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Mark Scheme (Results)

January 2017

International GCSE Mathematics A
4MA0/3HR

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Types of mark
    - M marks: method marks
    - A marks: accuracy marks
    - B marks: unconditional accuracy marks (independent of M marks)
- Abbreviations
    - cao – correct answer only
    - ft – follow through
    - isw – ignore subsequent working
    - SC - special case
    - oe – or equivalent (and appropriate)
    - dep – dependent
    - indep – independent
    - eeoo – each error or omission

- No working
  If no working is shown then correct answers normally score full marks
  If no working is shown then incorrect (even though nearly correct) answers score no marks.
- With working
  If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.
  If it is clear from the working that the "correct" answer has been obtained from incorrect working, award 0 marks.
  Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks.
  If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.
  If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line makes clear the method that has been used.
  If there is no answer on the answer line then check the working for an obvious answer.
- Ignoring subsequent work
  It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: eg. Incorrect cancelling of a fraction that would otherwise be correct.
  It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect eg algebra.
  Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.
- Parts of questions
  Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another.

International GCSE Maths January 2017 – Paper 3HR Mark scheme

Apart from Questions 11a, 15, 16a where the mark scheme states otherwise, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.

Q	Working	Answer	Mark	Notes
1	100^2 or 10 000			M1 e.g. 12×100^2
		120 000	2	A1
				Total 2 marks
2	$360 \div 18$ or $\frac{(2n-4)90}{n}=162$ or $\frac{(n-2)180}{n}=162$			M1
		20	2	A1
				Total 2 marks
3	$\left(\frac{4+8}{2},\frac{11+3}{2}\right)$			M1 for $\frac{4+8}{2}$ **or** $\frac{11+3}{2}$ oe **or** (6, *y*) **or** (*x*, 7) **or** (7, 6)
		(6 , 7)	2	A1
				Total 2 marks

4	15 ÷ 60 (=0.25) or 13.25 or 13 × 60 + 15 (=795) or 13 × 3600 + 15 × 60 (=47700)			M1	
	8740 ÷ "13.25" **or** 8740 ÷ "795" × 60 or 8740 ÷ "47700" × 3600			M1	accept 8740 ÷ 13.15 or an answer of 664 - 665
		660	3	A1	accept 659.6 – 660
					Total 3 marks

5	80 ÷ (3 + 1) (=20) **or** 20 **or** 60		5	M1	
	0.15 × (3 × "20") (=9)			M1	M1 for 0.85 × (3×"20") = 51
	"20" ÷ 5 (=4)			M1	M1 for $\frac{4}{5}$ × "20" (=16)
	80 – "9" – "4"			M1	M1 for "16" + "51"
		67		A1	
	or				
5	$\frac{3}{4}\times\frac{15}{100}\left(=\frac{9}{80}\text{ or }0.1125\right)$		5	M1	M1 $\frac{3}{4}\times\frac{85}{100}\left(=\frac{51}{80}\text{ or }0.6375\right)$
	$\frac{1}{4}\times\frac{1}{5}\ \left(=\frac{1}{20}\text{ or }0.05\right)$			M1	M1 $\frac{1}{4}\times\frac{4}{5}\left(=\frac{1}{5}\text{ or }0.2\right)$
	$"\frac{9}{80}"+"\frac{1}{20}"\left(=\frac{13}{80}\right)$ or "0.1125" + "0.05"(=0.1625)			M1	M1 $\frac{51}{80}+\frac{1}{5}$
	$(1-"\frac{13}{80}")\times 80$ or (1−"0.1625")×80 or $\frac{67}{80}$			M1	M1 $(\frac{51}{80}+\frac{1}{5})\times 80$ oe or $\frac{67}{80}$
		67		A1	
					Total 5 marks

6	a		Reflection in $y = -1$	2	B1 for reflection B1 for $y = -1$ NB. If more than one transformation then award no marks
	b		Vertices at (−2, 1) (−2, 6) (−5, 1) (−5, 3)	2	B2 If not B2 then award B1 for a correct transformation 90^{o} clockwise about (0, 0) **or** 3 vertices correct **or** correct shape in correct orientation but in wrong position
					Total 4 marks

<table>
<tr><td>7</td><td><table><tr><td>x</td><td>−2</td><td>−1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>y</td><td>10</td><td>8</td><td>6</td><td>4</td><td>2</td><td>0</td><td>−2</td></tr></table></td><td>$y = 6 - 2x$ drawn from
$x = -2$ to
$x = 4$</td><td>4</td><td>B4</td><td>For a correct line between $x = -2$ and $x = 4$</td></tr>
<tr><td></td><td></td><td></td><td></td><td>B3</td><td>For a correct straight line segment through at least 3 of
(−2, 10) (−1, 8) (0, 6) (1, 4) (2, 2) (3, 0) (4,−2)

