For **AQA**

Mathematics

Paper 3 (Calculator)

Higher Tier

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

1 75% of 70% = 0.75 × 0.7 = 0.525 = 52.5%
100 – 70 = 30% of animals are not dogs
40% of 30% = 0.4 × 0.3 = 0.12 = 12%
% of all that come back within 1 month = 52.5 + 12 = 64.5%

55.5% 64.5% 65.5% 67.5% B1 Total 1

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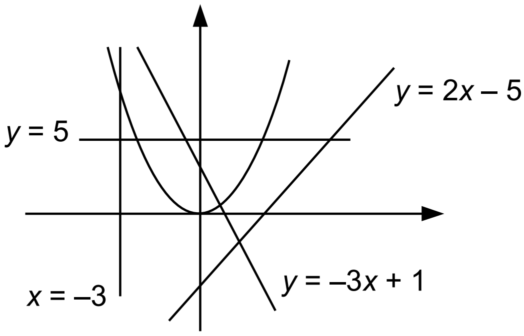
2 e.g.



$y = 5$ $x = -3$ $y = 2x - 5$ $y = -3x + 1$ B1 Total 1

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3 **(a)** 225 + 110 + 270 + 85 = 690
690 ÷ 30 = 23g

15g 17g 19g 23g B1

(b) $\frac{180}{270} = \frac{2}{3}$
$\frac{2}{3}$ of 30 = 20 cookies

15 18 20 24 B1

(c) To make 30 costs:
$\frac{225}{250} \times 85 + \frac{110}{2000} \times 245 + \frac{270}{1500} \times 100 + \frac{85}{100} \times 80$ M2
= 76.6 + 13.475 + 18 + 68
= 175.975p
1 cookie costs 175.975 ÷ 30 = 5.86...p = 5.9p (1dp) A1 Total 5

