For **AQA**

Mathematics
Paper 3 (Calculator)

Higher Tier

Churchill Paper 3B – 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
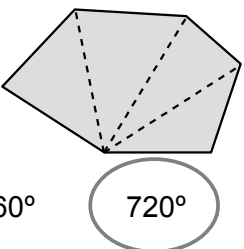
(B) marks are awarded independent of method

Churchill Maths

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1

Can divide hexagon into 4 triangles
Sum of angles in triangle = 180º
4 × 180º = 720º

360º (720º) 900º 1440º B1 Total 1

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2 **(a)** $\frac{3}{5}$ = 0.6 = 6 × 0.1 = 6 × 10^{-1}

0.6 (6 × 10^{-1}) 3 × 5^{-1} 0.6 × 10^{0} B1

(b) Half of 1.8 × 10^{5} = 0.9 × 10^{5} = 9 × 10^{4}

0.9 × 10^{5} 9 × 10^{5} 9 × 10^{6} (9 × 10^{4}) B1 Total 2

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3 P = $\frac{1}{6}$ × $\frac{1}{6}$ = $\frac{1}{36}$

($\frac{1}{36}$) $\frac{1}{6}$ $\frac{1}{18}$ $\frac{1}{12}$ B1 Total 1

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4 Adira: Plumber cost = 30 × 22.50 = £675
Assistant cost = 40 × 15.50 = £620 M1
Materials cost = 0.9 × 860 = £774 M1
Total cost = 675 + 620 + 774 = £2069 A1

Ben: Minimum cost = 60 × 20 + 500 = £1700
Maximum cost = 90 × 20 + 700 = £2500 B1

e.g. Pete should use Adira as her fixed price is less than the mid-point
of the range of prices offered by Ben B1

[There are other valid answers but they must be supported by calculations.] Total 5

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5 Median = $\frac{1}{2}$(35 + 1)th = 18th value

Cumulative frequencies: 2 + 9 = 11, 11 + 6 = 17, 17 + 7 = 24
So median is 8 M1
Total no. payments = 2 × 5 + 9 × 6 + 6 × 7 + 7 × 8 + 6 × 9 + 5 × 10
= 10 + 54 + 42 + 56 + 54 + 50
= 266
Mean = 266 ÷ 35 = 7.6 M1
Hence the mean is not higher than the median A1 Total 3

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6 **(a)** e.g. You can cover most of the distance on main roads and
motorways and drive faster on them   B1

     (b) 10 mile journey will be at 30 mph

Speed = $\dfrac{\text{distance}}{\text{time}}$ so   time = $\dfrac{\text{distance}}{\text{speed}}$

Time for 10 miles = $\dfrac{10}{30}$ = $\dfrac{1}{3}$ hour = 20 minutes   M1

20 mile journey will be at 40 mph

Time for 20 miles = $\dfrac{20}{40}$ = $\dfrac{1}{2}$ hour = 30 minutes

It will take 10 minutes longer   A1

     (c) 14 mile journey will be at 30 mph

Time for 14 miles = $\dfrac{14}{30}$ hours = 28 minutes   M1

16 mile journey will be at 40 mph

Time for 16 miles = $\dfrac{16}{40}$ hours = 24 minutes

Rob is correct   A1   Total 5

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7 Total weight of cake before = 750 + 600 = 1350 g
Total weight eaten = 1350 ÷ 2 = 675 g
Weight of chocolate cake eaten = 0.54 × 750 = 405 g   M1
Weight of carrot cake eaten = 675 – 405 = 270 g   M1

% of carrot cake eaten = $\dfrac{270}{600}$ × 100% = 45%   A1   Total 3

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8 **(a)** Common difference = 8 so nth term = $8n + c$ M1
0th term = 7 – 8 = –1
nth term = $8n – 1$ A1

     (b) Common ratio = $24\sqrt{3} \div 12 = 2\sqrt{3}$
1st term = $2\sqrt{3}$
2nd term = $(2\sqrt{3})^2$
3rd term = $(2\sqrt{3})^3$ etc.
10th term = $(2\sqrt{3})^{10}$ = 248832

     $576\sqrt{3}$ 20736 $20736\sqrt{3}$ (248832)   B1   Total 3

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9 $v = u + at$
$v – u = at$
$\dfrac{v - u}{a} = t$

$t = av - u$ $t = \dfrac{v}{a} - u$ $t = \dfrac{u}{v - a}$ $\left(t = \dfrac{v - u}{a} \right)$ B1   Total 1

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10 (a) e.g. $60 = 6 \times 10 = 2 \times 2 \times 3 \times 5$ M1
$70 = 7 \times 10 = 2 \times 5 \times 7$

Common factors are 1, 2, 5, $2 \times 5 = 10$ M1
There are 4 common factors   A1

(b) abc B1

(c) a^3b^2c B1   Total 5

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11 (a) e.g. He has not done enough trials to get a reliable indication of whether or not it is biased.   B1
His statement assigns exact probabilities based on his trials which is not possible.   B1

