10, 8)	2	SC1 for enlargement factor 4 correct orientation Ignore additional triangles
	(iv)	Stretch, y-axis invariant, [factor] 2	3	B1 each (independent)
	(b) (i)	$\mathbf{p} + 2\mathbf{s}$ final answer	2	M1 for recognising $\overrightarrow{OQ}$ as position vector soi
	(ii)	$\mathbf{s} + \frac{1}{2}\mathbf{p}$ final answer	2	B1 for $\mathbf{s} + k\mathbf{p}$ or $k\mathbf{s} + \frac{1}{2}\mathbf{p}$ or correct route ( $k \neq 0$ )
	(c)	parallel and $OQ = 2SR$ oe	1	

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5	(a) (i)	1.4 to 1.6	1	
	(ii)	1.15 to 1.25	1	
	(iii)	- 1	1	
	(iv)	- 2.25 to - 2.1 - 0.9 to - 0.75 2.2 to 2.35	3	<b>B2</b> for 2 correct or <b>B1</b> for one correct or <b>B1</b> for $y = x$ drawn ruled to cut curve 3 times
	(b) (i)	- 15	2	<b>B1</b> for $[h(3) =] 8$ seen or <b>M1</b> for $1 - 2(x^2 - 1)$ or better
	(ii)	$\frac{1-x}{2}$ or $\frac{1}{2} - \frac{x}{2}$ oe final answer	2	<b>M1</b> for $2x = 1 - y$ or $x = 1 - 2y$ or better
	(iii)	- 2, 2	3	<b>M1</b> for $x^2 - 1 = 3$ or better <b>B1</b> for one answer
(iv)	$\frac{1}{8}$ oe nfww	3	<b>M2</b> for $8x = 1$ or $8x - 1 = 0$ or <b>M1</b> for $1 - 2(3x) [= 2x]$	
6	(a)	24.7 or 24.66 to 24.67	4	<b>M1</b> for midpoints soi (condone 1 error or omission) (5, 15, 25, 35, 45, 55) and <b>M1</b> for use of $\sum fx$ with $x$ in correct interval including both boundaries (condone 1 further error or omission) and <b>M1</b> (dependent on second M) for $\sum fx \div 120$
	(b) (i)	50, 90, 114	2	<b>B1</b> for 2 correct
	(ii)	Correct curve or ruled polygon	3	Ignore section to left of $t = 10$ <b>B1</b> for 6 correct horizontal plots and <b>B1FT</b> for 6 correct vertical plots If 0 scored <b>SC1</b> for 5 out of 6 correct plots and <b>B1FT</b> for curve or polygon through at least 5 of <i>their</i> points dep on an increasing curve/polygon that reaches 120 vertically
	(iii)	21.5 to 23 15 to 16.5 24 to 26	4	<b>B1</b> <b>B1</b> <b>B2</b> or <b>B1</b> for 72 or 72.6 seen
	(c) (i)	50, 30	2	<b>B1</b> each
(ii)	Correct histogram	3FT	<b>B1</b> for blocks of widths 0 – 20, 30 – 60 <b>B1FT</b> for block of height 2.5 or <i>their</i> $50 \div 20$ and <b>B1FT</b> for block of height 1 or <i>their</i> $30 \div 30$	