OR for all of (−2, 10) (−1, 8) (0, 6) (1, 4) (2, 2) (3, 0) (4, −2)
plotted but not joined</td></tr>
<tr><td></td><td></td><td></td><td></td><td>B2</td><td>For at least 2 correct points plotted</td></tr>
<tr><td></td><td></td><td></td><td></td><td>B1</td><td>For at least 2 correct points stated (may be in a table) OR

for a line drawn with a negative gradient through (0, 6) OR
a line with gradient −2</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2">Total 4 marks</td></tr>
</table>

8	a	$224 \div 8$ oe	28	2	M1 A1
	b	$523 - 411$ (=112) **or** $\frac{523}{411}(=1.273...)$ **or** $\frac{523}{411}\times 100\,(=127.3...)$		3	M1
		$\frac{"112"}{411}\times 100$ **or** $100\times$"1.273" – 100 **or** "127.3" – 100			M1 dep
			27.3		A1 27.25 – 27.3
					Total 5 marks

9	a		$100 < w \leq 110$	1	B1
	b	$85 \times 3 + 95 \times 5 + 105 \times 7 + 115 \times 4 + 125$ $255 + 475 + 735 + 460 + 125$	2050	3	M2 for frequency × mid-interval for at least 4 products multiplied consistently and summing If not M2 then award M1 for multiplying consistently by value within intervals for at least 4 products (eg. end of interval) and summing products **or** mid-intervals used but not summed. A1 SC : B2 for an answer of 102.5
					Total 4 marks

10	$18^2 - (14 \div 2)^2$ (=275)		4	M1	**or** M1 for $\cos x = \frac{7}{18}$ **or** $\sin y = \frac{7}{18}$ **or** $\cos z = \frac{18^2 + 18^2 - 14^2}{2 \times 18 \times 18}$
	$\sqrt{18^2 - (14 \div 2)^2}$ **or** $\sqrt{275}$ **or** $5\sqrt{11}$ **or** 16.5… **or** 16.6			M1	**or** M1 for $x = \cos^{-1}\left(\frac{7}{18}\right)$ **or** $x = 67.1\ldots$ **or** $y = \sin^{-1}\left(\frac{7}{18}\right)$ **or** $y = 22.8\ldots$ **or** $z = \cos^{-1}\left(\frac{18^2 + 18^2 - 14^2}{2 \times 18 \times 18}\right)$ **or** $z = 45.77...$
	$0.5 \times 14 \times$ "16.5…" or $35\sqrt{11}$			M1	**or** M1 for 0.5×14×18×sin("67.1…") **or** 0.5×18×18×sin(2×"22.8…") **or** 0.5×18×18×sin("45.77...")
		116		A1	116 – 116.1 NB Allow use of Hero's formula
					Total 4 marks
	Alternative scheme				
	25(25 – 18)(25 – 18)(25 – 14)(= 13475) oe		4	M2	
	√13475 oe			M1	
		116		A1	
					Total 4 marks

11	a	e.g.$12x = 36$ **or** $24y = -60$		3	M1	for addition of given equations **or** a complete method to eliminate y or x (condone one arithmetic error)
		e.g. $7 \times$ "3"$+ 2y = 16$ or $7x + 2 \times -2.5 = 16$			M1	(dep) for method to find second variable
			$x = 3$ oe, $y = -2.5$		A1	dep on M1 for both values correct. NB. Candidates showing no working score zero
	b	$k^2 + 9k - 5k - 45$		2	M1	for 3 terms correct **or** all 4 terms correct ignoring signs **or** $y^2 + 4k + \ldots$ **or**… $+ 4k - 45$
			$k^2 + 4k - 45$		A1	
	c	eg $\left(\frac{1}{8x^6y^3}\right)^{-\frac{1}{3}}$ **or** $\left(\frac{8x^6y^8}{y^5}\right)^{\frac{1}{3}}$ **or** $\left(\frac{y^{\frac{-5}{3}}}{0.5x^{-2}y^{\frac{-8}{3}}}\right)$ oe		3		NB: **do not** accept decimal powers unless recurring dot is shown
					M1oe	any **one** of correct simplification of y term **or** reciprocal **or** cube root of at least all variables
		eg $\left(8x^6y^3\right)^{\frac{1}{3}}$ **or** $\left(\frac{1}{8^{\frac{-1}{3}}x^{-2}y^{-1}}\right)$ **or** $\left(\frac{2x^2y^{\frac{8}{3}}}{y^{\frac{5}{3}}}\right)$ oe			M1oe	any **two** of correct simplification of y term **or** reciprocal **or** cube root of at least all variables
			$2x^2y$		A1oe	e.g. $\left(\frac{y}{0.5x^{-2}}\right)$ SCB2 for $\left(\frac{1}{2x^2y}\right)$ or ax^ny^m with 2 of $a = 2, n = 2, m = 1$
						Total 8 marks