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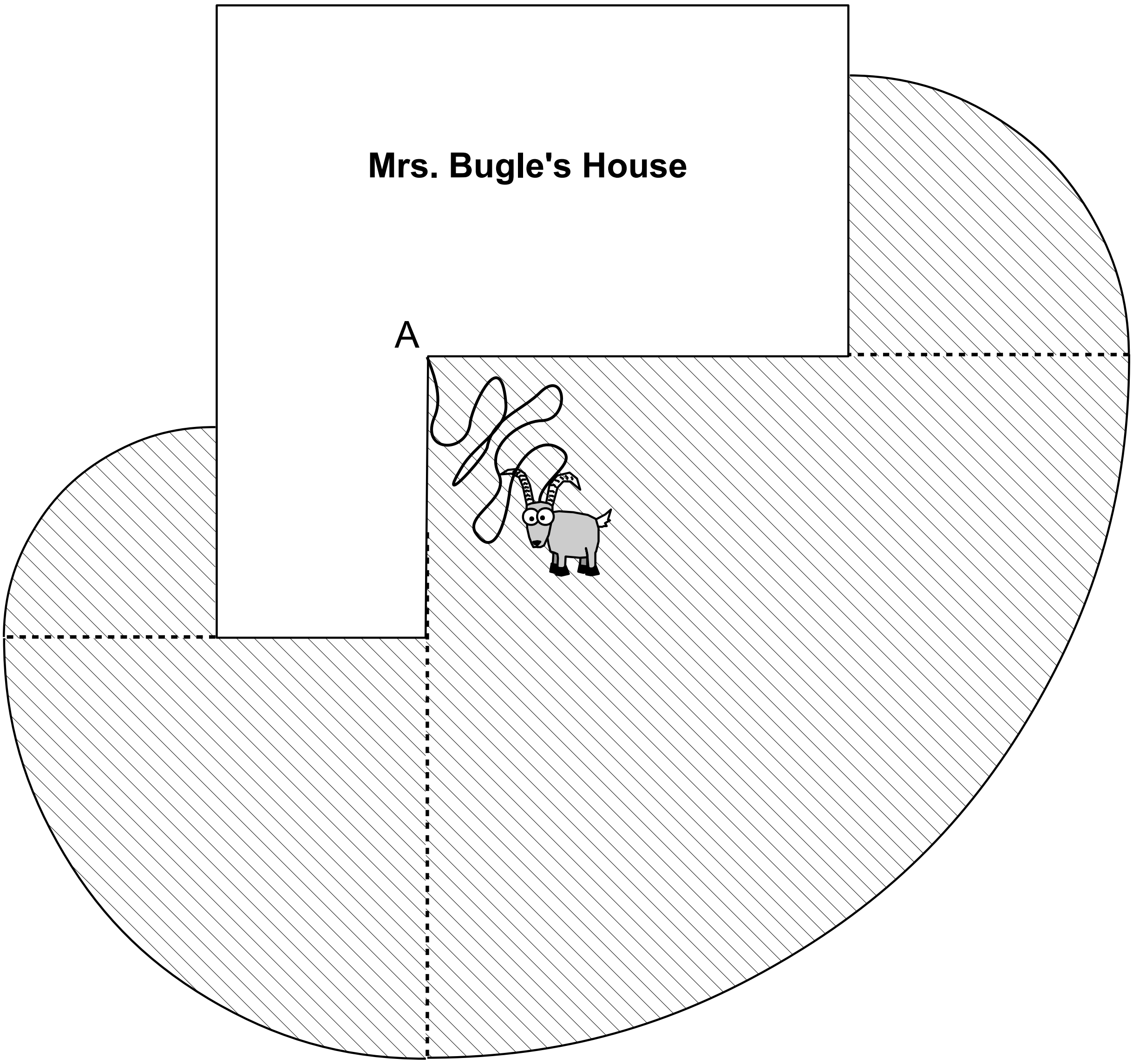
4 First rectangle: Height = 6 + 4 = 10 cm
Width = 2 × 6 = 12 cm
Perimeter = 2 × (10 + 12) = 2 × 22 = 44 cm M1
Second rectangle: Height = 6 cm
Width = 5 × 4 = 20 cm
Perimeter = 2 × (6 + 20) = 2 × 26 = 52 cm
Increase in perimeter = 52 – 44 = 8 cm
% increase = $\frac{8}{44} \times 100\%$ = 18.18...% M1
The perimeter increases by 18.2% (3sf) A1 Total 3

5



Quarter circle radius 10 cm	B1	
Quarter circles radius 6, 4 and 3 cm	M2	
All correct and accurate	A1	Total 4

