For **AQA**

Mathematics

Paper 3 (Calculator)

Higher Tier

Churchill Paper 3A – 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 3A Marking Guide – AQA Higher Tier

1		$\frac{(7.8)^2}{3.05+6.92} \approx \frac{8^2}{3+7} = \frac{64}{10} = 6.4$		
		0.64 6.084 [✓ 6.4] $28.\dot{3}$	B1	Total 1
2		Area of circle = πr^2		
		Radius = 8 ÷ 2 = 4		
		Area of circle = $\pi \times 4^2 = 16\pi$		
		Area of semicircle = $\frac{1}{2} \times 16\pi = 8\pi$		
		4π [✓ 8π] 16π 32π	B1	Total 1
3		$\frac{1}{\sqrt{2}} = 0.7071...$		
		$\frac{1}{2} = 0.5$, $\frac{5}{7} = 0.7142...$, $\frac{7}{10} = 0.7$, $\frac{12}{17} = 0.7058...$		
		Closest is 0.7058...		
		$\frac{1}{2}$ $\frac{5}{7}$ $\frac{7}{10}$ [✓ $\frac{12}{17}$]	B1	Total 1
4		[✓ $(x+3)(x-3)$] $(x-3)(x-3)$ $(x+1)(x-9)$ $x(x-9)$	B1	Total 1
5	**(a)**	= 2 × £7.80 + 3 × £6.00	M1	
		= 15.60 + 18.00		
		= £33.60	A1	
	(b)	Instead of spending £33.60 each week he spends £25.50		
		Saving per week = 33.60 – 25.50 = £8.10	M1	
		Saving per year = 46 × £8.10 = £372.60	M1	
		Yes, Martin is correct	A1	Total 5
6	**(a)**	B and D	B1	
	(b)	$p = 4$, $q = -5$	B2	
	(c)	2	B1	
	(d)	$x = 1$	B1	Total 5

7 **(a)** Let input = x
$5(x + 3) = 3x$ M1
$5x + 15 = 3x$
$2x = -15$
$x = -7.5$ The input was –7.5 A1

(b) Rosa is wrong
e.g. If the first input is 2, the first output is 25 and the second output is 140 which doesn't end in a 5 B1 Total 3

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8 We have: 2 workers check 120 phones in 6 hours
So, 1 worker checks 60 phones in 6 hours
1 worker checks 10 phones in 1 hour M1

Hence, 5 workers check 50 phones in 1 hour

$400 \div 50 = 8$

So, 5 workers check 400 phones in 8 hours A1

It takes them 8 hours Total 2

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9 Area of triangular XS = $\frac{1}{2} \times 9p \times 2p = 9p^2$
Volume of prism = $9p^2 \times 3p = 27p^3$ M1

Let length of edge of cube be x
Volume of cube = $x^3 = 27p^3$
$x = \sqrt[3]{27p^3} = \sqrt[3]{27}\,p = 3p$ M1 A1 Total 3

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10 **(a)** Fraction at primary with no siblings = $\frac{90}{240} = \frac{3}{8}$

Estimate for secondary = $\frac{3}{8} \times 960 = 360$ M1 A1

(b) e.g. It is likely to be an overestimate.
Primary school pupils are young and those that don't have any siblings now may do by the time they are at secondary school. So the fraction without siblings is likely to be lower at the secondary school. B2 Total 4

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11 Multiplying constant terms = $1 \times -1 \times 4 = -4$

–5 [✓ –4] 2 7 B1 Total 1

12 Let no. of girls be g and no. of boys be b

$g : b = 5 : 4$ so $b = \frac{4}{5}g$ (1) B1

$g = b + 3$ (2)

Sub (1) into (2) gives $g = \frac{4}{5}g + 3$ M1

$\frac{1}{5}g = 3$

$g = 15$

Hence $b = \frac{4}{5} \times 15 = 12$

Total of girls and boys = 15 + 12 = 27 A1 Total 3

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13 **(a)** $P \propto Q$

$P = kQ$

When $Q = 6$, $P = 15$ so $15 = k \times 6$ M1

$k = 15 \div 6 = 2.5$

$P = 2.5Q$

When $Q = 3.5$ $P = 2.5 \times 3.5 = 8.75$ M1 A1

(b) When x is multiplied by 2, y is divided by 4 which is 2^2

So y is inversely proportional to x^2

y is directly proportional to $\sqrt{x}$ y is directly proportional to x^2

y is inversely proportional to x [✓ y is inversely proportional to x^2] B1 Total 4

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14 Let the outward journey be x km and take t hours

Distance = speed × time

So, $x = 50t$ (1) B1

For return journey: distance = $x + 23$, av. speed = 56, time = $t + \frac{1}{4}$

So, $x + 23 = 56(t + \frac{1}{4})$ (2) M1

Sub for x from (1): $50t + 23 = 56t + 14$ M1

$9 = 6t$

$t = 1.5$

Outward journey took 1.5 hours = 1 hour 30 minutes

Return journey took 15 minutes more so 1 hour 45 minutes A1 Total 4

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15 Let short edge of rectangle be x cm long

