Mark Scheme (Results)

January 2017

International GCSE Mathematics A
4MA0/4H

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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
  - awrt – answer which rounds to
  - 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  If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.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.

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Apart from Questions 10, 16, 18 and 19 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	$\dfrac{45+1}{2}$ or 23 or $\dfrac{45}{2}$ or 22.5		2	M1 For an ordered list at least as far as the first 2
		2		A1
				Total 2 marks

Q	Working	Answer	Mark	Notes
2 (a)	$1-0.4-0.2-0.1$ or 0.3		3	M1
	$\dfrac{1-0.4-0.2-0.1}{2}$ or $\dfrac{"0.3"}{2}$			M1 dep
		0.15		A1
(b)	200×0.4		2	M1
		80		A1 Note: Award M1A1 for 80 out of 200 Award M1A0 for 80/200
				Total 5 marks

3		Eg $\frac{715.5}{530} \times 750$ or 1.35×750 oe Or $\frac{750}{530} \times 715.5$ or $1.41(509...) \times 715.5$ oe Or $750 \div \frac{530}{715.5}$ or $715.5 \div \frac{530}{750}$ oe		3	M2	For a complete method If not M2 then M1 for $\frac{715.5}{530}$ or 1.35 oe or $\frac{530}{715.5}$ or 0.740(740…) oe or $\frac{750}{530}$ or 1.41(509...) oe $\frac{530}{750}$ or 0.706(666…) oe $530x = 750 \times 715.5$
			1012.50		A1	Accept 1012.5
						Total 3 marks

4	(a)	(i)	$\frac{256}{36-\pi}$ or $\frac{256}{32.8(584...)}$		3	M1	For 32.8(58...) rounded or truncated to at least 3SF seen
				7.791004515		A1	Allow 7.791(0045...) rounded or truncated to at least 4SF
		(ii)		7.79		B1	ft if at least 4SF given in (i)
	(b)				2	M1	for 0.06 oe or 6×10^n where n is a negative integer other than -2
				6×10^{-2}		A1	
							Total 5 marks

5	(a)			straight line from $(12\,30, 3.5)$ to $(1315, 0)$	2	B2	B1 for a single straight line with negative gradient that starts at $(12\,30, 3.5)$ or ends at $(1315, 0)$ Ignore lines before 12:30
	(b)			1	1	B1	Ft if B1 scored in (a)
							Total 3 marks

6	(a)		6	1	B1	
	(b)	$(y=)\dfrac{3e+7e}{2}$ or $(y=)\dfrac{10e}{2}$ oe or $(y=)3e+\dfrac{7e-3e}{2}$ or $(y=)3e+2e$ oe or $(y=)7e-\dfrac{7e-3e}{2}$ or $(y=)7e-2e$ oe		2	M1	For an unsimplified expression equivalent to $5e$
			$5e$		A1	cao
						Total 3 marks

7	(a)	a, b, d, e	a, b, d, e	2	B2 B1 for a, e **or** a, b, d **or** b, d, e **or** a, b, e **or** a, d, e **or** a, b, c, d, e **or** a, b, d, e, f or a Venn diagram with a, c, e, f correctly shown	
	(b)		c, e, f	1	B1	
						Total 3 marks

8	(a)			2	M1	For a point marked due south of *A* or on a correct bearing (within overlay) from *B*.
			Correct point		A1	within overlay
	(b)	$168+180$ or $360-12$		2	M1	For a complete method or for clearly identifying the reflex angle on the diagram.
			348		A1	cao
	(c)		6.25	1	B1	cao
						Total 5 marks

9	(a)	$(EF^2 =)2.1^2 + 3.5^2 (= 4.41 + 12.25 = 16.66)$		3	M1	
		$(EF =)\sqrt{2.1^2 + 3.5^2}$ or $\sqrt{16.66}$			M1	dep
			4.1		A1	allow 4.08(166…) rounded or truncated to at least 2DP
	(b)	$\tan F = \dfrac{2.1}{3.5}$ or $\tan F = 0.6$ $\sin F = \dfrac{2.1}{4.1}$ or $\sin F = 0.512(195...)$ $\cos F = \dfrac{3.5}{4.1}$ or $\cos F = 0.853(658...)$		3	M1	ft 4.1 from (a)
		$\tan^{-1}\left(\dfrac{2.1}{3.5}\right)$ or $\tan^{-1} 0.6$ or $\sin^{-1}\left(\dfrac{2.1}{4.1}\right)$ or $\sin^{-1} 0.512(195…)$ or $\cos^{-1}\left(\dfrac{3.5}{4.1}\right)$ or $\cos^{-1} 0.853(658…)$			M1	ft 4.1 from (a)
			31		A1	ft 4.1 from (a) Accept 30.8 – 31.4
						Total 6 marks

