



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

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**MATHEMATICS (US)**

**0444/43**

Paper 4 (Extended)

**October/November 2016**

MARK SCHEME

Maximum Mark: 130

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**Published**

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
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
<b>1 (a)</b>	Triangle drawn at (-4, 3), (-1, 3), (-1, 4)	<b>2</b>	<b>SC1</b> for correct reflection in $x = k$ or $y = 1$
<b>(b)</b>	Triangle drawn at (1, 7), (1, 6), (4, 6)	<b>2</b>	<b>SC1</b> for translation by $\begin{pmatrix} -2 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 3 \end{pmatrix}$
<b>(c)</b>	Triangle drawn at (2, 3), (2, 1), (8, 1)	<b>2</b>	
<b>(d)</b>	Rotation	<b>1</b>	
	90° clockwise oe	<b>1</b>	Accept -90°
	(7, 4)	<b>1</b>	

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Question	Answer	Mark	Part marks
<b>2 (a) (i)</b>	1050	<b>2</b>	<b>M1</b> for $924 \div 22$ oe or $924 \div 0.88$ oe If zero scored, <b>SC1</b> for 126 seen
<b>(ii)</b>	12	<b>1</b>	
<b>(iii)</b>	$5\frac{1}{4}$ hrs or 5.25 hrs	<b>2</b>	<b>M1</b> for $9 \div (7 + 5)$ or $540 \div (7 + 5)$ If zero scored, <b>SC1</b> for answer 3.75h or 3h 45 mins
<b>(b)</b>	24.6[0]	<b>3</b>	<b>M2</b> for $15.99 \div \left(1 - \frac{35}{100}\right)$ oe or <b>M1</b> for 65% associated with 15.99
<b>(c)</b>	63	<b>3</b>	<b>M2</b> for $35 \times \sqrt{\frac{2835}{875}}$ oe or <b>M1</b> for $\sqrt{\frac{2835}{875}}$ or $\sqrt{\frac{875}{2835}}$ or better or $\frac{\sqrt{2835}}{?} = \frac{\sqrt{875}}{35}$ oe OR <b>M2</b> for $\sqrt{2835 \times \frac{35}{\text{their}(875 \div 35)}}$ oe or <b>M1</b> for $\frac{35}{\text{their}(875 \div 35)}$ or $\frac{\text{their}(875 \div 35)}{35}$
<b>(d) (i)</b>	0.661[0]	<b>1</b>	
<b>(ii)</b>	48	<b>3</b>	<b>M2</b> for $\frac{18.50 - 12.50}{12.50} \times 100$ or <b>M1</b> for $\frac{18.50 - 12.50}{12.50}$ or $\frac{18.50}{12.50} \times 100$

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Question	Answer	Mark	Part marks
3 (a)	−4.5 and 10.5	2	<b>B1</b> for each value
(b)	Correct curve	5	<b>B4</b> for correct curve with branches joined OR <b>B3 FT</b> for 9 or 10 points or <b>B2 FT</b> for 7 or 8 points or <b>B1 FT</b> for 5 or 6 points and <b>B1</b> independent for one branch on each side of the y-axis and <b>not touching</b> or crossing the y-axis
(c)	5	1	
(d) (i)	Line $y = 15 - 3x$ ruled and −0.4 to −0.31 0.35 to 0.45 2.2 to 2.3	4	<b>B3</b> for correct line and 2 correct values or <b>B2</b> for correct line or <b>M1</b> for ruled line with gradient −3 or through (0, 15) or <b>SC2</b> for no/wrong line and three correct values or <b>SC1</b> for no/wrong line and two correct values or for correct freehand line
(ii)	$[a =] 6$ $[b =] -14$ $[c =] 0$	3	<b>B2</b> for $6x^3 - 14x^2 + 2 = 0$ oe or <b>M1</b> for correct removal of denominator or collection of terms on one side
4 (a)	$\frac{1}{64}$	2	<b>M1</b> for $\frac{1}{8} \times \frac{1}{8}$
(b)	$\frac{63}{64}$	1FT	<b>FT 1 – their (a)</b>
(c)	$\frac{30}{64}$ oe	2	<b>M1</b> for $[2 \times] \frac{3}{8} \times \frac{5}{8}$ oe
(d)	$\frac{7}{64}$	3	<b>M2</b> for $\frac{1}{8} \times \frac{1}{8} + \frac{1}{8} \times \frac{3}{8} + \frac{3}{8} \times \frac{1}{8}$ oe or <b>M1</b> for identifying combinations required, (8, 8) and (8, 6) and (8, 5) or identifying 6 out of the 7 possible outcomes
(e)	$\frac{24}{64}$ oe	3	<b>M2</b> for $\frac{1}{8} \times \frac{7}{8} + \frac{3}{8} \times \frac{4}{8} + \frac{2}{8} \times \frac{2}{8} + \frac{1}{8} \times \frac{1}{8}$ oe or $\frac{7}{8} \times \frac{1}{8} + \frac{6}{8} \times \frac{1}{8} + \frac{4}{8} \times \frac{2}{8} + \frac{1}{8} \times \frac{3}{8}$ oe or <b>M1</b> for the sum of any two correct products from above oe isw

