For **AQA**

Mathematics

Paper 2 (Calculator)

Higher Tier

Churchill Paper 2E – Marking Guide

Method marks (M) are awarded for a correct method which could lead to a correct answer

Accuracy marks (A) are awarded for a correct answer, having used a correct method, although this can be implied

(B) marks are awarded independent of method

Churchill Maths

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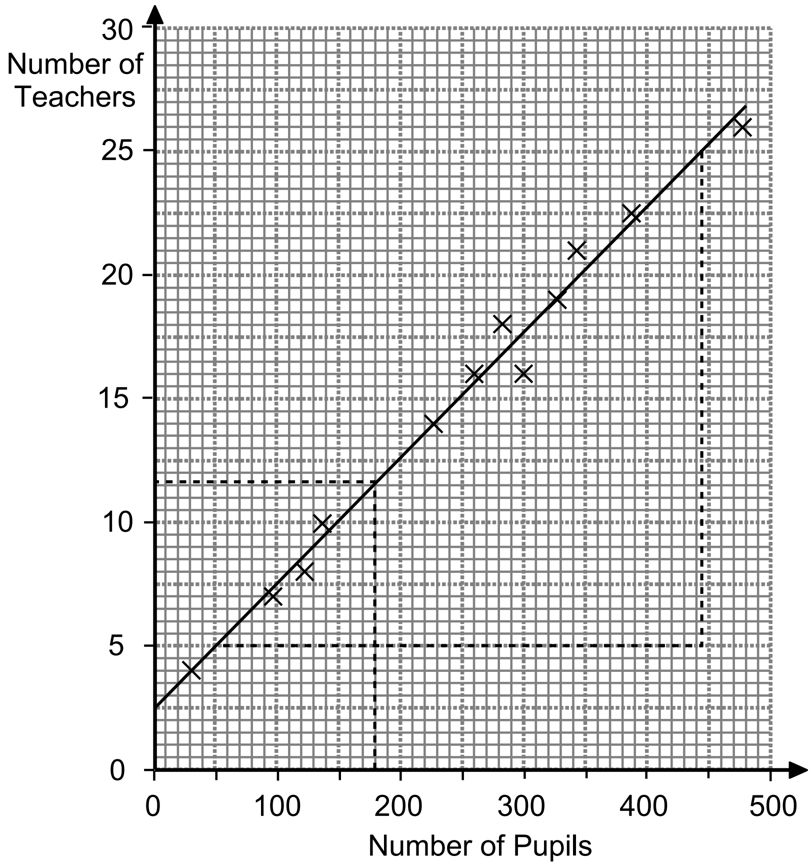
Churchill Paper 2E Marking Guide – AQA Higher Tier

1	**(a)**	$180 - 2 \times 31 = 180 - 62 = 118^\circ$ $a = 360 - 118 = 242^\circ$		
		62° 118° 222° 242°	B1	
	(b)	External angle of regular octagon = $360 \div 8 = 45^\circ$ External angle of regular hexagon = $360 \div 6 = 60^\circ$ $b = 45 + 60 = 105^\circ$		
		95° 105° 111° 115°	B1	Total 2
2		$(2p^3)^2 = 2^2 \times (p^3)^2 = 4p^6$		
		$2p^6$ $4p^5$ $4p^6$ $32p^5$	B1	Total 1
3		$\sqrt{0.58} = 0.7615...$ $\sqrt{0.59} = 0.7681...$ $\frac{10}{13} = 0.7692...$ $\frac{13}{17} = 0.7647...$ $\frac{17}{22} = 0.7727...$ $\frac{35}{46} = 0.7608...$		
		$\frac{10}{13}$ $\frac{13}{17}$ $\frac{17}{22}$ $\frac{35}{46}$	B1	Total 1
4		Kevin's share = $3 \times 36 = £108$	M1	
		8 portions = 108 so 1 portion = $108 \div 8 = £13.50$	M1	
		Jamal gets 5 portions = $5 \times 13.50 = £67.50$	A1	Total 3

5 **(a)** $\approx 300 - 260 = 40$ B1

(b)



