

# AQA

GCSE

# Mathematics

SET A – Higher Tier

Author: Mike Fawcett

# H

FOR USE OF DIGITAL COPYRIGHT HOLDER ONLY

## Answers

### Key to abbreviations used within the answers

M	method mark (e.g. M1 means 1 mark for method)
A	accuracy mark (e.g. A1 means 1 mark for accuracy)
B	independent marks that do not require method to be shown (e.g. B2 means 2 independent marks)
C	communication mark
oe	or equivalent
ft	follow through
dep	dependent on previous mark
cao	correct answer only
sc	special case
indep	independent

### Acknowledgements

The author and publisher are grateful to the copyright holders for permission to use quoted materials and images.

All images are © HarperCollinsPublishers and Shutterstock.com

Every effort has been made to trace copyright holders and obtain their permission for the use of copyright material. The author and publisher will gladly receive information enabling them to rectify any error or omission in subsequent editions. All facts are correct at time of going to press.

Published by Collins  
An imprint of HarperCollinsPublishers  
1 London Bridge Street  
London SE1 9GF

© HarperCollinsPublishers Limited 2018

ISBN 9780008302122

First published 2018

10 9 8 7 6 5 4 3 2 1

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of Collins.

British Library Cataloguing in Publication Data.

A CIP record of this book is available from the British Library.

Commissioning Editor: Kerry Ferguson  
Project Leader and Management: Chantal Addy and Richard Toms  
Author: Mike Fawcett  
Cover Design: Sarah Duxbury  
Inside Concept Design: Ian Wrigley  
Text Design and Layout: QBS Learning  
Production: Karen Nulty

# Paper 1

Question	Answer	Mark	Comments
1 (a)	$x < -1$	B1	
1 (b)	$-2 \leq x < 2$	B1	
2	Equilateral	B1	
3 (a)	4	B1	
3 (b)	$16^{\frac{1}{2}}$ and $64^{\frac{1}{3}}$	B1	With no other boxes ticked
4	$\frac{15}{20} - \frac{8}{20}$ seen, oe.	M1	Allow one error in the numerators
	$21\frac{7}{20}$	A1	oe
5	2, 3, 3, and 3 identified; could be within a factor tree.	M1	Allow one arithmetic error in the method
	$2 \times 3 \times 3 \times 3$ or $2 \times 3^3$	A1	
6	$40 \div 3$ seen or 13	M1	
	$1.25 \times '13'$ [= 16.25]	M1	Must attempt a partition method
	$'16.25' + 0.48$	B1	cao
	£16.73	A1	scB1 for £17.50 (with no other method marks seen)
7	$a = 8, b = 14,$ $c = 2, d = 8$	B1	Any 2 correct
		B1	Fully correct
8	$120 \div 5 \times 2$ (= 48)	M1	
	$'120' - '48'$ (= 72)	M1dep	
	$'72' \div [4 + 5]$ (= 8)	M1dep	
	40 mins	A1	
9	ADE = $58^\circ$ or DGC = $77^\circ$	M1	May be labelled on the diagram
	$x = 77^\circ$	A1	
	Corresponding angles are equal <b>and</b> angles on a straight line add up to $180^\circ$ Or Vertically opposite angles are equal <b>with</b> angles in a triangle add up to $180^\circ$ <b>and</b> alternate angles are equal	C1	Allow 2 out of 3 reasons for C1

