



MATHEMATICS (US)

0444/41

Paper 4 Extended

May/June 2016

MARK SCHEME

Maximum Mark: 130

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	Mark	Part marks
1	(a) Triangle drawn, vertices (2, - 4), (2, - 5), (4, - 4)	2	SC1 for translation $\begin{pmatrix} 5 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -2 \end{pmatrix}$ or correct points not joined
	(b) Triangle drawn, vertices (- 3, 4), (- 3, 5), (- 1, 4)	2	SC1 for reflection in line $y = k$ or line $x = 1$ or correct points not joined
	(c) Enlargement	1	
	[factor] 3	1	
	[centre] (- 6, - 5)	1	
	(d) Stretch	1	
x-axis invariant	1		
[factor] 2	1		
2	(a) (i) 48	2	M1 for $\frac{72}{3}$
	(ii) 32.4[0]	1	
	(iii) $\frac{13}{30}$	2	M1 for $\frac{72 - \text{their}(ii) - 8.4}{72}$ oe
	(iv) 24	3	M2 for $\frac{19.2}{0.8}$ oe or M1 for recognising 19.2 is 80%
	(b) 660	3	M2 for $\frac{550 \times 2 \times 10}{100} + 550$ oe or M1 for $\frac{550 \times 2 \times 10}{100}$ oe
	(c) 663.9[0]	2	M1 for 550×1.019^{10} oe

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Question	Answer	Mark	Part marks
(d)	1.5[0]	3	M2 for $\sqrt[10]{\frac{638.3[0]}{550}}$ oe or M1 for $550 \times m^{10} = 638.3[0]$
3 (a) (i)	400	1	
(ii)	350	1	
(iii)	70	1	
(iv)	170	2	B1 for 30 seen
(b) (i)	Mid-values 40, 80, 125, 200 soi Σfx with correct frequencies and x 's in correct intervals or on boundaries of correct intervals $\div 200$ 106 nfw	M1 M1 M1(dep) A1	Dependent on second M1 SC2 for correct answer without working
(ii)	Correct histogram	4	B1 for correct widths and B1 for each rectangle of correct height at 0.8, 1.6, 1.6 (up to B3) After 0 scored, SC1 for 3 correct frequency densities seen
(iii)	$\frac{10712}{39800}$ oe isw	2	M1 for $\frac{104}{200} \times \frac{103}{199}$ oe
4 (a)	14 137 to 14 137.2 or 14 139	2	M1 for $\frac{4}{3} \times \pi \times 15^3$
(b) (i)	104 000 or 103 600 to 103 700	3	M2 for $\pi \times 25^2 \times 60 - 14140$ or M1 for $\pi \times 25^2 \times 60$
(ii)	52.8 or 52.75 to 52.81...	2	M1 for <i>their</i> (b)(i) $\div (\pi \times 25^2)$ or $14\,140 \div (\pi \times 25^2)$
(c) (i)	15.8 or 15.81.....	3	M2 for $[r^2 =] \frac{14140}{\frac{1}{3} \times \pi \times 54}$ or M1 for $\frac{1}{3} \times \pi \times r^2 \times 54 = 14140$ oe

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Question	Answer	Mark	Part marks
(ii)	3580 or 3576 to 3581 nfw	4	M1 for $(their\ (c)(i))^2 + 54^2$ M1 for $\pi \times (their\ (c)(i)) \times \sqrt{\{(their\ (c)(i))^2 + 54^2\}}$ M1 for $\pi \times (their\ (c)(i))^2$
5 (a)	9 10.5	1 1	
(b)	Fully correct curve	5	SC4 for correct curve, but branches joined B3 FT for 9 or 10 points plotted or B2 FT for 7 or 8 points plotted or B1 FT for 5 or 6 points plotted and B1 for two separate branches not touching or cutting y-axis
(c)	2.1 to 2.6	1	
	8.5 to 9	1	
(d)	2, 3, 5, 7	2	SC1 for correct 4 values and no more than one extra positive integer or $\pm 2, \pm 3, \pm 5, \pm 7$ or 3 correct values and no extras
(e)	(-2, -12)	1	
(f) (i)	$20 + x^2 = x^3$ $x^3 - x^2 - 20 = 0$	M1 A1	Multiplication by x No errors or omissions
(ii)	Fully correct curve $y = x^2$	2	SC1 for U – shaped parabola, vertex at origin
(iii)	2.5 to 3.5	1	
(iv)	3.[0] to 3.1 or FT their answer to (iii)	1FT	FT dep on (iii) > 0
6 (a) (i)	$[y =] \frac{1}{2}(80 - 2x)$ $A = their\ \frac{1}{2}(80 - 2x) \times x\ oe$ $A = 40x - x^2$ and $x^2 - 40x + A = 0$	M1 M1 A1	$40 - x$ is enough No errors or omissions