6 $1\ m^2 = 100 \times 100 = 10000\ cm^2$

$20\ cm^2 = 20 \div 10000\ m^2 = 0.002\ m^2$

$0.2\ m^2$	$0.02\ m^2$	$0.002\ m^2$	$0.0002\ m^2$	B1	Total 1

7 e.g. M1

	Year 10	Year 11	Total
Boys		13	37
Girls			
Total		33	75

Leading to M1

	Year 10	Year 11	Total
Boys	24	13	37
Girls	18	20	38
Total	42	33	75

P(Yr10 girl) = $\frac{18}{75}$ [= $\frac{6}{25}$] A1 Total 3

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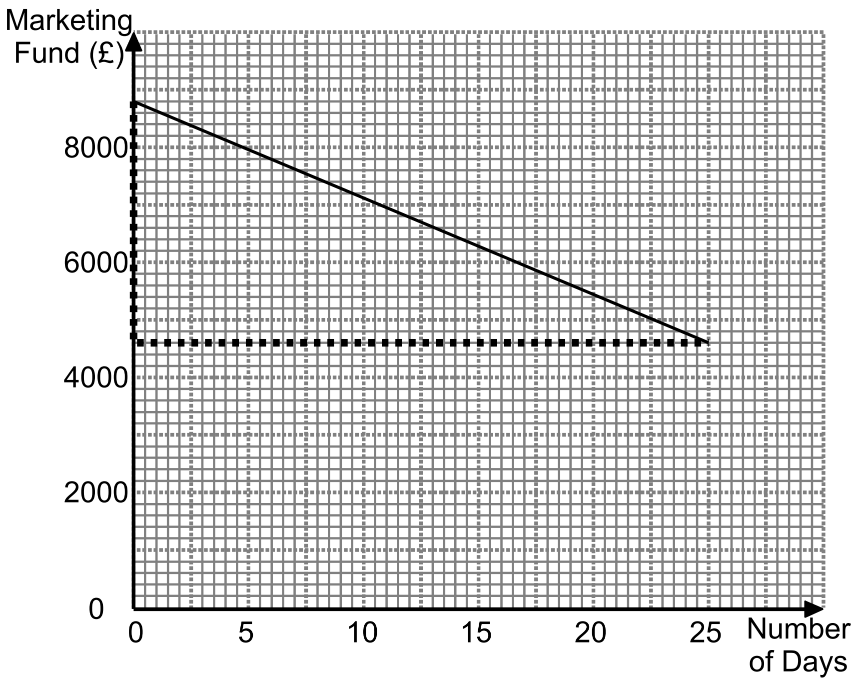
8 **(a)** £8800 B1

(b)



Gradient ≈ $\frac{4600 - 8800}{25 - 0}$ = –168 M1 A1

(c) e.g. That the charity spent £168 per day from the marketing fund B1 Total 4

9	Let Ayyub have x eggs Bran has $(x + 1)$ eggs Curtis has $1.5(x + 1)$ eggs		
	So, $x + (x + 1) + 1.5(x + 1) = 48$	M1	
	$3.5x + 2.5 = 48$ $3.5x = 45.5$ $7x = 91$		
	$x = 13$	M1	
	Curtis has $1.5(13 + 1) = 1.5 \times 14 = 21$ eggs		
	He must end up with $48 \div 3 = 16$ eggs	B1	
	Curtis gives away 5 eggs	A1	Total 4
10	Common ratio = 0.5 $5^{th} = 2 \div 2 = 1$, $6^{th} = 1 \div 2 = 0.5$, $7^{th} = 0.5 \div 2 = 0.25$, $8^{th} = 0.25 \div 2 = 0.125$		
	0.25 0.125 0.0625 0.0001	B1	Total 1
11	$\frac{x^2 - 6x + 9}{2x - 6} = \frac{(x-3)^2}{2(x-3)} = \frac{x-3}{2}$		
	$\frac{x^2 + 9}{2}$ $x^2 - 8x + 15$ $\frac{x - 15}{2}$ $\frac{x-3}{2}$	B1	Total 1
12	**(a)** e.g. The median of 5 numbers will be the 3rd one when they are arranged in order of size so it will be one of the numbers. As all the numbers are odd, the median will be odd.	B1	
	(b) e.g. No. For example, if we have 2, 4, 6, 8, 12, the total of the numbers is 32 and the mean is $32 \div 5 = 6.4$ which is not an even number.	B2	Total 3
13	**(a)** $x = \frac{\cancel{x} + 10}{\cancel{x} + 4}$		
	e.g. He has cancelled the x on top with the one on the bottom This is wrong because neither x is a factor, you cannot subtract something from top and bottom of a fraction without changing it	B2	
	(b) In multiplying out the bracket she hasn't multiplied the x by the 4	B1	
	In factorising the quadratic the signs are the wrong way round	B1	
	(c) $x^2 + 4x = x + 10$ $x^2 + 3x - 10 = 0$		
	$(x + 5)(x - 2) = 0$	M1	
	$x = -5$ or 2	A1	Total 6

