For **AQA**

Mathematics

Paper 3 (Calculator)

Higher Tier

Churchill Paper 3C – 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

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Churchill Paper 3C Marking Guide – AQA Higher Tier

1 $3x - 15 = 5x$
$-15 = 2x$
$x = -15 \div 2 = -7.5$

–12.5   –7.5   –5   –2.5   B1   Total 1

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2 –0.15 × 210   0.15 × 210   0.85 × 210   1.15 × 210   B1   Total 1

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3 (4, 0)   (2, 2)   (–1, 4)   (4, –4)   B1   Total 1

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4 $(5 \times 10^{120}) \times (2 \times 10^{130}) = 5 \times 2 \times 10^{120} \times 10^{130}$
$= 10 \times 10^{250}$
$= 10^{251}$

10^{249} 10^{250} 10^{251} 10^{2500} B1   Total 1

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5 **(a)** $\sqrt[4]{11000} = 10.24...$
$(1.95)^2 = 3.8025$
$\sqrt[4]{11000} - (1.95)^2 = 10.24... - 3.8025 = 6.438...$ M1
$\dfrac{\sqrt[4]{11000} - (1.95)^2}{0.493} = 6.438... \div 0.493 = 13.0601154$ A1

(b) $\sqrt[4]{11000} \approx \sqrt[4]{10000} = 10$
$(1.95)^2 \approx 2^2 = 4$
$\sqrt[4]{11000} - (1.95)^2 \approx 10 - 4 = 6$ M1
$\dfrac{\sqrt[4]{11000} - (1.95)^2}{0.493} \approx 6 \div 0.5 = 12$
My answer to part **(a)** is sensible as 13.06... is close to 12   A1   Total 4

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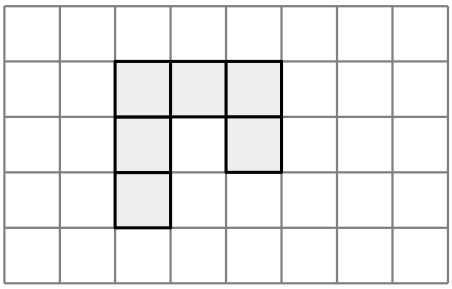
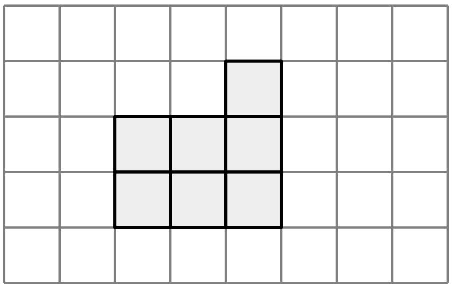
6 **(a)**



B2

(b)



B2

Total 4

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7 Myra got 6 – 3 = 3 portions more than Louise
3 portions = 12 cards — M1
1 portion = 12 ÷ 3 = 4 cards — M1
Nell got 7 portions = 7 × 4 = 28 cards — A1 — Total 3

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8 Speed = $\frac{\text{distance}}{\text{time}}$ so time = $\frac{\text{distance}}{\text{speed}}$

First bullet, time = $\frac{100}{200}$ = 0.5 seconds

Second bullet, time = $\frac{100}{220}$ = 0.4545... seconds

So, second bullet arrives after 0.5545... seconds
Time gap = 0.5545... – 0.5 = 0.0545... = 0.055 seconds (3dp)

0.035 0.044 0.045 0.055 — B1 — Total 1

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9 **(a)** $\frac{1}{4}$ — B1

(b) e.g. On average they last a lot longer after practising as the median has increased from 15 to 24. The shortest time is roughly the same (4 up from 3) but the longest time has increased quite a bit (54 up from 42). That has increased the range but the interquartile range is similar to before being 18 up from 17. This means that the variation in how long they lasted is similar to before the practise. — B3

[Valid comparison of median, IQR and one other.] — Total 4

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10 **(a)** Frame and mattress: 12 × 8 = 96
Frame and headboard: 12 × 6 = 72 — M1
Frame and footboard: 12 × 3 = 36
Total no. of ways = 96 + 72 + 36 = 204 — M1 A1