M1

$\approx$ 12 teachers (from line of best fit, nearest whole number) A1

(c) $\approx \dfrac{25 - 5}{445 - 50} = 0.051$ (2dp) M1 A1

(d) e.g. You need an extra 0.051 teachers for every extra pupil B1

[OR: You need an extra teacher for every extra 20 pupils] Total 6

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6 e.g. 20% off is $\frac{1}{5}$ off

Buy 2 get 1 half price means he would pay $2\frac{1}{2}$ times the usual price for 3 packets M1

The fraction of full price he pays is $\dfrac{2\frac{1}{2}}{3} = \dfrac{5}{6}$

The discount is $\frac{1}{6}$ M1

$\frac{1}{5}$ is larger than $\frac{1}{6}$ so 20% off is better value A1

[Can get full marks with an assumed price and suitable words] Total 3

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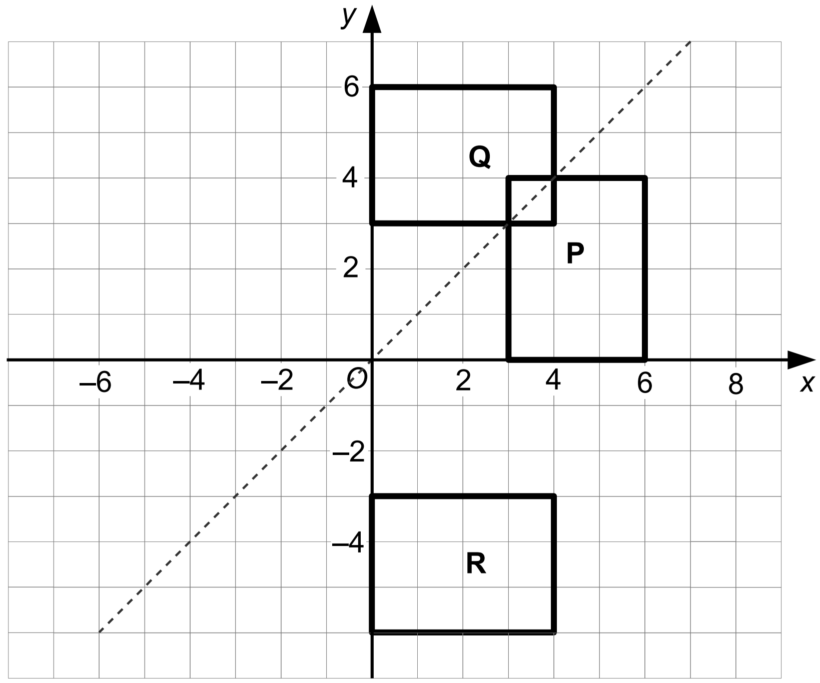
7 **(a)**



M1 A1

(b) (3, 3) and (4, 4) — B1

(c) Rotation by 90º clockwise about the point (0, 0) — M2 A1 — Total 6

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8 A kite has two pairs of equal sides

Here: $2p + 2 = 3p - 3$ — M1

$2p + 5 = 3p$

$5 = p$ — A1

So, $2p + 2 = 2 \times 5 + 2 = 12$

Each half of kite is a right-angled triangle

Base = $2p + 2 = 12$ cm and perpendicular height = $p = 5$ cm

Area of half of kite = $\frac{1}{2} \times 5 \times 12 = 30 \text{ cm}^2$ — M1

Area of kite = $2 \times 30 = 60 \text{ cm}^2$ — A1 — Total 4

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9 **(a)** The mean — B1

e.g. There is no prize of 50p so that cannot be the mode.
With 5 values, the median will be the 3rd value (in order) and as there is no prize of 50p the median cannot be 50p. — B1

(b) e.g. He has assumed the ball is equally likely to go through each of the gates. — B1

(c) e.g. To go through the outer gates the ball has to move quite a bit to the side. Hence the ball is less likely to go through the outer gates and his assumption is not reasonable. — B1
The outer gates win the bigger prizes so the true mean prize will be considerably less (and almost certainly less than the 40p it costs for a roll!) — B1 — Total 5