14	**(a)**	e.g.	7 is a prime number		
			When $p = 7$, $2p + 1 = 15$	M1	
			$15 = 3 \times 5$ so 15 is not prime, hence Faruq is not correct	A1	
			[There are many other values of p that can be used.]		
	(b)	e.g.	2 is the only even prime number		
			As p and q are both greater than 2 they must be odd	B1	
			pq will be odd × odd giving an odd answer		
			$pq + 1$ will be odd + 1 giving an even answer	M1	
			$pq + 1$ is greater than 2 so the answer cannot be prime	A1	Total 5

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15 Area of triangle $ABC = \frac{1}{2} \times 7.5 \times 4 = 15 \text{ cm}^2$ — B1

Pythagoras': $AC^2 = 7.5^2 + 4^2$ — M1

$= 56.25 + 16 = 72.25$

$AC = \sqrt{72.25} = 8.5$ cm

Similarity: $\frac{DC}{8.5} = \frac{7.5}{4}$ — M1

$DC = \frac{8.5 \times 7.5}{4} = 15.9375$ cm

Area of triangle $ACD = \frac{1}{2} \times 8.5 \times 15.9375 = 67.73... \text{ cm}^2$

Area of quadrilateral $ABCD = 15 + 67.73... = 82.7 \text{ cm}^2$ (3sf) — A1 — Total 4

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16 $-1 \le \sin x \le 1$

$-3 \le 3 \sin x \le 3$

$5 \le 8 - 3 \sin x \le 11$

3 5 8 11 — B1 — Total 1

17	**(a)**	e.g.	After 1 minute, 20% of the original amount is lost. After another minute, 20% of the new, smaller amount is lost which is less than 20% of the original amount. Hence, after 5 minutes they haven't lost 100% (5 × 20%) of the original.	B1	
	(b)		When reduced by 20%, 80% or 0.8 is left		
			After 1 minute, amount left is 0.8 × £8000 (= £6400)	M1	
			After 2 full minutes, amount left = 0.8 × 0.8 × £8000 = £5120	A1	Total 3

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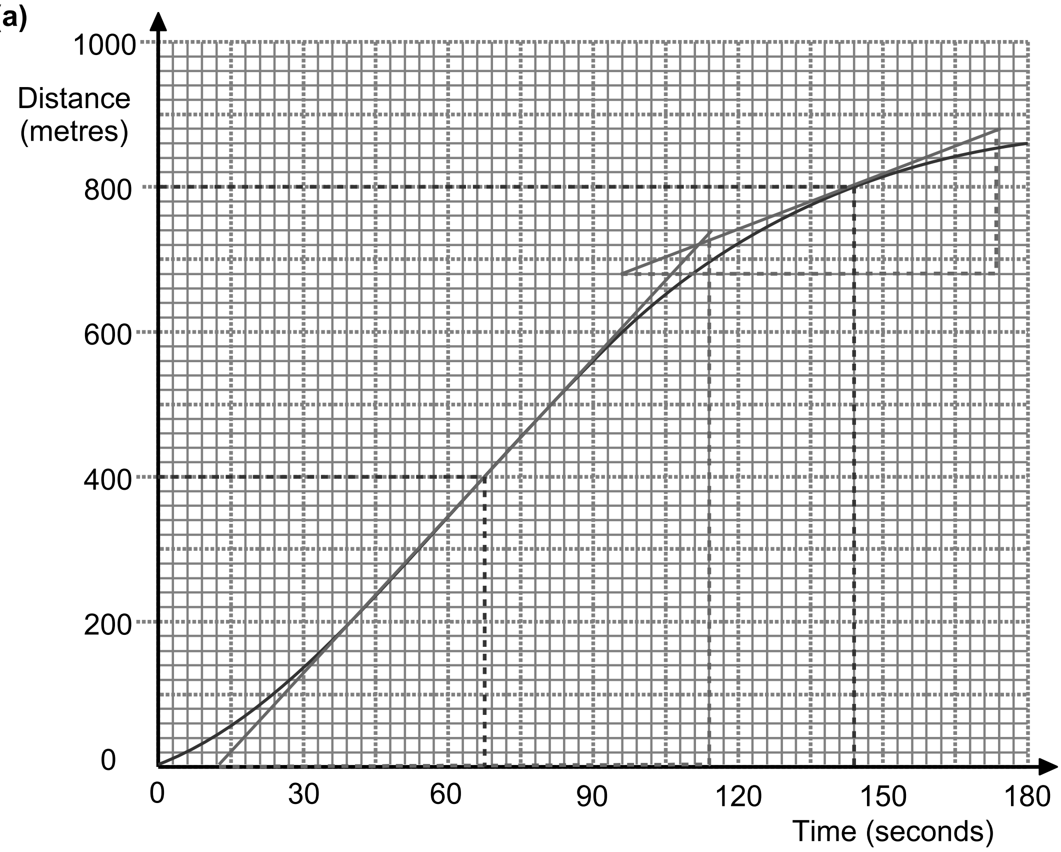
18 **(a)**