10	Eg $8y--2y=18-33$ or $10y=-15$ or $-2y-8y=33-18$ or $-10y=15$ or $25x=150$ or $5x+4(5x-33)=18$ or $33+2y+8y=18$ or $18-8y-2y=33$		3	M1	For a correct method to find an equation in x or y. Allow one arithmetical error.
	Eg $5\times6-2y=33$ or $5\times6+8y=18$ or $5x-2\times-1.5=33$ or $5x+8\times-1.5=18$			M1	For a correct substitution Dep on first M1awarded
		$x=6$, $y=-1.5$		A1	oe dep on M1
					Total 3 marks

11	(a)			2	M1	For clearly identifying the line $x = 1$ or For a reflection in any vertical line
			triangle drawn $(-3, 0)$ $(-1, -3)$, $(-3, -2)$		A1	SCB1 for a correct reflection in $y = 1$
	(b)	**S** $(-3, 0), (-3, 2), (-1, 3)$		3	M1	Ft for **S**
			rotation of $180°$ with centre (1, 0)		A1	rotation $180°$ oe or Enlargement sf $= -1$
					A1	(1, 0)
						SCB2 for a fully correct description of their transformation if **S** is in the incorrect position

Note: Award M1A1A1 for a correct description even if S not drawn

Award no Answer marks if more than one transformation is given. |
| | | | | | | **Total 5 marks** |

12	(a)	$2y = 3x - 15$ or $-2y = 15 - 3x$ or $1.5x - y = 7.5$		3	M1	Or for finding the coordinates of two correct points that lie on the line
		$y = 1.5x - 7.5$ or $y = \dfrac{3x-15}{2}$ or $y = \dfrac{15-3x}{-2}$ oe			M1	or $\dfrac{\text{difference of } y \text{ values}}{\text{difference of } x \text{ values}}$ for any two correct points on the line
			1.5		A1	oe Do not penalise a mistake in the constant term if the correct answer is given. SCB2 for $1.5x$ SCB1 ft from their $y = ax + b$
	(b)		$(0, -7.5)$	1	B1	oe
	(c)	$0 = 1.5 \times -2 + c$ or $3 \times -2 = k$ or $y - 0 = 1.5(x - -2)$		2	M1	ft 1.5 from (a) or $c = 3$
			$y = 1.5x + 3$		A1	ft 1.5 from (a) or $3x - 2y = -6$ or $y = 1.5(x + 2)$ oe
						Total 6 marks

13	(a)		79°	1	B1	
	(b)	$\angle BDE = 79 - 41$ or $180 - 101 - 41(= 38)$ or $\angle OBE = 90 - 38$ or $90 - (180 - 101 - 41)$ (=52)		2	M1	may be marked on diagram
			76		A1	
						Total 3 marks