10	**(a)**	$= x^2 - x - 5x + 5$ $= x^2 - 6x + 5$		
		$x^2 - 6x + 5$ $\quad x^2 - 6x - 5$ $\quad x^2 - 4x + 5$ $\quad x^2 - 5x + 6$	B1	
	(b)	$(x - 1)(x + 10)$ $\quad (x + 2)(x - 5)$		
		$(x - 2)(x - 5)$ $\quad (x - 2)(x + 5)$	B1	Total 2
11	**(a)**	≈ -3.8	B1	
	(b)	$x \approx -1$, $x \approx 4$	B1	Total 2
12		$y = \frac{1}{3}(x - 2)$		
		For inverse, swap x and y: $\quad x = \frac{1}{3}(y - 2)$ $3x = y - 2$ $3x + 2 = y$		
		$\dfrac{3}{x+2}$ $\quad 3(x + 2)$ $\quad \dfrac{3}{2-x}$ $\quad 3x + 2$	B1	Total 1
13		$\sqrt[4]{40000} = \sqrt[4]{4} \times \sqrt[4]{10000} = \sqrt[4]{4} \times 10$	M1	
		$\sqrt[4]{4} = \sqrt{(\sqrt{4})} = \sqrt{2}$	M1	
		$\sqrt[4]{40000} = \sqrt[4]{4} \times 10 = 10\sqrt{2}$	A1	Total 3
14	**(a)**	Gradient of graph $\approx \dfrac{60 - 0}{200 - 0} = 0.3$	M1	
		So, height increases at a rate of 0.3 cm per second volume increases at a rate of $0.3 \times 40 \times 50$ $= 600\ \text{cm}^3$ per second	M1	
		water is supplied at a rate of 600 ml per second $= 600 \times 3600$ ml per hour $= 2160000$ ml per hour $= 2160$ litres per hour	A1	
	(b)	e.g. I have assumed that the sides of the tank are so thin that they can be ignored.	B1	
		As they will have a thickness, the volume supplied is less so the rate at which the water is supplied will be less meaning that my answer is too big.	B1	Total 5

15 Equate $3x^2 - x + 7 = 9 - 6x$ M1

$3x^2 + 5x - 2 = 0$

$(3x - 1)(x + 2) = 0$ M1

$x = \frac{1}{3}$ or -2 A1

When $x = \frac{1}{3}$, $y = 7$

When $x = -2$, $y = 21$ A1

So $x = -2, y = 21$ or $x = \frac{1}{3}, y = 7$ Total 4

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16 **(a)** e.g. As the density of gold is higher, a certain volume of gold will contribute more to the total mass than the same volume of silver. The % gold will be higher by mass than by volume. B1

(b) Let volume of gold be x cm^3

Mass = density × volume

Mass of gold = 19.3*x* grams M1

Volume of silver = $(0.6 - x)$ cm^3

Mass of silver = $10.5(0.6 - x)$ grams

Total mass = 10 grams so:

$19.3x + 10.5(0.6 - x) = 10$ M1

$19.3x + 10.5 \times 0.6 - 10.5x = 10$

$19.3x - 10.5x = 10 - 6.3$

$8.8x = 3.7$

$x = \frac{3.7}{8.8} = 0.4204...$

Percentage of volume that is gold = $\frac{0.4204..}{0.6} \times 100\%$ M1

$= 70.1\%$ (3sf) A1

Hence about 70% of the volume is gold Total 5

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17 **(a)** Area $= \frac{1}{2} \times 6 \times 8 \times \sin 30^\circ$

$= \frac{1}{2} \times 48 \times \frac{1}{2}$

$= 12$ cm^2

12 cm^2 $12\sqrt{2}$ cm^2 $12\sqrt{3}$ cm^2 24 cm^2 B1

(b) e.g. If angle *PQR* is a right angle then $\cos 45^\circ = \frac{3\sqrt{2}}{6}$

We know $\cos 45^\circ = \frac{1}{\sqrt{2}}$ B1

And we have $\frac{3\sqrt{2}}{6} = \frac{\sqrt{2}}{2} = \frac{\sqrt{2}}{(\sqrt{2})^2} = \frac{1}{\sqrt{2}} = \cos 45^\circ$ M1

Therefore angle *PQR* must be a right angle so triangle *PQR* is a right-angled triangle and Sam is correct A1 Total 4