Time ≈ 144 seconds B1

(b) Speed = gradient of tangent

At 800 m, speed ≈ $\dfrac{880-680}{174-96}$ = 2.56... m/s M1

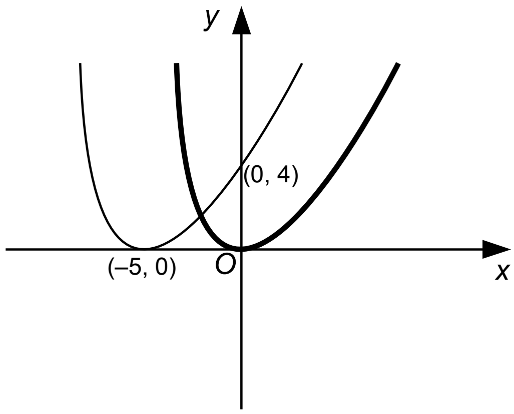
At 400 m, speed ≈ $\dfrac{740-0}{114-12}$ = 7.25... m/s

7.25 ÷ 2 = 3.6... M1

Speed at end is less than half speed at halfway point

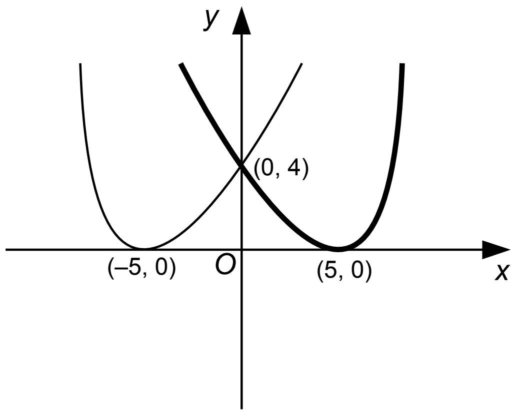
Gill is correct A1 Total 4

19 **(a)**



M1 A1

(b)



B1

Total 3

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20 **(a)** $T \propto m^2$

$T = km^2$

When $m = 2$, $T = 15$ so $15 = k \times 2^2 = 4k$ M1

$k = 15 \div 4 = 3.75$

Hence, $T = 3.75m^2$

When $m = 6$ $T = 3.75 \times 6^2$ M1

$T = 3.75 \times 36 = 135$ as required A1

(b) e.g. If m increases by 4 again we have $m = 10$

When $m = 10$ $T = 3.75 \times 10^2$ M1

$T = 3.75 \times 100 = 375$

However, $135 + 120 = 255$ so T has not increased by 120 A1 Total 5

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21 **(a)**

Will's:		Grace's:		
	$x_1 = 2.7071\ldots$		$x_1 = 2.3268\ldots$	M1
	$x_2 = 2.0853\ldots$		$x_2 = 2.3506\ldots$	
	$x_3 = 2.6106\ldots$		$x_3 = 2.3522\ldots$	
	$x_4 = 2.1511\ldots$		$x_4 = 2.3523\ldots$	M1
	$x_5 = 2.5413\ldots$		$x_5 = 2.3523\ldots$	