12	a		correct graph	2	B2	Points at end of intervals and joined with curve or line segments If not B2 then B1 for 5 or 6 of their points from table plotted consistently within each interval at their correct heights and joined with smooth curve or line segments
	b		57 – 59	2	M1 ft A1 ft	for a cf graph horizontal line or mark drawn at 40 or 40.5 or vertical line at correct place, ft their cf graph from their cf graph
	c		8	2	M1ft A1ft	for reading from cf axis ft their graph from 90 on time axis **or** 72 ft
						Total 6 marks

13	a		0.00079	1	B1	cao
	b		2.015×10^{10}	2	M1 A1	for 20.15×10^9 **or** 20 150 000 000 or 2.015×10^n where $n \neq 10$ For 2×10^{10} or better
						Total 3 marks

14	9000×0.018 (= 162) **or** 9000×1.018 (=9162)		3	M1	or for $\frac{3\times1.8}{100}\times 9000$ (=486) or 9486	M2 for 9000×1.018^3
	(9000 + "162)×0.018 (=164.916) ("9162" + "164.916")×0.018 (= 167.88…) "9162" + "164.916" + "167.88"			M1	for complete method	
		9494.8(0)		A1	accept 9494.8 - 9495	
						Total 3 marks

15	$-4y = 5 - 3x$		4	M1	isolates term in y
	$y = 0.75x$ (+ c) **or** gradient of **A** = 0.75 oe			M1	
	gradient of **B** = $\frac{3-7}{-1-4}\left(=\frac{4}{5}\right)$ oe			M1	or $y = 0.8x$ (+ c) oe
		No with correct figures		A1	eg. No gradient of **A** = 0.75 but gradient of **B** = 0.8 oe
					Total 4 marks

16	a	e.g. $3(3x + 1) - 5(x - 4) = 2\times15$ **or** $\frac{3(3x+1)}{15} - \frac{5(x-4)}{15} = 2$ **or** $\frac{3(3x+1)-5(x-4)}{15} = 2$		3	M1	deals with fractions eg. finds common denominator (15 or a multiple of 15) or multiplies by common multiple in a correct equation.
		e.g. $9x + 3 - 5x + 20 = 30$			M1	Expands brackets and multiplies by common denominator in a correct equation
			1.75 oe		A1	dep on M1
	b	$t(3p + 1) = 7 - 2p$		4	M1	multiplies by $3p + 1$ must have brackets
		$3pt + 2p = 7 - t$			M1	isolates terms in p
		$p(3t + 2) = 7 - t$			M1	takes p out as a common factor
			$p = \frac{7-t}{3t+2}$		A1	or $p = \frac{t-7}{-3t-2}$ oe with p as the subject
						Total 7 marks

17	e.g. $\frac{12}{3} = \frac{RX}{4}$ or $12 \times 4 = XR \times 3$ or $3x = 48$	3	M1	or $(2r - 3) \times 3 = 12 \times 4$
	$(XR =)\ 12 \times 4 \div 3\ (=16)$		M1	or $2r - 3 = 12 \times 4 \div 3$ or $XR = 16$ or an answer of 19
	9.5		A1oe	e.g. $\frac{19}{2}$
				Total 3 marks

18	$\frac{7\sqrt{p}-p^2}{p\sqrt{p}}$ **or** $\frac{7\sqrt{p}-p^2}{\sqrt{p^3}}\times\frac{\sqrt{p^3}}{\sqrt{p^3}}$ oe		3	M1 e.g. $\frac{7p^{\frac{1}{2}}-p^2}{p^{\frac{3}{2}}}$
	$\frac{7\sqrt{p}-p^2}{p\sqrt{p}}\times\frac{\sqrt{p}}{\sqrt{p}}$ **or** $\frac{7\sqrt{p}-p\sqrt{p}\sqrt{p}}{p\sqrt{p}}$ **or** $\frac{7\sqrt{p}\sqrt{p^3}-p^2\sqrt{p^3}}{p^3}$ oe			M1 e.g. $\frac{7p^2-p^{\frac{7}{2}}}{p^3}$ oe
		$\frac{7-p\sqrt{p}}{p}$		A1 for $\frac{7-p\sqrt{p}}{p}$ **or** $\frac{7}{p}-\sqrt{p}$ oe **or** $\frac{7-p^{\frac{3}{2}}}{p}$ oe
				Total 3 marks