14	(a)		$\dfrac{12}{52},\dfrac{40}{52},\dfrac{11}{51},\dfrac{40}{51},\dfrac{12}{51},\dfrac{39}{51}$	3	B3	B1 for each pair. Accept equivalent fractions Eg $\dfrac{12}{52}=\dfrac{3}{13},\dfrac{40}{52}=\dfrac{10}{13},\dfrac{12}{51}=\dfrac{4}{17},\dfrac{39}{51}=\dfrac{13}{17}$ Accept equivalent decimals correct to at least 2dp (0.23, 0.77, 0.22, 0.78, 0.24, 0.76)	
	(b)	$\dfrac{12}{52}\times\dfrac{11}{51}$ or $\dfrac{132}{2652}$ or $\dfrac{11}{221}$ or $0.049(773...)$ or $\dfrac{40}{52}\times\dfrac{39}{51}$ or $\dfrac{1560}{2652}$ or $\dfrac{130}{221}$ or $\dfrac{10}{17}$ or $0.588(235...)$		3	M1	ft their tree diagram	M2 for $1-\left(\dfrac{12}{52}\times\dfrac{40}{51}+\dfrac{40}{52}\times\dfrac{12}{51}\right)$ $(=1-0.361(99...))$
		$\dfrac{12}{52}\times\dfrac{11}{51}+\dfrac{40}{52}\times\dfrac{39}{51}$ or $\dfrac{132}{2652}+\dfrac{1560}{2652}$ or $\dfrac{11}{221}+\dfrac{10}{17}$ oe			M1		
			$\dfrac{141}{221}$		A1	0.638(009…) rounded or truncated to at least 3 DP or oe	
						Total 6 marks	
		Alternative Method - With Replacement					
		$\dfrac{12}{52}\times\dfrac{12}{52}$ or $\dfrac{144}{2704}$ or $\dfrac{9}{169}$ or $0.053(254...)$ or $\dfrac{40}{52}\times\dfrac{40}{52}$ or $\dfrac{1600}{2704}$ or $\dfrac{100}{169}$ or $0.591(715...)$			M1	M2 for $1-\left(\dfrac{12}{52}\times\dfrac{40}{52}+\dfrac{40}{52}\times\dfrac{12}{52}\right)$ $(=1-0.355(029...))$	
		$\dfrac{12}{52}\times\dfrac{12}{52}+\dfrac{40}{52}\times\dfrac{40}{52}$ or $\dfrac{144}{2704}+\dfrac{1600}{2704}$ or $\dfrac{9}{169}+\dfrac{100}{169}$ or $\dfrac{1744}{2704}$ or $\dfrac{109}{169}$ or $0.644(970....)$ oe			M1		

15	(a)	$\begin{pmatrix} 4 \\ -1 \end{pmatrix} - \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ oe		2	M1	
			$\begin{pmatrix} 1 \\ -3 \end{pmatrix}$		A1	
	(b)	$2\begin{pmatrix} 4 \\ -1 \end{pmatrix} - \begin{pmatrix} 1 \\ -3 \end{pmatrix} \left(= \begin{pmatrix} 7 \\ 1 \end{pmatrix}\right)$		3	M1	Ft their $\overrightarrow{BC}$ in (a) For a correct expression for $\overrightarrow{CE}$ or $\overrightarrow{EC}$ in terms of column vectors
		$\sqrt{7^2 + 1^2}$			M1	Dep on first M1 awarded ft their $\overrightarrow{CE}$
			7.07		A1	7.07106… rounded or truncated to at least 2DP Accept $\sqrt{50}$ or $5\sqrt{2}$
						Total 5 marks

16	(a)	$2^{3+1} \times 3^{1+1} \times 7^{2+3}$		2	M1	or for a product of powers of 2, 3 and 7 with two powers correct, or for an attempt to find prime factors of 2420208 (allow one arithmetical error) or for 2^4, 3^2, 7^5
			$2^4 \times 3^2 \times 7^5$		A1	
	(b)	$2^{3-1} \times 3^{1-1} \times 7^{2-3}$		2	M1	or for any two correct.
			2, 0, −1		A1	Accept $2^2 \times 3^0 \times 7^{-1}$
	(c)	Eg $7^2 - (2\sqrt{5})^2$ or $7^2 - 14\sqrt{5} + 14\sqrt{5} - (2\sqrt{5})^2$		2	M1	For a correct unsimplified exact expansion 7^2 may be simplified to 49 and $(2\sqrt{5})^2$ as far as 20
			Show that		A1	Correct solution (simplified correctly) dep on M1
	(d)	$\dfrac{1}{9^{4/3}}$ or $9^{-\frac{4}{3}}$ or $\dfrac{1}{\sqrt[3]{(3^2)^4}}$ or $\dfrac{1}{\sqrt[3]{3^8}}$ oe		3	M1	Or for $9^4 = 3^8$
		$(3^2)^{-\frac{4}{3}}$ or $3^{-\frac{8}{3}}$ or $\dfrac{1}{3^{8/3}}$			M1	
			$-\dfrac{8}{3}$		A1	oe Eg $-2\dfrac{2}{3}$ or $-2.\dot{6}$ but not a decimal approximation.
						Total 9 marks

17	$(v =)8t + \dfrac{9}{t^2}$ or $(v =)8t + 9t^{-2}$		3	M2
				M1 for $8t$ or $9t^{-2}$ or $\dfrac{9}{t^2}$
		40.36		A1 oe
				Total 3 marks