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Question	Answer	Mark	Part marks
<b>5</b>	<b>(a)</b>		
	$[\cos ABL =] \frac{40^2 + 61.1^2 - 92.1^2}{2 \times 40 \times 61.1}$	<b>M2</b>	<b>M1</b> for correct implicit version
	130.11...	<b>A2</b>	<b>A1</b> for $[\cos ABL =] -0.644...$ or $-\frac{7873}{12220}$ or $-\frac{3149.2}{4888}$
<b>(b)</b>	[0]59.5 or 59.50 to 59.511	<b>4</b>	<b>M2</b> for $\frac{40 \sin 130.1}{92.1}$ or $\frac{61.1 \sin 130.1}{92.1}$ or <b>M1</b> for $\frac{\sin A}{40} = \frac{\sin 130.1}{92.1}$ or $\frac{\sin L}{61.1} = \frac{\sin 130.1}{92.1}$ <b>and</b> <b>A1</b> for 19.39 to 19.4... or 30.48 to 30.49...
<b>(c)</b>	1h 50min	<b>5</b>	<b>M2</b> for $[BC =] 2 \times 40 \times \cos(180 - 130.1)$ oe or <b>M1</b> for $\frac{x}{40} = \cos(180 - 130.1)$ oe  OR <b>M2</b> for $[BC =]$ $\sqrt{40^2 + 40^2 - 2 \times 40 \times 40 \cos(\text{their } 80.2)}$ or <b>M1</b> for correct implicit version  OR <b>M2</b> for $[BC =] \frac{40 \sin(\text{their } 80.2)}{\sin 49.9}$ or <b>M1</b> for correct implicit version  <b>and</b> <b>M1</b> for $\frac{\text{their } BC}{28}$  <b>A1</b> for 1.84[0...] to 1.841

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Question	Answer	Mark	Part marks
6 (a) (i)	6000 [7600] 10 200 4200	2	<b>B1</b> for 6000 or 10200 If <b>B0</b> then <b>B1FT</b> for <i>their</i> (UQ – LQ)
(ii) (a)	True, median price is lower	1	No inclusion of other statistic
(b)	False, A's UQ < 13 600 oe 11025	1FT 4	<b>FT</b> <i>their</i> UQ in (a)(i) Listed values are in thousands <b>M1</b> for 3, 7, 9, 11, 13, 18 soi <b>M1</b> for $\Sigma fm$ [1323] <b>M1</b> (dep on second <b>M1</b> ) for <i>their</i> $\Sigma fm \div 120$
(c)	323.25 nfw	3	<b>M2</b> for $9948 - 0.25 \times 8760$ or <b>M1</b> for $0.25 \times 8760$
7 (a)	Attempt to use $18 - r$ in Pythagoras' $144 = r^2 - 324 + 18r + 18r - r^2$ oe $468 = 36r$ oe	<b>M1</b> <b>B2</b> <b>A1</b>	or <b>B1</b> for $324 - 18r - 18r + r^2$ Correct simplification with no errors
(b)	$[2 \times] \sin^{-1}\left(\frac{12}{13}\right)$ oe  134.76...	<b>M1</b>  <b>A1</b>	or $\cos = \left(\frac{13^2 + 13^2 - 24^2}{2 \times 13 \times 13}\right)$ or better or $[180 - ] 2 \times \sin^{-1}\left(\frac{5}{13}\right)$
(c) (i)	332 or 332.1 to 332.2...	3	<b>M2</b> for $\frac{(360 - 134.8)}{360} \times \pi \times 13^2$ or <b>M1</b> for $\frac{134.8}{360} \times \pi \times 13^2$
(ii)	392 or 392.0 to 392.2...	3	<b>M2</b> for $\frac{1}{2} \times 24 \times 5 + \text{their (c)(i)}$ or $\frac{1}{2} \times 13^2 \times \sin 134.8 + \text{their (c)(i)}$ or <b>M1</b> for $\frac{1}{2} \times 24 \times 5$ or $\frac{1}{2} \times 13^2 \times \sin 134.8$
(iii)	15700 or 15670 to 15690	1FT	<b>FT</b> for answer to $40 \times \text{their (c)(ii)}$
(d)	29.5 or 29.6 or 29.51 to 29.57...	2FT	<b>M1</b> for $\pi \times 13^2 \times h = \text{their (c)(iii)}$ or better