(b) Frame, mattress and headboard: 12 × 8 × 6 = 576
Frame, mattress and footboard: 12 × 8 × 3 = 288
Frame, headboard and footboard: 12 × 6 × 3 = 216
Total no. of ways = 576 + 288 + 216 = 1080

1728 1080 612 576 — B1 — Total 4

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11 1 5 11 19 29
4 6 8 10 **12** **14** **16**

29 + 12 = 41
41 + 14 = 55
55 + 16 = 71

38 57 59 71 — B1 — Total 1

12	**(a)**	$= y(y^2 - 9)$	M1
		$= y(y - 3)(y + 3)$	A1
	(b)	$(z + 8)(z - 6) = 0$	M1
		$z = -8$ or 6	A1 Total 4

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13 **(a)** $\frac{2}{6}$ $[= \frac{1}{3}]$ B1

(b) 6 = 1 outcome (6)

Even = 4 outcomes (4, 4, 4, 6)   M1

$P(6 \mid \text{Even}) = \frac{1}{4}$ A1

(c) e.g.

B↓ A→	1	1	2	3	3	4
1			✔	✔	✔	✔
3						✔
4						
4						
4						
6						

$\frac{5}{36}$ M1 A1   Total 5

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14 **(a)** Perpendicular height of one triangle $= \frac{1}{2} \times (20 - x)$ M1

Area of one triangle $= \frac{1}{2} \times x \times \frac{1}{2}(20 - x)$

$= \frac{1}{4}x(20 - x)$ cm^2

S.A. = area of square base + 4 × area of one triangle

$= x^2 + 4 \times \frac{1}{4}x(20 - x)$ M1

$= x^2 + x(20 - x)$

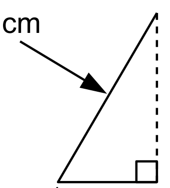
$= x^2 + 20x - x^2$

$= 20x$ cm^2 A1

(b) Area of base $= 8^2 = 64$ cm^2

Perpendicular height of triangle $= \frac{1}{2}(20 - 8) = 6$ cm

Let perpendicular height of pyramid $= h$ cm



Pythagoras': $h^2 = 6^2 - 4^2$ M1

$= 36 - 16 = 20$

$h = \sqrt{20}$

Volume of pyramid $= \frac{1}{3} \times 64 \times \sqrt{20}$ M1

$= 95.4$ cm^3 (3sf)   [or $\frac{128}{3}\sqrt{5}$]   A1   Total 6

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15 $2x^2 + x - 3 = (2x + 3)(x - 1)$ M1

$$\frac{2x^2 + x - 3}{x^2 - x} \div \frac{x-5}{x^2 - 5x} = \frac{(2x+3)(x-1)}{x(x-1)} \div \frac{x-5}{x(x-5)}$$