18	Number of games won out of 523 must be less than 52.5%		
	$0.525 \times 523 = 274.575$	M1	
	Must be whole number so greatest = 274	A1	
	Number of games won out of 543 must be at least 52.5%		
	$0.525 \times 543 = 285.075$		
	Must be whole number so least = 286		
	Smallest number won = 286 – 274 = 12 games	M1 A1	Total 4

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19 Volume of cake = $\frac{1}{3} \times \pi \times 8^2 \times 20 = \frac{1280}{3}\pi$

Volume of one piece = $\frac{1}{2} \times \frac{1280}{3}\pi = \frac{640}{3}\pi$ — M1

Let base radius of top piece be r and height be h

By similar triangles $\frac{r}{h} = \frac{8}{20}$ — M1

Hence $r = \frac{2}{5}h$

Volume of top piece = $\frac{1}{3} \times \pi \times (\frac{2}{5}h)^2 \times h = \frac{640}{3}\pi$

$\frac{4}{25}h^3 = 640$

$h^3 = \frac{25}{4} \times 640 = 4000$

$h = \sqrt[3]{4000} = 15.874...$ — M1

Height above base = 20 – 15.874 = 4.125... = 4.1 cm (1dp) — A1

[Quick method: From whole to top half, volume scale factor = 0.5
so length scale factor = $\sqrt[3]{0.5}$ = 0.7937...
so height above base = 20 – 0.7937 × 20 = 4.1] — Total 4

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20 P(1st is red) = $\frac{x}{x+2x} = \frac{x}{3x} = \frac{1}{3}$

If 1st is red, there are now (x + 4) red and x blue in box Q

P(2nd is red given 1st is red) = $\frac{x+4}{2x+4}$ — M1

P(both are red) = $\frac{1}{3} \times \frac{x+4}{2x+4} = \frac{1}{4}$ — M1

$4(x + 4) = 3(2x + 4)$

$4x + 16 = 6x + 12$

$4 = 2x$

$x = 2$ — A1

So P has 2 red and 4 blue and Q has 5 red and 2 blue

P(1st is blue) = $\frac{4}{6} = \frac{2}{3}$

If 1st is blue there are now 5 red and 3 blue in box Q

P(2nd is blue given 1st is blue) = $\frac{3}{8}$ — M1

P(both are blue) = $\frac{2}{3} \times \frac{3}{8} = \frac{2}{8} = \frac{1}{4}$ — A1 — Total 5

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21 Let short side of rectangle be x cm
So side of equilateral triangle = $2x$ cm
Let height of equilateral triangle = h cm
Using Pythagoras' on half of equilateral triangle:

	$x^2 + h^2 = (2x)^2$	M1	
	$x^2 + h^2 = 4x^2$		
	$h^2 = 3x^2$		
	$h = x\sqrt{3}$	A1	
Perimeter of rectangle = $2(x + h) = 2(x + x\sqrt{3})$			
So,	$2(x + x\sqrt{3}) = 20$	M1	
	$x + x\sqrt{3} = 10$		
	$x(1 + \sqrt{3}) = 10$		
	$x = \dfrac{10}{1+\sqrt{3}}$	M1	
Perimeter of equilateral triangle = $2x + 2x + 2x = 6x$			
	$= \dfrac{60}{1+\sqrt{3}} = 21.961...$		
	= 22.0 cm (3sf)	A1	Total 5

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22 OA and AB are adjacent sides of a square and therefore perpendicular
Line through A and B has equation $y = -3x + 20$

Comparing with $y = mx + c$, gradient of $AB = -3$		M1	
Gradient of $OA = \dfrac{-1}{-3} = \dfrac{1}{3}$		M1	
OA passes through origin so equation is $y = \frac{1}{3}x$			
A is intersect of lines so	$\frac{1}{3}x = 20 - 3x$	M1	
	$x = 60 - 9x$		
	$10x = 60$		
	$x = 6$	A1	
When $x = 6$, $y = \frac{1}{3} \times 6 = 2$ so A is $(6, 2)$			
OC will be OA rotated 90º so C can be $(-2, 6)$		A1	
[Other correct answer is (2, –6)]			Total 5

TOTAL FOR PAPER: 80 MARKS