19	a		2	1	B1
	b		0.5 oe	1	B1
	c	$y(2-x) = 3$ or $x(2-y) = 3$ oe	$\frac{2x-3}{x}$	2	M1
					A1 $\frac{3-2x}{-x}$ or $2-\frac{3}{x}$ must be in terms of x
	d	$\frac{3}{2-\frac{2x+1}{3}}$ oe	$\frac{9}{5-2x}$	2	M1
					A1
					Total 6 marks

20	a		$3x^2 - 8x + 5$	2	M1	for any 2 of $3x^2$ or $-8x$ or $+5$ differentiated correctly
					A1	
	b	$3x^2 - 8x + 5 = 1$	$\frac{2}{3}$, 2	4	M1	ft from (a)
		$3x^2 - 8x + 4 = 0$			M1	ft rearrange ready to solve, ft as long as $ax^2 - bx + c$
		eg $(3x - 2)(x - 2) = 0$			M1	ft correct method to solve quadratic – if using formula, every term to be substituted correctly as long as $ax^2 - bx + c$
					A1	cao dep on M2 Ignore any attempts to find y values
						Total 6 marks

21	$(OB^2 =)\ 12^2 + 16^2 - 2 \times 12 \times 16 \times \cos(60^o)$		5	M1	M2 for $\sqrt{(12^2 + 16^2 - 2 \times 12 \times 16 \times \cos(60^o))}$
	$(OB =)\sqrt{208}$ **or** $4\sqrt{13}$ **or** 14.4…. **or** $(OB^2) = 208$			M1	
	$0.5 \times 12 \times 16 \times \sin(60^o)$ (= 83.1…or $48\sqrt{3}$) **or** $\frac{38}{360} \times \pi \times "14.4" \times "14.4"$ (=68.9…) **or** $\frac{38}{360} \times \pi \times "208"$ (=68.9…)			M1	ft their 14.4 provided first M1 awarded.
	$0.5 \times 12 \times 16 \times \sin(60^o) + \frac{38}{360} \times \pi \times "14.4" \times "14.4"$ (68.9....+ 83.1...)			M1	ft their 14.4 provided first M1 awarded.
		152		A1	awrt 152
					Total 5 marks

22	$\frac{4}{12}\times\frac{3}{11}\times\frac{4}{10}(=\frac{48}{1320}=\frac{2}{55})$ oe		5	M1	M2 for $\frac{4}{12}\times\frac{3}{11}\times\frac{8}{10}(=\frac{96}{1320}=\frac{4}{55})$ oe
	$3\times\frac{4}{12}\times\frac{3}{11}\times\frac{4}{10}$ **or** $2\times\frac{4}{12}\times\frac{3}{11}\times\frac{4}{10}$			M1	
	$3\times2\times\frac{4}{12}\times\frac{3}{11}\times\frac{4}{10}$ oe **or** $3\times3\times\frac{4}{12}\times\frac{3}{11}\times\frac{4}{10}$			M1	M1 for $3\times\frac{4}{12}\times\frac{3}{11}\times\frac{8}{10}$ oe
	$3\times3\times2\times\frac{4}{12}\times\frac{3}{11}\times\frac{4}{10}$ oe			M1	M1 for $3\times3\times\frac{4}{12}\times\frac{3}{11}\times\frac{8}{10}$ oe
		$\frac{36}{55}$		A1	oe eg. $\frac{864}{1320}$ (0.65(45454...))
	Alternative using 1 – (all different + all the same)				
	$\frac{4}{12}\times\frac{4}{11}\times\frac{4}{10}$ **or** $\frac{4}{12}\times\frac{3}{11}\times\frac{2}{10}$		5	M1	
	$\frac{4}{12}\times\frac{4}{11}\times\frac{4}{10}\times6$ **or** $\frac{4}{12}\times\frac{3}{11}\times\frac{2}{10}\times3$			M1	
	$\frac{4}{12}\times\frac{4}{11}\times\frac{4}{10}\times6$ **and** $\frac{4}{12}\times\frac{3}{11}\times\frac{2}{10}\times3$			M1	
	$1-[(\frac{4}{12}\times\frac{4}{11}\times\frac{4}{10}\times6)+(\frac{4}{12}\times\frac{3}{11}\times\frac{2}{10}\times3)]$			M1	
		$\frac{36}{55}$		A1	oe eg. $\frac{864}{1320}$ (0.65(45454...))
					Total 5 marks