Question	Answer	Mark	Comments
10 (a)	$50 \times (60 \div 6)$ (= 500) $50 \div 6 \approx 8$	M1	
	$500 \times 8 = 4000$ or $500 \times 20 = 10000$ $500 \times 24 = 12000$  $'8' \times 60 \times 8 =$ $480 \times 8 \approx 500 \times 8 =$ $4000$ or $'8' \times 60 \times 24$ $= 480 \times 24$ $\approx 500 \times 20$ $= 10000$ or $'8' \times 60 \times 24$ $= 480 \times 24$ $\approx 500 \times 25$ $= 12500$	A1	This answer will depend on assumptions made
10 (b)	An assumption which supports their method in part (a) e.g. 'the machine operates for 8 hours per day' or 'the machine operates for 24 hours a day'	B1	
11 (a)	$4^2 + 2 \times 3 \times -2$	M1	
	$\sqrt{16 - 12}$	M1	
	$v = 2$	A1	Allow $v = 2$ and $v = -2$
11 (b)	$v^2 - u^2 = 2as$	M1	
	$a = \frac{v^2 - u^2}{2s}$	A1	
12	$a = -2$	B1	
	$b = 0.5$	B1	

Question	Answer	Mark	Comments
<b>13</b>	$8 \times 1$ or $2 \times 2$ or $5 \times 1$	M1	
	$8 + 4 (= 12)$ or $4 + 5 (= 9)$	M1	Award full method marks for subtraction method e.g. $(8 \times 3) - (2 \times 6)$
	12 and 9 seen	B1	
	$\frac{'12' - '9'}{9}$	M1dep	
	33.3(333...)%	A1	
	No	C1dep	
<b>14 (a) Alt 1</b>	$\frac{3}{25} > \frac{1}{10} > \frac{4}{50}$	B1	
	Benjamin	C1dep	
<b>14 (a) Alt 2</b>	'Because they each did different numbers of trials'	B1	Accept similar statement
	'I can't tell'	B1dep	Accept similar statement
<b>14 (b)</b>	Josue	B1	
	He did the most trials	B1	Accept similar statement
<b>15</b>	$2n^2$	B1	
	$2n^2 - 3$	A1	
<b>16</b>	$4x$ or $x + 12$ seen	M1	Accept other letters used instead of 'x'
	$x + 4x = x + 12$	M1	
	3	A1	Trial and error scores zero unless final answer is correct
<b>17 (a)</b>	7 (6) 13 (4) (9) (13) 11 15 (26)	B1	At least 3 out of 5 values correct
	Fully correct	B1	
<b>17 (b)</b>	$\frac{9}{13}$	A1ft	oe
<b>18 (a)</b>	30 seconds	B1	
<b>18 (b)</b>	$\frac{1200}{5}$ or $\frac{1.2}{5}$	M1	
	4 m/s	A1	

Question	Answer	Mark	Comments
<b>18 (c)</b>	$\frac{1200}{6} \div 60$ (= 3.33... mins)	M1	
	3 mins 20 seconds	B1	
	Straight line drawn from (6, 1.2) to a point marked on the $x$ axis between 9 and 9.5	A1	Point must be $> 9$
<b>19</b>	$\cos 60^\circ = \frac{1}{2}$	A1	
<b>20</b>	$x^2 + 5x + 6$ or $x^2 + x - 2$ or $x^2 + 2x - 3$	M1	
	$x^3 + 3x^2 + 2x^2 - x^2 + 6x - 3x - 2x - 6$	M1	Allow 4 out of 8 terms correct
	$x^3 + 4x^2 + x - 6$	A1	cao
<b>21</b>	$fg(x) = (x-1)(x-1)$	M1	or $fg(x) = (x-1)^2$
	$g(x) = x-1$	A1	cao
<b>22 (a)</b>	3, 8, 15, 33, 50, 57, 60	B1	Fully correct cumulative frequencies
	At least 6 points plotted from (1, 3), (2, 8), (3, 15), (4, 33), (5, 50), (6, 57), (7, 60)	B1ft	Allow follow through from part (a)
	Points joined with a smooth curve	A1	Fully correct graph
<b>22 (b)</b>	3.8 to 3.95 mins	B1	
<b>22 (c)</b>	Whisker starts at zero, LQ at 3, median at '3.8', UQ at 4.6, whisker ends at 7	B1	Allow 3 correct, 2 of which must be median and upper or lower quartile
	Fully correct box plot [ft values from their <b>cumulative</b> graph]	B1	