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Question	Answer	Mark	Part marks
(ii)	$(x-30)(x-10)$	B2	B1 for $x(x-30)-10(x-30) [= 0]$ or $x(x-10)-30(x-10) [= 0]$ or SC1 for $(x+a)(x+b)$ where $ab = 300$ or $a + b = -40$
	30, 10	B1	
(iii)	$\sqrt{(-40)^2 - 4(1)(200)}$ or better	B1	or for $(x-20)^2$
	$p = -40$ and $r = 2(1)$	B1	Must see $\frac{p+\sqrt{q}}{r}$ or $\frac{p-\sqrt{q}}{r}$ or both or for $20 \pm \sqrt{200}$
	5.86 34.14	B1 B1	If B0 , SC1 for 5.9 or 5.857 to 5.858 and 34.1 or 34.14... or 5.86 and 34.14 seen in working or -5.86 and -34.14 as final answers
(b) (i)	$\frac{200}{x} - \frac{200}{x+10}$ $\frac{200(x+10)-200x}{x(x+10)} = \frac{2000}{x(x+10)}$	M2 A1	or M1 for $\frac{200}{x}$ or $\frac{200}{x+10}$ soi No errors or omissions
(ii)	16 [min] 40 [s]	3	B2 for 0.27 or 0.278 or 0.2777 to 0.2778 or $\frac{5}{18}$ [h] oe or 16.6 or 16.7 or 16.66 to 16.67 or $\frac{50}{3}$ [min] or M1 for $2000 \div 80(80+10)$ or $\frac{200}{80} - \frac{200}{90}$
7 (a) (i)	$\frac{1}{2} \mathbf{p}$	1	
(ii)	$\frac{1}{2} \mathbf{p} - \frac{1}{3} \mathbf{r}$	1	
(iii)	$\mathbf{p} + \frac{2}{3} \mathbf{r}$	1	

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Question	Answer	Mark	Part marks
(b)	$\mathbf{r} + \frac{3}{2}\mathbf{p}$	2	M1 for correct unsimplified answer or for correct route or for recognising $\overline{\text{OU}}$ as position vector
(c)	6 nfw	3	B2 for $(2k)^2 + ([-]k)^2 = 180$ oe or M1 for $(2k)^2 + ([-]k)^2$ oe
8 (a)	2	2	M1 for $2x + 1 = 1 + 4$
(b)	17	2	B1 for [h(3) =] 8 soi or $2 \times 2^x + 1$ oe
(c)	$\frac{x-1}{2}$ oe final answer	2	M1 for $y - 1 = 2x$ or $\frac{y}{2} = x + \frac{1}{2}$ or $x = 2y + 1$
(d)	$4x^2 + 4x + 5$ final answer	3	M1 for $(2x+1)^2 + 4$ and B1 for $[(2x+1)^2 =] 4x^2 + 2x + 2x + 1$ or better
(e)	$\sqrt{2}$ or 1.41 or 1.414....	1	
(f)	-1	1	
9 (a)	4.5	2	M1 for $\frac{7}{10.5} = \frac{3}{PQ}$ oe
(b) (i)	The lengths 12 and 18 are also in the ratio 2 : 3 oe	1	Must see 12, 18 in explanation
(ii)	$\frac{27V}{8}$	2	M1 for $\left(\frac{3}{2}\right)^3$ or $\left(\frac{2}{3}\right)^3$ oe soi
(c)	23.7 or 23.74 to 23.75	3	M2 for $\frac{3\sin 110}{7}$ or M1 for $\frac{7}{\sin 110} = \frac{3}{\sin ACB}$ oe
10 (a) (i)	$-\frac{1}{2}x + 2$ oe	3	SC2 for $y = -\frac{1}{2}x + c$ oe or SC1 for $y = kx + 2$ oe, $k \neq 0$ or M1 for [gradient =] $\frac{-2}{4}$ and M1 for substituting (4, 0) or (0, 2) into $y =$ (their m) $x + c$

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Question	Answer	Mark	Part marks
(ii)	$\frac{16}{a^2} \left[+ \frac{0^{[2]}}{b^2} \right] = 1$ or $\frac{4^2}{a^2} \left[+ \frac{0^{[2]}}{b^2} \right] = 1$ and $a^{[2]} = 4^{[2]}$	1	
	$\left[\frac{0^{[2]}}{a^2} \right] + \frac{4}{b^2} = 1$ or $\left[\frac{0^{[2]}}{a^2} \right] + \frac{2^2}{b^2} = 1$ and $b^{[2]} = 2^{[2]}$	1	
(b) (i)	1.73 or 1.732.. or $\sqrt{3}$	3	M2 for $\frac{k^2}{4} = \frac{3}{4}$ or better or M1 for $\frac{2^2}{16} + \frac{k^2}{4} = 1$ oe
(ii)	81.8 or 81.78 to 81.79	3	M2 for $2 \times \tan^{-1} \left(\frac{\text{their} \sqrt{3}}{2} \right)$ oe or M1 for $\tan = \frac{\text{their} \sqrt{3}}{2}$ oe
(c) (i)	8π final answer	1	
(ii)	72π final answer	2FT	FT their (c)(i) $\times 9$ in terms of π M1 for area factor of 3^2 or 9 or [new a] = 12, [new b] = 6