Grace's process as it converges much more quickly A1

(b) Using Grace's process: $x_4 = 2.352384\ldots$

$x_5 = 2.352392\ldots$

$x_6 = 2.352392\ldots$

$x = 2.3524$ (4dp) B1 Total 4

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22 Density = $\dfrac{\text{mass}}{\text{volume}}$

$3 = \dfrac{400}{\text{volume}}$ M1

Volume = $\dfrac{400}{3}$ = 133.3... cm^3

Hence $\frac{1}{2} \times \frac{4}{3}\pi r^3 = \dfrac{400}{3}$ M1

$r^3 = \dfrac{200}{\pi}$

$r = \sqrt[3]{\dfrac{200}{\pi}}$ = 3.9929... cm M1

Box measures $2r$ by $2r$ by r

Volume of box = 7.99 × 7.99 × 3.99

= 254.6... = 255 cm^3 (3sf) A1 Total 4

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23 **(a)** 1st tablet can be any type (so probability = 1)

After 1st tablet, there are 3 left of that type and 4 each of other types

P(2nd tablet is different type) = $\frac{8}{11}$ M1

After 2nd tablet, and given 1st and 2nd were different, there are 3 left of each type that she's had already and 4 left of the third type

P(3rd tablet is different type from 1st and 2nd) = $\frac{4}{10}$

P(one of each type) = $1 \times \frac{8}{11} \times \frac{4}{10} = \frac{32}{110}$ [= $\frac{16}{55}$] M1 A1

(b) e.g. I have assumed that each type of tablet is equally likely to come out B1 Total 4

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24 **(a)** $\overrightarrow{AB} = \overrightarrow{OC} = 4\mathbf{q}$

$\overrightarrow{MB} = \frac{3}{4}\overrightarrow{AB} = 3\mathbf{q}$ M1

$\overrightarrow{CB} = \overrightarrow{OA} = 2\mathbf{p}$

$\overrightarrow{NB} = \frac{1}{2}\overrightarrow{OA} = \mathbf{p}$

$\overrightarrow{MN} = \overrightarrow{MB} + \overrightarrow{BN} = \overrightarrow{MB} - \overrightarrow{NB}$ M1

$= 3\mathbf{q} - \mathbf{p}$ or $-\mathbf{p} + 3\mathbf{q}$ A1

(b) $\overrightarrow{OB} = \overrightarrow{OA} + \overrightarrow{AB} = 2\mathbf{p} + 4\mathbf{q}$

$\overrightarrow{AM} = \frac{1}{4}\overrightarrow{AB} = \mathbf{q}$

$\overrightarrow{MP} = \frac{3}{5}\overrightarrow{MN} = \frac{3}{5}(-\mathbf{p} + 3\mathbf{q}) = -\frac{3}{5}\mathbf{p} + \frac{9}{5}\mathbf{q}$ M1

$\overrightarrow{OP} = \overrightarrow{OA} + \overrightarrow{AM} + \overrightarrow{MP}$

$= 2\mathbf{p} + \mathbf{q} + (-\frac{3}{5}\mathbf{p} + \frac{9}{5}\mathbf{q})$ M1

$= \frac{7}{5}\mathbf{p} + \frac{14}{5}\mathbf{q}$

$= \frac{7}{5}(\mathbf{p} + 2\mathbf{q})$

$= \frac{7}{10}(2\mathbf{p} + 4\mathbf{q}) = \frac{7}{10}\overrightarrow{OB}$

So P is $\frac{7}{10}$ of the way from O to B and therefore lies on OB

Dinesh is correct A1 Total 6

TOTAL FOR PAPER: 80 MARKS