Question	Answer	Mark	Comments
<b>23</b>	Enlargement	B1	
	Scale factor $-1.5$	B1	
	centre (0,3)	B1	
<b>24</b>	$300 \times 2^3 (= 2400)$	M1	oe
	$2400 \div 1000$	M1 indep	Correct method seen to change any amount of ml into litres
	2.4 litres	A1	
<b>25</b>	$\sqrt{12} = \sqrt{3} \times \sqrt{4}$ or $\sqrt{27} = \sqrt{3} \times \sqrt{9}$	M1	
	$4\sqrt{3} + 2$	A1	
<b>26</b>	$\frac{10}{7}$ (= Gradient of radius to the point)	M1	oe
	$m = -\frac{7}{10}$ (gradient of the tangent)	M1dep	oe
	$10 = -\frac{7}{10} \times 7 + c$	M1dep	
	$y = -\frac{7}{10}x + 14.9$ or $10y = 149 - 7x$	A1	oe

### Paper 2

Question	Answer	Mark	Comments
<b>1</b>	7 : 24	B1	
<b>2</b>	9:31 pm	B1	
<b>3</b>	(7, 10, 12)	B1	
<b>4</b>	$8\pi$	B1	
<b>5</b>	Identity	B1	
<b>6</b>	$x^2$	B1	
<b>7 (a)</b>	Primary <b>and</b> continuous	B1	With no other boxes ticked
<b>7 (b)</b>	Ensure each student is equally likely to be picked e.g. names in a hat	C1	Either a statement or example is acceptable

Question	Answer	Mark	Comments
<b>8</b>	$\frac{(2x+8)(x-2)}{2}$ or $2x^2 + 8x - 4x - 16$	M1	Allow 1 error in the expansion
	Complete the proof to get $x^2 + 2x - 8$	A1	
<b>9</b>	42, 84, 126, ... and 70, 140, 210, ...	M1	Allow errors if intention is clear
	210 identified	M1	Or a multiple of 210
	$x = 5$ and $y = 3$	A1	Or multiples of 5 and 3
<b>10</b>	Any translation	B1	The shape should be exactly the same size and orientation
	Fully correct translation Top right corner should be the point (4,4)	B1	
<b>11 (a)</b>	$202\,000 \times 1.015^n$ seen	M1	$n$ can be any positive integer
	5 years	A1	
<b>11 (b)</b>	$180\,000 \div 1.18$ Or $180\,000 \div 1.06$	M1	
	$180\,000 \div 1.18$ $\div 1.06$ (= 143907)	M1	
	£144 000	A1	
<b>12 (a)</b>	$2.176 \times 10^4 \div$ $3.2 \times 10^7$	M1	
	$6.8 \times 10^{-4}$	A1	
	0.00068	B1	
<b>12 (b)</b>	$\left( \frac{1.15 \times 10^{-3}}{2.3 \times 10^{-5}} \right) \div 8$	M1	Allow 2 out of 3 terms correct
	6.25 N/m <sup>2</sup>	A1	