The long edge fits with 2 short edges so is $2x$ cm long M1

The area (of one side) of a piece is $2x \times x = 2x^2$ cm^2

There are 2 × 8 = 16 pieces so area (of one side) is 288 ÷ 16 = 18 cm^2

So, $2x^2 = 18$ M1

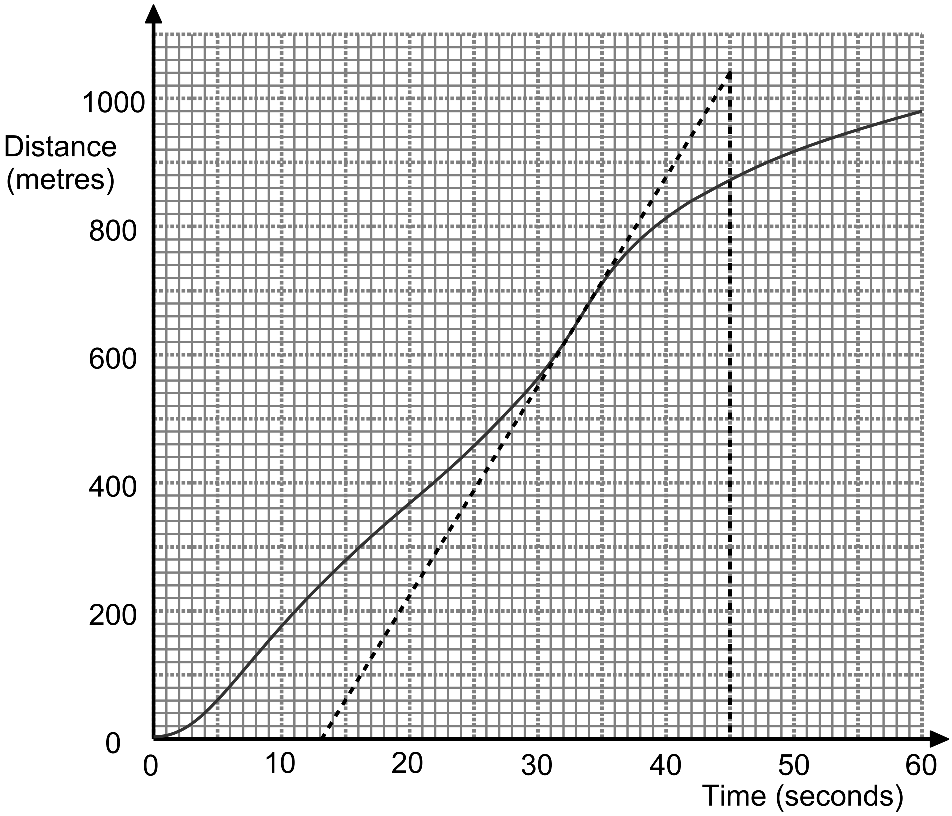
$x^2 = 9$

$x = 3$ [can't be –3 as it's a length]

Dimensions of cuboid = 9 cm by 6 cm by 6 cm M1

Volume of cuboid = 9 × 6 × 6 = 324 cm^3 A1 Total 4

16



M1

Max. speed = max. gradient $\approx \dfrac{1040 - 0}{45 - 13}$ M1

$= \dfrac{1040}{32}$

= 32.5 m/s A1 Total 3

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17 Probability of orange, yellow or white = 1 – 0.36 = 0.64 B1

Let *o*, *y* and *w* represent probability of orange, yellow and white.

$o : w = 4 : 1$
$y : w = 3 : 1$
So, $o : y : w = 4 : 3 : 1$
4 + 3 + 1 = 8 portions
1 portion = 0.64 ÷ 8 = 0.08 M1

y = 3 portions = 3 × 0.08 = 0.24
Probability of red to probability of yellow = 0.36 : 0.24 = 3 : 2 M1
Number of red counters = $\frac{3}{2}$ × 18 = 27 A1 Total 4

18

$5.05 \le w < 5.15$ [✓ $5.1 \le w < 5.2$]

$5.10 \le w < 5.15$ $5.0 \le w < 5.2$ B1 Total 1

19	**(a)**	$3y = x + 6 \rightarrow y = \frac{1}{3}x + 2$ so gradient = $\frac{1}{3}$	M1	
		$3y = x - 3 \rightarrow y = \frac{1}{3}x - 1$ so gradient = $\frac{1}{3}$		
		The lines have the same gradient so are parallel		
		TRUE	A1	
	(b)	$y = 5 - 2x$ has gradient = –2		
		$2y = 2 - x \rightarrow y = 1 - \frac{1}{2}x$ so gradient = $-\frac{1}{2}$	M1	
		Product of gradients = $-2 \times -\frac{1}{2} = 1$	M1	
		As this is not –1 the lines are not perpendicular		
		FALSE	A1	
	(c)	Curve meets x-axis when $y = 0$		
		So, $0 = x^2 - 6x + 9$		
		$0 = (x - 3)^2$	M1	
		$x = 3$		
		There is only one solution so they meet at exactly one point		
		TRUE	A1	Total 7
20	$x_2 = \sqrt[3]{4\times1-7} = \sqrt[3]{-3} = -1.4422...$			
	$x_3 = \sqrt[3]{4\times(-1.4422...)-7} = \sqrt[3]{-12.7689...} = -2.3373...$			
	–15.592 –9.787 [✓ –2.337] –1.442		B1	Total 1
21	Let $x = 0.3888888...$			
	$10x = 3.888888...$			
	So $10x - x = 3.888888... - 0.3888888$		M1	
	$9x = 3.8 - 0.3 = 3.5$			
	$x = \frac{3.5}{9} = \frac{7}{18}$		A1	
	Therefore $0.3\dot{8} = \frac{7}{18}$			Total 2
22	Yes			
	e.g.	The increase is by 20% of the original number. You now have a bigger number so the decrease is by 20% of a bigger number. That means the decrease is larger than the increase so you don't get back to the original number.	B2	Total 2