18	(a)		4	1	B1	
	(b)	$6 = \dfrac{3}{x+4}$ or $(x =) \dfrac{3}{6} - 4$ or $\dfrac{3 - 4 \times 6}{6}$ oe		2	M1	or $\left(g^{-1}(x) =\right)\dfrac{3}{x} - 4$ or $\dfrac{3 - 4x}{x}$
			$-3\frac{1}{2}$		A1	oe
	(c)	$f(-3)$ or $\dfrac{2 \times -3}{3 \times -3 + 5}$ or $\dfrac{2 \times \dfrac{3}{-5+4}}{3 \times \dfrac{3}{-5+4} + 5}$		2	M1	Or for $(g(-5) =)\dfrac{3}{-5+4}$ or -3
			$1\dfrac{1}{2}$		A1	or $\dfrac{6}{4}$ or $\dfrac{3}{2}$ or 1.5
	(d)	$2x(x+4) = 3(3x+5)$ or $2x^2 + 8x = 9x + 15$ oe or $\dfrac{2x(x+4)}{(3x+5)(x+4)} = \dfrac{3(3x+5)}{(3x+5)(x+4)}$ or $\dfrac{2x(x+4)}{(3x+5)(x+4)} - \dfrac{3(3x+5)}{(3x+5)(x+4)} (= 0)$		4	M1	
		$2x^2 - x - 15 (= 0)$ or $\dfrac{2x^2 - x - 15}{(3x+5)(x+4)} (= 0)$			A1	
		$(2x+5)(x-3)(= 0)$ or $\dfrac{(2x+5)(x-3)}{(3x+5)(x+4)} (= 0)$			M1	or correct substitution into quadratic formula or correctly completing the square
			$-2\frac{1}{2},\ \ 3$		A1	dep on previous M1
						Total 9 marks

19	(a)	tangent at $(-1, 6)$		3	M1	For a drawing a tangent
		$\dfrac{\text{difference in } y \text{ values}}{\text{difference in } x \text{ values}}$			M1	Dep on first M1 awarded For $\dfrac{\text{difference in } y \text{ values}}{\text{difference in } x \text{ values}}$ for any two points on a tangent (ignore negative gradient) or For gradient in the range 4 to 6 inclusive
			-5		A1	Accept answer in the range -6 to -4 inclusive dep on M1
	(b)	graph $y = -2x + 7$		2	M1	For the correct line drawn
			2.2		A1	dep on M1 Accept 2.15 – 2.25
	(c)				M1	For $a = -4$ or $8.2 \leqslant b \leqslant 8.3$
			$-4, 8.2$		A1	allow $8.2 \leqslant b \leqslant 8.3$
						Total 7 marks

20	(a)	$6 + 10 + 8$ or $12 \times \dfrac{1}{2} + 20 \times \dfrac{1}{2} + 16 \times \dfrac{1}{2}$ or 48×0.5 or $60 \times 0.1 + 100 \times 0.1 + 80 \times 0.1$ or 240×0.1 or $2.4 \times 2.5 + 4 \times 2.5 + 3.2 \times 2.5$ or 9.6×2.5		2	M1	Or for 1 (small) square = 0.1 or 1 (big) square = 2.5 or For 6, 10 and 8 marked correctly on the diagram
			24		A1	
	(b)	$50 - 6 - 10 - 16$ or $50 - 32$ or $36 \times \frac{1}{2}$ or $\frac{1}{3} \times 54$ or 18 or 180 (small) squares or 180×0.1 or 7.2 (big) squares or 7.2×2.5		2	M1	For a vertical line at Time = 87
			87		A1	cao
						Total 4 marks

21	(a)	Eg $\dfrac{16.5}{\sin BAK} = \dfrac{21}{\sin 68}$ or $\dfrac{\sin BAK}{16.5} = \dfrac{\sin 68}{21}$		3	M1	For a correct equation using the Sine Rule
		$(\sin BAK =) \dfrac{16.5 \times \sin 68}{21}$ or 0.728(5016…) oe or $(BAK =) \sin^{-1}\left(\dfrac{16.5 \times \sin 68}{21}\right)$ or $(BAK =) \sin^{-1}(0.728(5016...))$ oe			M1	
			46.8		A1	Accept 46.7(609...) rounded or truncated to at least 1dp
	(b)	$\sin \alpha = \dfrac{9}{16.5}$ or $(\alpha =) \sin^{-1}\left(\dfrac{9}{16.5}\right)$		2	M1	Or for a correct equation using the Sine Rule
			33.1		A1	Accept 33.0(557...) rounded or truncated to at least 1dp
						Total 5 marks