Question	Answer	Mark	Comments								
13	$161 \times 20$ (= 3220)	M1									
	$145 \times 3 + 155 \times 6 + 165 \times 6 + 175 \times 4$ (= 3055)	M1									
	‘3220’ – ‘3055’ (= 165)	M1dep									
	$160 < h \leq 170$ should have freq = 7	A1dep	Zero marks with no working								
14	$(x + 5)(x - 3)$	M1									
	$x = 3$ and $-5$	A1									
15 (a)	$y = \frac{5x}{3} + 1$	M1									
	<table border="1"><tr><td><math>x</math></td><td>-3</td><td>0</td><td>3</td></tr><tr><td><math>y</math></td><td>-4</td><td>1</td><td>6</td></tr></table>	$x$	-3	0	3	$y$	-4	1	6	M1	At least one of these points correctly plotted
	$x$	-3	0	3							
	$y$	-4	1	6							
Fully correct line plotted	B1										
$x = 1.5, y = 3.5$	A1	scB1 if correct answer with no graph drawn									
15 (b)	$y = -x + c$	M1	Allow gradient = $-1$								
	$x + y = 7$	A1	oe								
16 (a)	$0.23 \times 0.23 \times 0.77$	M1									
	0.040733	A1	Allow rounding to 0.04								
16 (b)	$\sqrt{0.0961}$ (= 0.31)	M1									
	0.69	A1									
17	$\frac{30}{360} \times \pi r^2$ (= $2.5\pi$ )	M1	oe								
	$\sqrt{12 \times 2.5}$	M1	oe								
	5.48 cm	A1									
18 (a)	12 to 12:30am	B1									
18 (b)	Tangent drawn on the graph at 10:30pm	M1									
	Answer in range 1.1 – 1.4 (cm/h)	A1									
19 (a)	$y = k\sqrt[3]{x}$	M1	Allow $k = 2.5$ for M1								
	$y = 2.5\sqrt[3]{x}$	A1	oe								

Question	Answer	Mark	Comments
<b>19 (b)</b>	$15 = 2.5\sqrt[3]{x}$	M1ft	
	$x = 216$	A1	
<b>20</b>	$455 \div 5 (= 91)$ and either 13 or 7 identified as a factor of 91	M1	
	20	A1	Allow 92 for full marks
<b>21 (a)</b>	$\frac{5a}{2} + 45a = 400$	M1	oe
	8.42 m/s	A1	
<b>21 (b)</b>	$1.5 \times 10$ or $0.4 \times 5$ or $0.4 \times 15$	M1	
	$1.5 \times 10 + 0.4 \times 5 + 0.4 \times 15$	M1	
	23	A1	
<b>22 (a)</b>	$4 \left[ x^2 - \frac{5}{4}x + 3 \right]$	M1	
	$4 \left[ \left( x - \frac{5}{8} \right)^2 - \frac{25}{64} + 3 \right]$	M1	
	$\left( \frac{5}{8}, 10\frac{7}{16} \right)$ oe	A2	1 mark for each
<b>22 (b)</b>	(5,3)	B2	1 mark for each
<b>23</b>	UB = 50.005m, LB = 49.995m, UB = 135.5s, LB = 134.5s	M1	At least one correct
	$\frac{200.02}{134.5}$ or $\frac{199.98}{135.5}$	M1dep	oe
	1.487(137546) or 1.475(867159)	B1dep	
	1.5	A1dep	No marks if 1.5 comes from $\frac{4 \times 50}{135}$
<b>24</b>	$2n(2n+2)(2n+4)$	M1	At least 2 correct expressions for even, consecutive numbers
	$8n^3 + 16n^2 + 8n^2 + 16n$	M1ft	At least 2 terms correct
	$8(n^3 + 3n^2 + 2n)$	A1	

Question	Answer	Mark	Comments
<b>25</b>	$\overline{BC} = \frac{3}{4}\mathbf{b}$	M1	
	$\overline{CE} = \frac{1}{8}\mathbf{b}$	M1	
	$\overline{AE} = \overline{AB} + \overline{BC} + \overline{CE}$	M1	
	$\overline{AE} = \mathbf{a} + \frac{7}{8}\mathbf{b}$	A1	oe
<b>26</b>	$CD = \frac{10.8 \sin 65}{\sin 61}$ (= 11.191...)	M1	
	$\sin \widehat{CBD}$ $= \frac{'CD' \times \sin 54}{9.1}$ (= 0.994...)	M1dep	
	$\widehat{CBD} = \sin^{-1}$ $\left( \frac{'CD' \times \sin 54}{9.1} \right)$ (= 84.233...)	M1dep	
	$\frac{1}{2} \times 9.1 \times 'CD' \times$ $\sin '41.766...'$	M1dep	
	33.9 cm <sup>2</sup>	A1	