(b) e.g. With 100 trials she has got significantly more heads than tails so her coin is very likely to be biased.   B1

(c) e.g. He is assuming that a probability of $\frac{1}{3}$ means he will get exactly 1 head in 3 flips. In fact, the probability of him getting at least 1 head is $1 - \left(\frac{2}{3}\right)^3 = \frac{19}{27}$ so he is not certain of getting a head.   B2

[Either a relevant calculation or a more thorough explanation]   Total 5

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12 (a) $t = 5$
$P = 6000 \times 1.05^5$ M1
$= 7657.689375$
£7657.69 (nearest pence)   A1

(b) 0.05%   1.05%   (5%)   105%   B1

(c) Compound
e.g. When t increases by 1, the previous value of P is multiplied by 1.05 so the value increases by 5%, not by a fixed amount. The 5% interest applies to all the money in the account including interest already gained.   B1

[Can be brief, identifying any one key difference]   Total 4

13 (a) $x = 0$, $x^3 - 5x^2 + 8 = 8$
$x = 1$, $x^3 - 5x^2 + 8 = 1 - 5 + 8 = 4$ M1
$x = 2$, $x^3 - 5x^2 + 8 = 8 - 20 + 8 = -4$ A1

x	0	1	2	3	4	5
$x^3 - 5x^2 + 8$	8	4	−4	−10	−8	8

(b) 2 solutions
The sign of $x^3 - 5x^2 + 8$ changes twice   B1

(c) Putting 5 in you do $5 - 5 = 0$ and then $8 \div 0$ which is undefined
so you don't get a value for x_2 B1

(d) $x_2 = 1.4142...$ M1
$x_3 = 1.4936...$
$x_4 = 1.5104...$
$x_5 = 1.5141...$ M1
$x_6 = 1.5149...$
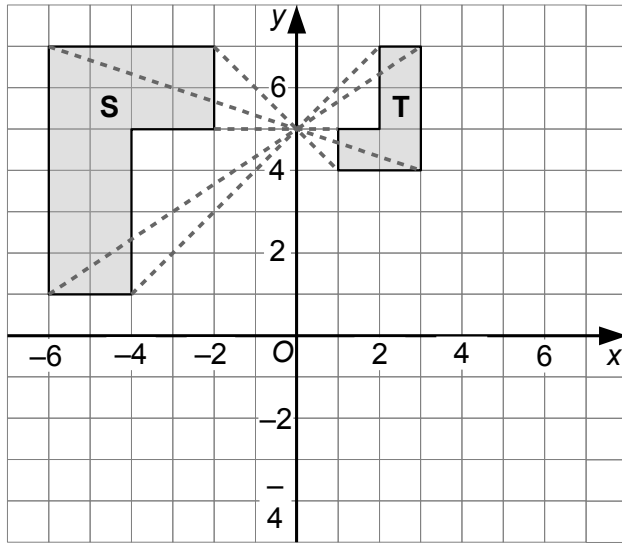$x_7 = 1.5150...$
Solution = 1.52 (2dp)   A1   Total 7

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14 Radius = $\sqrt{36} = 6$

$\sqrt{6}$ ⬭6   18   36   B1   Total 1

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15 (a) e.g.

M1 A1
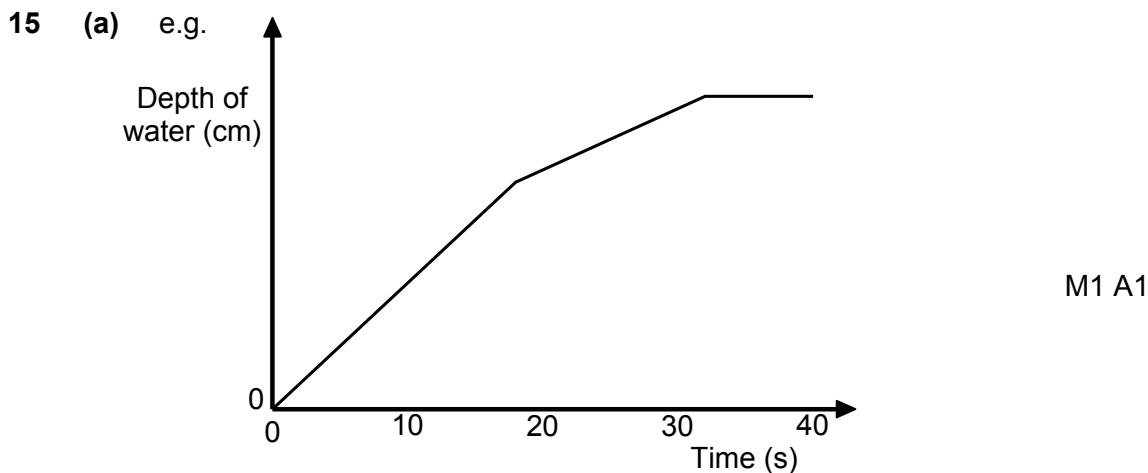
(b) Volume = area under graph
= $240 \times 18 + 140 \times 14$ M2
= 4320 + 1960
= 6280 cm^3
= 6.28 litres   A1   Total 5