$$= \frac{(2x+3)}{x} \div \frac{1}{x}$$ M1

$$= \frac{(2x+3)}{x} \times \frac{x}{1}$$ M1

$$= \frac{x(2x+3)}{x}$$

$= 2x + 3$ A1 Total 4

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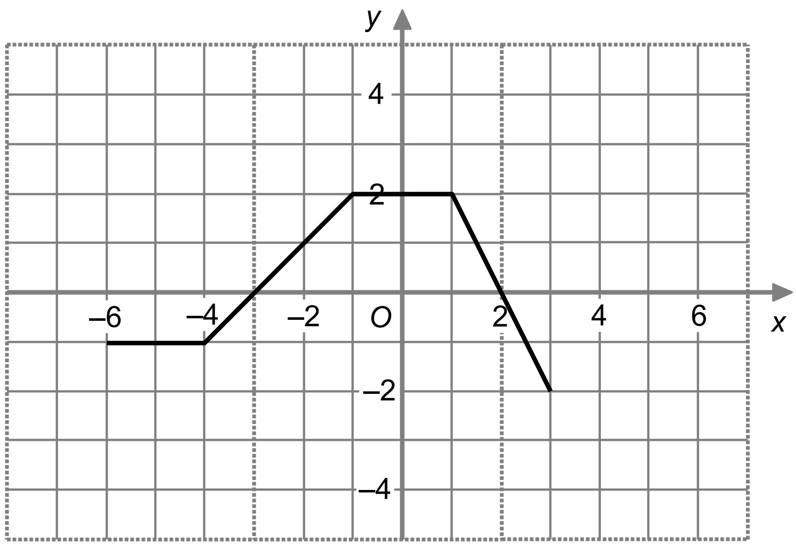
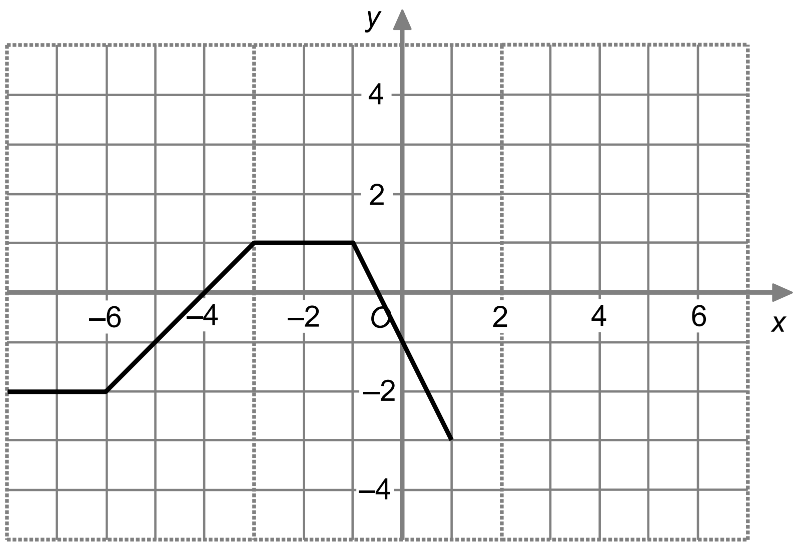
16 **(a)** $x = -2$ or 1.5 B1

(b)



(–3, 0), (2, 0) and (0, 2) M1 A1

(c)



(–4, 0), (–0.5, 0) and (0, –1) M1 A1 Total 5

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17 **(a)** $y \propto \dfrac{1}{x}$

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

When $x = 5$, $y = 0.5$ so $\quad 0.5 = \dfrac{k}{5}$ M1

$k = 5 \times 0.5 = 2.5$

Hence, $y = \dfrac{2.5}{x}$

When $x = 20$ $\quad y = \dfrac{2.5}{20}$ M1

$y = \frac{1}{8}$ or 0.125 A1

(b) The value of p is divided by 4 [or multiplied by $\frac{1}{4}$] B1

[$p = \dfrac{k}{q^2}$, *when* $q \to 2q$, $p = \dfrac{k}{(2q)^2} = \dfrac{k}{4q^2} = \frac{1}{4} \times \dfrac{k}{q^2}$ *]* Total 4

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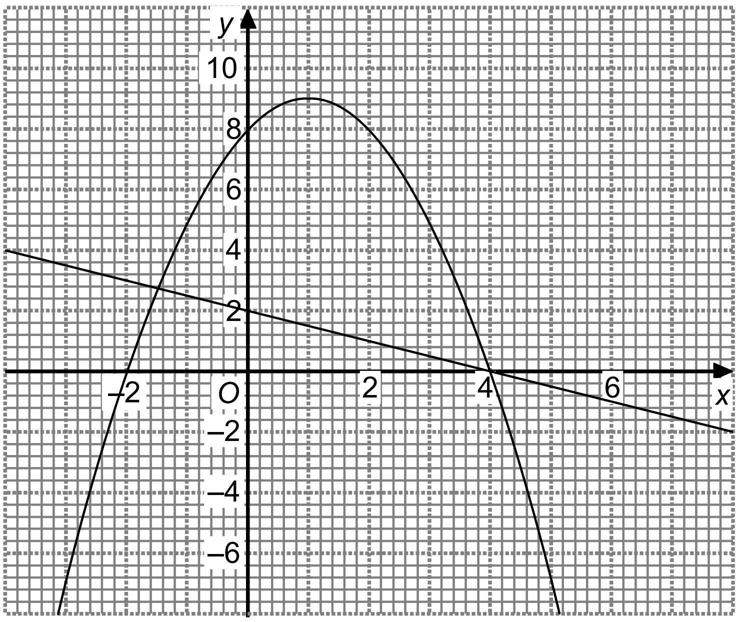
18 **(a)** $x = 1$ B1