### Paper 3

Question	Answer	Mark	Comments
<b>1 (a)</b>	£125	B1	
<b>1 (b)</b>	$350 \times 0.87$	B1	
<b>2</b>	Geometric	B1	
<b>3</b>	$x + y = 7$ and $5 - y = x$	B1	With no other boxes ticked
<b>4</b>	Top right diagram circled	B1	
<b>5</b>	6.25 cm	B1	
<b>6 (a)</b>	9.6474(95698)	B1	
<b>6 (b)</b>	9.65	B1ft	Allow follow through from answer to part (a)
<b>7 (a)</b>	At least 8 points plotted correctly	B1	Allow $\pm 1sq$ accuracy
<b>7 (b)</b>	No correlation	B1	
	Correct interpretation e.g. 'there is no connection between height and salary earned'	C1	

Question	Answer	Mark	Comments
<b>8</b>	Attempt at a method to find prime factors for both $135 = 3 \times 3 \times 3 \times 5$ $630 = 2 \times 3 \times 3 \times 5 \times 7$	M1	Accept at least one correct step for each
	either $3 \times 3 \times 3 \times 5$ or $2 \times 3 \times 3 \times 5 \times 7$ or $3 \times 3 \times 5$ seen	M1 indep	At least one fully complete
	HCF = 45	A1	
<b>9</b>	An example showing that when $x \leq 1, \frac{1}{x^2} \geq x$	M1	e.g. when $x = 0.5$ $\frac{1}{0.5^2} = 4$
	No	C1dep	
<b>10</b>	<div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"><b>51</b></div> <div style="text-align: center;"> <math>\begin{array}{r} 30 \\ 21 \end{array}</math> </div> <div style="text-align: center;"> <math>\begin{array}{r} 13 \\ 17 \\ 15 \\ 6 \end{array}</math> </div> </div>	M2	1 mark for two correct entries 2 marks for three or four correct entries
	Fully correct diagram	A1	3 marks for fully correct
<b>11</b>	$\frac{26 - 19}{26} \times 100$	M1	
	26.9 %	A1	Allow 27%
<b>12</b>	Complete method seen e.g. $\frac{19}{5} \times \frac{4}{3}$	M1	oe
	$\frac{76}{15}$	A1	
	$5\frac{1}{15}$ inches	B1	
<b>13</b>	(exterior angle = ) $180 - 2x$	M1	
	$\frac{360}{180 - 2x}$	M1	
	$\frac{180}{90 - x}$	A1	

Question	Answer	Mark	Comments
<b>14</b>	$3 \times 4 \times 7 (= 84\text{cm}^3)$	M1	
	$\frac{1}{3} \times \pi \times 3^2 \times 5$	M1	
	$15\pi$ or $47.123\dots (\text{cm}^3)$	M1	
	$\frac{661}{84}$ or $\frac{557}{55}$ or $\frac{336}{15\pi}$	M1dep	
	$\frac{661}{84}$ and $\frac{557}{55}$ and $\frac{336}{15\pi}$	M1dep	
	At least one of $7.869\dots$ or $10.127\dots$ or $7.13\dots$	A1	
	Zinc, Iron, Copper, Silver and $7.8\dots$ , and $10.1\dots$ , and $7.1\dots$ seen	C1dep	
<b>15</b>	Perpendicular bisector of Brooks and Redding constructed	M1	Arcs should be visible
	Arc / Circle about Dufresne with radius of 3.1 cm	M1	Accept $3 \rightarrow 3.2$ cm
	Correct region shaded bounded by 'arc' and 'bisector'	A1dep	Dependent on at least one M1
<b>16</b>	$2x^2 - 5x - 3 \leq 0$	M1	Allow '=' in place of ' $\leq$ '
	$(2x + 1)(x - 3)$	M1dep	
	$-0.5$ or $3$ identified as boundary solutions	A1dep	
	$-0.5 \leq x \leq 3$	A1	
<b>17</b>	Median = 21	B1	
	Upper quartile = 30.5 Lower quartile = 9	M1	At least one correct
	Yes, with 21, 30.5 and 9 identified	A1dep	