23 26 times are represented by the area above 57.2
58.0 to 59.0 area = 20 × 4 = 80 small squares
57.4 to 58.0 area = 12 × 15 = 180 small squares
57.2 to 57.4 area = 4 × 65 = 260 small squares
So 26 times are represented by 80 + 180 + 260 = 520 small squares M1
Therefore 1 time is represented by 520 ÷ 26 = 20 small squares

56.0 to 56.6 area = 12 × 5 = 60 small squares
60 small squares represents 60 ÷ 20 = 3 times M1 A1
Estimate of number of times quicker than 56.6 is 3 times Total 3

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24 **(a)** = 0.18 × 0.18 = 0.0324 M1 A1

(b) = 1 – P(no post over 4 days)
$= 1 - (0.18)^4$ M1
= 1 – 0.00104...
= 0.9989...
= 0.999 (3sf) A1 Total 4

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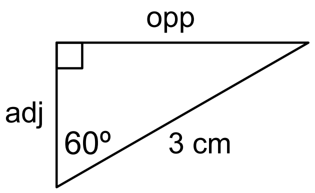
25 External angle of regular hexagon = 360 ÷ 6 = 60º
Consider top left triangle:



$\sin x = \dfrac{OPP}{HYP}$

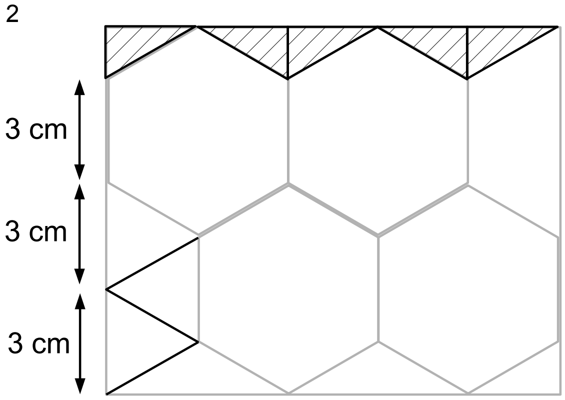
$\sin 60º = \dfrac{OPP}{3}$ *(or for Pythagoras')* M1

$OPP = 3 \times \sin 60º = 3 \times \dfrac{\sqrt{3}}{2} = \frac{3}{2}\sqrt{3}$ A1

$\cos x = \dfrac{ADJ}{HYP}$

$\cos 60º = \dfrac{ADJ}{3}$

$ADJ = 3 \times \cos 60º = 3 \times \frac{1}{2} = \frac{3}{2}$ M1



$\text{Height} = 3 \times 3 + \frac{3}{2}$ M1
$= 10\frac{1}{2}$ or $\frac{21}{2}$

$\text{Width} = 5 \times \frac{3}{2}\sqrt{3}$
$= \frac{15}{2}\sqrt{3}$

$\text{Area} = \frac{21}{2} \times \frac{15}{2}\sqrt{3} = \frac{315}{4}\sqrt{3}\ \text{cm}^2$ A1 Total 5

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26 **(a)** Quad. sequence so second differences constant:

$$\begin{array}{ccccccccccc} 7 & & 9 & & 13 & & 19 & & k & & 37 \\ & 2 & & 4 & & 6 & & & & & \\ & & 2 & & 2 & & \mathbf{2} & & \mathbf{2} & & \end{array}$$

Hence first differences are:

$$\begin{array}{ccccccccccc} 7 & & 9 & & 13 & & 19 & & k & & 37 \\ & 2 & & 4 & & 6 & & \mathbf{8} & & \mathbf{10} & \\ & & 2 & & 2 & & 2 & & 2 & & \end{array}$$ M1

$k = 19 + 8 = 27$ A1

(b) Let nth term = $an^2 + bn + c$

We have $a + b + c = 7$

$3a + b = 2$

$2a = 2$

Hence, $a = 1$ B1

So $(3 \times 1) + b = 2$ M1

$b = 2 - 3 = -1$

And $1 + (-1) + c = 7$

$c = 7$ M1

nth term = $n^2 - n + 7$ A1 Total 6

TOTAL FOR PAPER: 80 MARKS