(b) $x \approx -1.6$, $x \approx 3.6$ B1

(c) e.g. For $x + 2y = 4$:

When $x = 0$, $y = 2$

When $y = 0$, $x = 4$



M1

From graph: $x \approx -1.5$, $y \approx 2.8$ M1

$x \approx 4$, $y \approx 0$ A1 Total 5

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19 **(a)** Each burger weighs 500 ÷ 4 = 125g

Density = $\frac{\text{mass}}{\text{volume}}$

$1.1 = \frac{125}{\text{volume}}$ M1

volume = $\frac{125}{1.1}$ = 113.6... cm^3 A1

Volume of cylinder = $\pi r^2 h$

radius of burger = 8 ÷ 2 = 4 cm

113.6 = $\pi \times 4^2 \times h$ M1

$h = \frac{113.6...}{16\pi}$ = 2.2607... = 2.3 cm (1dp) A1

(b) New volume = 70% of original volume

70% = 0.7 so Volume scale factor = 0.7 B1

Length scale factor = $\sqrt[3]{0.7}$ = 0.8879...

Area scale factor = $(0.8879)^2$ = 0.7883... M1

0.7883 = 78.83%

Area reduced by 100 – 78.83... = 21.16... = 21.2% (3sf) A1 Total 7

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20 $(\text{radius})^2 = 15$

So inside the circle, [distance from (0, 0)]^2 will be less than 15

$(-2)^2 + 4^2$	= 4 + 16	= 20	> 15
$0^2 + (-5)^2$	= 0 + 25	= 25	> 15
$2^2 + (-3)^2$	= 4 + 9	= 13	< 15
$3^2 + 3^2$	= 9 + 9	= 18	> 15

(–2, 4) (0, –5) (2, –3) (3, 3) B1 Total 1

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21 Alternate segment theorem → angle QPR = angle QRV = 64º B1

As $PQ = PR$, triangle PQR is isosceles so

Angle $PRQ = \frac{1}{2}(180 - 64) = \frac{1}{2} \times 116 = 58$º M1

Angles on a straight line total 180º so

Angle PRU = 180 – (58 + 64) = 180 – 122 = 58º A1 Total 3

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22 Let angle $POQ = a$

Considering the triangle with corners at O, P and R (3, 0) gives:

$\tan a = \frac{PR}{OR} = \frac{4}{3}$ M1

$a = \tan^{-1}\frac{4}{3}$ = 53.130...º A1

Area sector $OPQ = \frac{53.13}{360} \times \pi \times 5^2$ M1

= 11.591...

Area triangle $OPQ = \frac{1}{2} \times 5 \times 4 = 10$ B1

Area segment = 11.591... – 10 = 1.591... = 1.59 (3sf) A1 Total 5

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23 Gradient of $y = 2x$ is 2

PQ is perpendicular so gradient = $\frac{-1}{(2)} = -\frac{1}{2}$ M1

Equation of PQ: $y = -\frac{1}{2}x + c$

$4 = (-\frac{1}{2} \times -3) + c$ M1

$c = 4 - \frac{3}{2} = \frac{5}{2}$

$y = -\frac{1}{2}x + \frac{5}{2}$

Midpoint of PQ will be intersection, so:

$2x = -\frac{1}{2}x + \frac{5}{2}$ M1

$\frac{5}{2}x = \frac{5}{2}$

$x = 1$ A1

When $x = 1$, $y = 2 \times 1 = 2$ so midpoint of PQ is (1, 2)

If Q is (x, y) then $(1, 2) = \left(\frac{-3+x}{2}, \frac{4+y}{2}\right)$

Hence $x = 2 \times 1 + 3 = 5$ and $y = 2 \times 2 - 4 = 0$ M1

Q is (5, 0) A1 Total 6

TOTAL FOR PAPER: 80 MARKS