	SC: With replacement (maximum marks M3)			**Total 5 marks**	
22	$3\times\frac{4}{12}\times\frac{4}{12}\times\frac{4}{12}\left(=\frac{192}{1728}=\frac{1}{9}\right)$ **or** $2\times\frac{4}{12}\times\frac{4}{12}\times\frac{4}{12}\left(=\frac{128}{1728}=\frac{2}{27}\right)$		3	M1	or $\frac{4}{12}\times\frac{4}{12}\times\frac{8}{12}$
	$3\times2\times\frac{4}{12}\times\frac{4}{12}\times\frac{4}{12}$ oe **or** $3\times3\times\frac{4}{12}\times\frac{4}{12}\times\frac{4}{12}$ oe			M1	or $3\times\frac{4}{12}\times\frac{4}{12}\times\frac{8}{12}$
	$3\times3\times2\times\frac{4}{12}\times\frac{4}{12}\times\frac{4}{12}$ oe			M1	M1 for $3\times3\times\frac{4}{12}\times\frac{4}{12}\times\frac{8}{12}$

23	a	$\overrightarrow{CD} = \overrightarrow{CB} + \overrightarrow{BA} + \overrightarrow{AD}$ **or** $-\mathbf{c} - \mathbf{b} + 3\mathbf{c}$		2	M1
			$2\mathbf{c} - \mathbf{b}$		A1
	b	$\overrightarrow{BP} = \overrightarrow{BA} + \frac{2}{3}\overrightarrow{AC}$ **or** $\overrightarrow{PD} = \frac{1}{3}\overrightarrow{AC} + \overrightarrow{CD}$		4	M1ft Ft their $\overrightarrow{CD}$
		$\overrightarrow{BP} = -\mathbf{b} + \frac{2}{3}(\mathbf{b} + \mathbf{c})$ $(= \frac{2}{3}\mathbf{c} - \frac{1}{3}\mathbf{b})$ **or** $\overrightarrow{PD} = \frac{1}{3}(\mathbf{b} + \mathbf{c}) + 2\mathbf{c} - \mathbf{b}$ $(= \frac{7}{3}\mathbf{c} - \frac{2}{3}\mathbf{b})$			M1ft
		$\overrightarrow{BP} = -\mathbf{b} + \frac{2}{3}(\mathbf{b} + \mathbf{c})$ $(= \frac{2}{3}\mathbf{c} - \frac{1}{3}\mathbf{b})$ **AND** $\overrightarrow{PD} = \frac{1}{3}(\mathbf{b} + \mathbf{c}) + 2\mathbf{c} - \mathbf{b}$ $(= \frac{7}{3}\mathbf{c} - \frac{2}{3}\mathbf{b})$ **OR** $\overrightarrow{BP} = -\mathbf{b} + \frac{2}{3}(\mathbf{b} + \mathbf{c})$ $(= \frac{2}{3}\mathbf{c} - \frac{1}{3}\mathbf{b})$ **AND** $\overrightarrow{BD} = -\mathbf{b} + 3\mathbf{c}$ **OR** $\overrightarrow{PD} = \frac{1}{3}(\mathbf{b} + \mathbf{c}) + 2\mathbf{c} - \mathbf{b}$ $(= \frac{7}{3}\mathbf{c} - \frac{2}{3}\mathbf{b})$ **AND** $\overrightarrow{BD} = -\mathbf{b} + 3\mathbf{c}$			M1 **or** $\overrightarrow{BP} = \frac{1}{3}(2\mathbf{c} - \mathbf{b})$ **and** $\overrightarrow{CD} = 2\mathbf{c} - \mathbf{b}$

		No with correct appropriate vectors and reason		A1	E.g. $\overrightarrow{BP} = \frac{1}{3}(2\mathbf{c} - \mathbf{b})$ and $\overrightarrow{CD} = 2\mathbf{c} - \mathbf{b}$ are parallel and therefore not in a straight line **OR** Correct simplified vectors for two of *BP, BD, PD* with explanation that vectors are not a multiple of each other
					Total 6 marks

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