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16 When $x = 9$, $x^{\frac{1}{2}} = \sqrt{9} = 3$

$x^{\frac{3}{2}} = \left(\sqrt{9}\right)^3 = 27$ B1

So, $27 - 3k = 6$
$21 = 3k$ M1
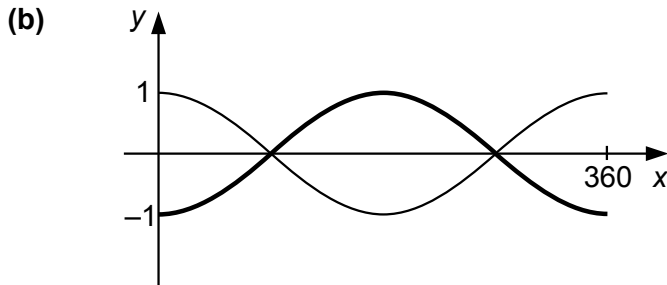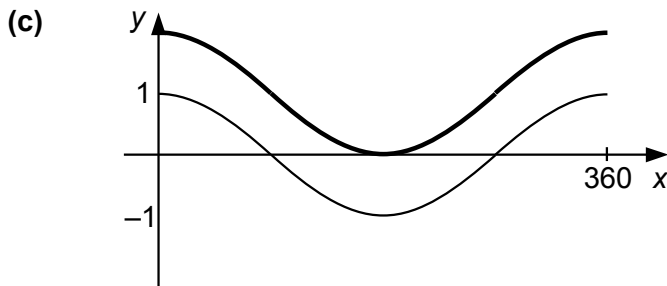$k = 7$ A1   Total 3

17

M2 A1

Total 3

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18 **(a)** (90, 0) and (270, 0)   B1

(b)

B1

(c)

B1

Total 3

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19 Perimeter, longer sides touching = 2*L* + 4*W*   B1
Perimeter, shorter sides touching = 4*L* + 2*W*
So, 4*L* + 2*W* is 50% larger than 2*L* + 4*W*

$$4L + 2W = 1.5(2L + 4W)$$ M1
$$4L + 2W = 3L + 6W$$
$$L = 4W$$ M1
Hence, *W* : *L* = 1 : 4   A1   Total 4

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20 Height of cylinder = 15 − 1.8 = 13.2 cm
Radius of cylinder = 0.8 ÷ 2 = 0.4 cm
Volume of cylinder = $\pi \times 0.4^2 \times 13.2 = 6.6350...$ cm³   M1
Volume of cone = $\frac{1}{3} \times \pi \times 0.4^2 \times 1.8 = 0.3015...$ cm³   M1
Volume of pencil = 6.6350... + 0.3015...
= 6.9366... cm³ = 6.94 cm³ (3sf)   A1   Total 3

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21 *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 $y = \dfrac{1}{3}x$

A is intersect of lines so $\dfrac{1}{3}x = 20 - 3x$ M1
                                 $x = 60 - 9x$
                                 $10x = 60$
                                 $x = 6$ A1
When $x = 6$, $y = \dfrac{1}{3} \times 6 = 2$ 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

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22 $\tan a = \dfrac{'9.4'}{'17.1'}$ M1

$\tan a \geq \dfrac{9.35}{17.15}$ M1
$a \geq \tan^{-1} 0.5451...$
$a \geq 28.59...º$
$\tan a < \dfrac{9.45}{17.05}$
$a < \tan^{-1} 0.5542...$
$a < 28.99...º$ M1
So, $28.59...º \leq a < 28.99...º$
Minimum and maximum values of *a* are both 29º to nearest degree   A1
Hence Tim is correct   Total 4

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23 $y \propto \dfrac{1}{\sqrt{x}}$

$y = \dfrac{k}{\sqrt{x}}$

When $x = 9$, $y = c$ so $c = \dfrac{k}{\sqrt{9}} = \dfrac{k}{3}$ (1)   M1

When $x = 25$, $y = c - 16$ so $c - 16 = \dfrac{k}{\sqrt{25}} = \dfrac{k}{5}$ (2)

Sub for *c* from (1) into (2) $\dfrac{k}{3} - 16 = \dfrac{k}{5}$ M1
                                $\dfrac{k}{3} - \dfrac{k}{5} = 16$
                                $5k - 3k = 15 \times 16$
                                $2k = 240$
                                $k = 120$ M1

Hence, $y = \dfrac{120}{\sqrt{x}}$

When $x = 36$, $y = \dfrac{120}{\sqrt{36}} = \dfrac{120}{6} = 20$ as required   A1   Total 4

TOTAL FOR PAPER: 80 MARKS

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