Question	Answer	Mark	Comments
<b>18</b>	2500 ml or 0.5 litres seen	M1	
	$2500 \times (0.965)^n$	M1	Any positive value of $n$ tried
	7 mins	A1	
<b>19 (a)</b>	Bottom right diagram circled	B1	
<b>19 (b)</b>	A (parabolic) curve starting at zero and getting steeper	B1	
<b>20</b>	One correct angle identified from $\widehat{ADC} = 90^\circ$ , $\widehat{BOC} = 2 \times 38 (= 76)$	B1	
	$2 \times ('90' - 38)$ or $180 - '76'$	M1dep	
	$x = 104^\circ$	A1	
<b>21</b>	$x = 0.2333\dots$ or $10x = 2.333\dots$ or $100x = 23.333\dots$	M1	
	$90x = 21$	M1dep	
	$\frac{21}{90} = \frac{7}{30}$	A1dep	
<b>22 (a)</b>	$5x = 3 - x^3$	M1	Attempt to add 3 and subtract $5x$ from both sides
	$x = \frac{3 - x^3}{5}$	A1	
<b>22 (b)</b>	$0^3 + 5 \times 0 - 3 = -3$ AND $1^3 + 5 \times 1 - 3 = 3$	M1	
	Sign changes, therefore $x$ must lie between 1 and 0	C1	oe

Question	Answer	Mark	Comments
<b>22 (c)</b>	$x_1 = \frac{3-0}{5} (= 0.6)$	M1	
	$x_2 = \frac{3 - '0.6^3'}{5}$ (= 0.556...)	M1dep	
	$x_3 = 0.565...$ , $x_4 = 0.563...$ and $x_5 = 0.564...$ with 0.56 identified as the final answer to 2 decimal places	A1dep	
<b>23 (a)</b>	Even only : 4, 10, 20, 50, 100 Prime only: 5	B1	
	Intersection: 2	B1	
	Outside the circles: 1 and 25	B1	
<b>23 (b)</b>	$\frac{1}{9}$	A1	cao
<b>24</b>	$(\sqrt{2})^n$ or $(\sqrt{2})^9$ seen	M1	
	$16\sqrt{2}$	A1	cao
<b>25</b>	$\frac{4}{x-3} + \frac{3}{x+1} = 1$	M1	
	$\frac{4(x+1)}{(x-3)(x+1)} +$ $\frac{3(x-3)}{(x+1)(x-3)}$	M1	
	$(x-3)(x+1)$ $= x^2 - 3x + x - 3$	M1 indep	3 out of 4 terms correct
	$7x - 5$ $= x^2 - 2x - 3$	M1dep	oe
	$x^2 - 9x + 2 = 0$	M1	
	$\frac{9 \pm \sqrt{81 - 4 \times 1 \times 2}}{2}$	M1	
	$x = 8.77, y = 0.31$ and $x = 0.23, y = 2.44$	A1	Fully correct

Question	Answer	Mark	Comments
<b>26 (a)</b>	$AG = \sqrt{1^2 + 1^2}$ (= $\sqrt{2}$ )	M1	'1' could be replaced by any other chosen value for the side length of the cube
	$AF = \sqrt{(\sqrt{2})^2 + 1^2}$ (= $\sqrt{3}$ )	M1 depft	Ft from their chosen value for '1'
	$1 : \sqrt{3}$	A1	cao
<b>26 (b)</b>	$\tan^{-1}\left(\frac{1}{\sqrt{2}'}\right)$	M1ft	Or their values for '1' and ' $\sqrt{2}$ ' in part (a)
	$35.3^\circ$	A1	cao