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Question	Answer	Mark	Part marks
<b>8</b>	<b>(a) (i)</b> $\begin{pmatrix} 12 \\ -5 \end{pmatrix}$	<b>2</b>	<b>M1</b> for $\begin{pmatrix} 12 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ -5 \end{pmatrix}$
	<b>(ii)</b> 13 nfw	<b>2FT</b>	<b>M1FT</b> for $\sqrt{\text{their } 12^2 + \text{their } (-5)^2}$ <b>FT</b> dep on <i>their</i> <b>(a)</b> being $\begin{pmatrix} a \\ b \end{pmatrix}$ where $a, b$ are both non-zero
	<b>(b) (i) (a)</b> $\mathbf{b} - \mathbf{a}$	<b>1</b>	
	<b>(b)</b> $\frac{3}{5}(\mathbf{b} - \mathbf{a})$ or $\frac{3}{5}\mathbf{b} - \frac{3}{5}\mathbf{a}$ final answer	<b>1FT</b>	<b>FT</b> $\frac{3}{5}$ <i>their</i> vector, in terms of $\mathbf{a}$ and $\mathbf{b}$ , in <b>(b)(i)(a)</b>
	<b>(c)</b> $\frac{1}{5}(2\mathbf{a} + 3\mathbf{b})$ or $\frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$ final answer	<b>2</b>	<b>M1</b> for $\mathbf{a} + \text{their}$ vector in <b>(b)(i)(b)</b> or any correct route
	<b>(ii)</b> $\frac{3}{2}$ oe	<b>1</b>	
<b>9</b>	<b>(a)</b> 2.25 oe	<b>2</b>	<b>M1</b> for $8x + 4x = 22 + 5$ or better
	<b>(b)</b> $x \geq 3.5$ final answer	<b>2</b>	<b>M1</b> for $6x - 2x \geq 14$ or better
	<b>(c)</b> $(x - 7)(x + 3)$ final answer	<b>2</b>	<b>M1</b> for $x(x + 3) - 7(x + 3)$ or $x(x - 7) + 3(x - 7)$  or for $(x + a)(x + b)$ where $ab = -21$ or $a + b = -4$
	<b>(d)</b> $12x^2 + xy - 6y^2$ final answer	<b>3</b>	<b>M2</b> for $12x^2 + 9xy - 8xy - 6y^2$ or <b>M1</b> for any two of the four terms correct

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<b>10 (a)</b>	A: 14 $3n - 1$ oe	<b>3</b>	<b>B1</b> for 14 <b>B2</b> for $3n - 1$ oe or <b>M1</b> for $3n + k$ , for any $k$ oe
	B: -4 $26 - 6n$ oe	<b>3</b>	<b>B1</b> for -4 <b>B2</b> for $26 - 6n$ oe or <b>M1</b> for $k - 6n$ , for any $k$ oe
	C: 25 $n^2$ oe	<b>2</b>	<b>B1</b> for 25 <b>B1</b> for $n^2$
	D: 20 $n^2 - n$ oe	<b>2</b>	<b>B1</b> for 20 <b>B1</b> for $n^2 - n$ oe
<b>(b) (i)</b>	$\frac{n(3n+1)}{2} = 155$	<b>M1</b>	accept $\frac{3n^2 + n}{2} = 155$
	$3n^2 + n = 310$		Intermediate step must include elimination of fraction, e.g. $n(3n + 1) = 310$
	$3n^2 + n - 310 = 0$	<b>A1</b>	with no errors or omissions
<b>(ii)</b>	$10, -\frac{31}{3}$ oe	<b>3</b>	<b>M2</b> for $(3n + 31)(n - 10) [= 0]$ or <b>M1</b> for $3n(n - 10) + 31(n - 10)$ or $n(3n + 31) - 10(3n + 31)$ or $(3n + a)(n + b)$ where $ab = -310$ or $a + 3b = 1$
<b>(iii)</b>	10	<b>1FT</b>	<b>FT</b> <i>their (b)(ii)</i> if only one positive integer solution



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11	5 and $-\frac{27}{2}$ oe	7	<p><b>M2</b> for <math>12 \times 2(2x - 1) + (x + 3)(2x - 1) = 12 \times 3(x + 3)</math> oe or <b>M1</b> for a common denominator with 2 or more of the terms</p> <p>and <b>B2</b> for <math>2x^2 + 17x - 135 [= 0]</math> oe or <b>B1</b> for <math>48x - 24</math> or <math>2x^2 - x + 6x - 3</math> or <math>36x + 108</math></p> <p>or <math>2x^2 - x + 54x - 27</math></p> <p>or <math>132 - 12x</math></p> <p>or <math>37x + 111 - 2x^2 - 6x</math></p> <p>and <b>M2</b> for <math>(2x + 27)(x - 5)</math> or <i>their</i> correct factors or formula or <b>M1</b> for <math>2x(x - 5) + 27(x - 5)</math> or <math>x(2x + 27) - 5(2x + 27)</math> or <math>(2x + a)(x + b)</math> where <math>ab = -135</math> or <math>a + 2b = 17</math></p>