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<p>7 (a)</p> <p><math>\sqrt{(-11)^2 - 4(8)(-11)}</math> or better</p> <p><math>p = -(-11), r = 2(8)</math> or better</p> <p>- 0.67, 2.05 final answers</p> <p>(b) 132</p> <p>(c) 20 with supporting algebraic working</p>		<p><b>B1</b></p> <p><b>B1</b></p> <p><b>B1B1</b></p> <p><b>3</b></p> <p><b>6</b></p>	<p>Seen anywhere <b>or</b> for <math>\left(x - \frac{11}{16}\right)^2</math></p> <p>Must be in the form <math>\frac{p + \sqrt{q}}{r}</math> or <math>\frac{p - \sqrt{q}}{r}</math></p> <p><b>or B1</b> for <math>\sqrt{\frac{11}{8} + \left(\frac{11}{16}\right)^2} + \frac{11}{16}</math></p> <p><b>SC1</b> for - 0.7 or - 0.672 to - 0.671 <b>and</b> 2.0 or 2.046 to 2.047 or answers 0.67 <b>and</b> - 2.05</p> <p><b>M1</b> for <math>y = k\sqrt{x}</math> oe or <math>\sqrt{x} = ky</math> oe <b>A1</b> for <math>k = 6</math> oe or better or for <math>k = 0.1666</math> to <math>0.167</math> [<math>k = 6</math> implies M1A1] oe</p> <p><b>B2</b> for <math>\frac{x}{2.5} + \frac{x - 14.5}{0.5} = 19</math> oe <b>or B1</b> for <math>\frac{x}{2.5}</math> or <math>\frac{x - 14.5}{0.5}</math></p> <p><b>M1dep on B2</b> for first completed correct move to clear both fractions <b>M1</b> for second completed correct move to collect terms in <math>x</math> to a single term <b>M1</b> for third completed correct move to collect numeric term[s] leading to <math>ax = b</math></p> <p><b>SC1</b> for 20 with no algebraic working</p>
<p>8 (a)</p> <p><math>y = 2</math> oe</p> <p><math>y = 2x</math> oe</p> <p><math>y = -\frac{1}{2}x + 5</math> oe</p> <p>(b)</p> <p><math>y = 2</math> oe</p> <p><math>y = 2x</math> oe</p> <p><math>y = -\frac{1}{2}x + 5</math> oe</p> <p>(c) (i) 4 [bushes], 3 [trees]</p> <p>(ii) 2 [bushes], 4 [trees]</p> <p>860</p>		<p><b>1</b></p> <p><b>2</b></p> <p><b>2</b></p> <p><b>3</b></p> <p><b>2</b></p> <p><b>2</b></p> <p><b>1</b></p>	<p><b>M1</b> for <math>y = kx, k \neq 0</math> or gradient 2 soi</p> <p><b>M1</b> for gradient <math>-\frac{1}{2}</math> soi or <math>y = kx + 5</math> oe or <math>x + 2y = k, k \neq 0</math> oe</p> <p>If <math>L_2</math> and <math>L_3</math> both correct but interchanged then <b>SC3</b></p> <p><b>B1</b> for each correct inequality, allow in any order After <b>0</b> scored, <b>SC1</b> for all inequalities reversed</p> <p><b>M1</b> for any correct trial using integer coordinates in region <b>or</b> <math>30x + 200y = 720</math> seen</p> <p><b>M1</b> for any correct trial using integer coordinates in region</p>

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9	(a) (i)	$1 + 2 + 3 + 4 + 5 = 15$	1	
	(ii)	Correct substitution equating to sum e.g. $\frac{2(2+1)}{k} = 3$ and $k = 2$ stated with no errors seen	2	M1 for using a value of $n$ in $\frac{n(n+1)}{k}$ e.g. $\frac{2(2+1)}{k}$ or for a verification using $k = 2$ e.g. $\frac{2(2+1)}{2} = 3$
	(iii)	1830	1	
	(iv)	30	2	M1 for $\frac{n(n+1)}{2} = 465$ or better
	(v)	$n - 8$	1	
	(b) (i)	225, 15	2	B1 either
	(ii)	$\frac{n^2(n+1)^2}{4}$ oe	1	
	(iii)	36100	2	M1 for $\frac{19^2(19+1)^2}{4}$ oe or $190^2$
10	(a)	4724	3	M2 for $8000 \times 0.9^5$ oe (implied by 4723.92) M1 for $8000 \times 0.9^n$ $n > 1$
	(b)	$100 \times 1.005^2 + 100 \times 1.005$ oe	M2	M1 for $100 \times 1.005^2$ seen
	(c)	$2^n - 1$	2	M1 for use of $a(r^n - 1)/(r - 1)$ oe