

Write your name here

Surname

Other names

**Pearson Edexcel**  
**Level 1/Level 2 GCSE (9 - 1)**

Centre Number

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Candidate Number

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# Mathematics

## Paper 3 (Calculator)

**Higher Tier**

Sample Assessment Materials for first teaching September 2015

**Time: 1 hour 30 minutes**

Paper Reference

**1MA1/3H**

**You do not need any further materials.**

Total Marks

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Calculators may be used.**
- If your calculator does not have a  $\pi$  button, take the value of  $\pi$  to be 3.142 unless the question instructs otherwise.
- Diagrams are NOT accurately drawn, unless otherwise indicated.
- You must **show all your working out** with your **answer clearly identified** at the **end of your solution**.



### Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

### Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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**PEARSON**

## Formulae Sheet

### *Perimeter, area, surface area and volume formulae*

Where  $r$  is the radius of the sphere or cone,  $l$  is the slant height of a cone and  $h$  is the perpendicular height of a cone:

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

### *Kinematics formulae*

Where  $a$  is constant acceleration,  $u$  is initial velocity,  $v$  is final velocity,  $s$  is displacement from the position when  $t = 0$  and  $t$  is time:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

**Answer ALL questions.**

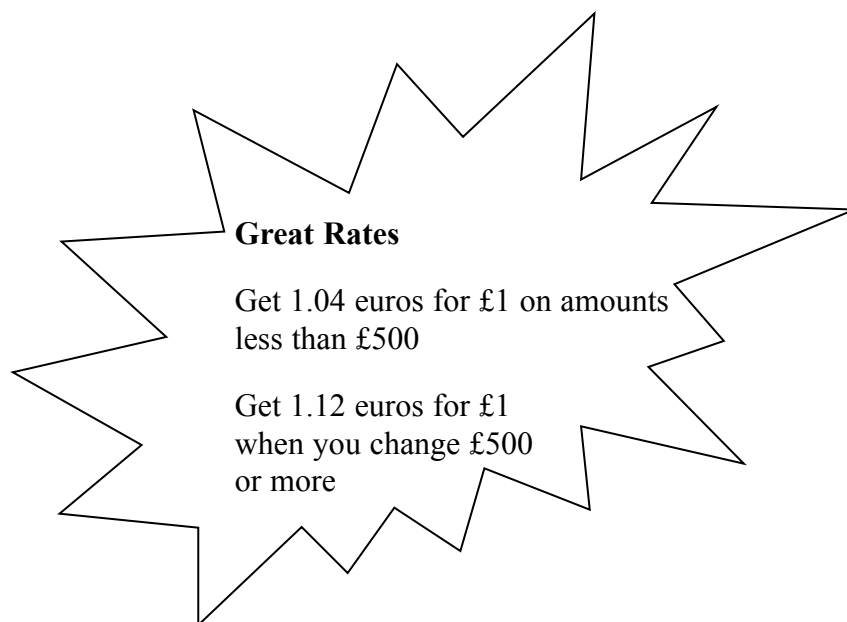
**Write your answers in the spaces provided.**

**You must write down all the stages in your working.**

**1** Mr and Mrs Sharma are going to France.

They each have £300 which they want to change into euros.

They see this deal in a bank.



Mr and Mrs Sharma want the best deal.

They put their money together before changing it into euros.

How much extra money do they get by putting their money together before they change it?

**(Total for Question 1 is 3 marks)**

2 Stephen throws a fair dice until he gets a six.  
Work out the probability that Stephen throws the dice

(i) exactly once

(ii) exactly twice

(iii) more than twice.

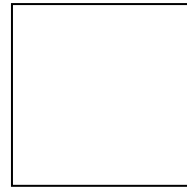
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**(Total for Question 2 is 4 marks)**

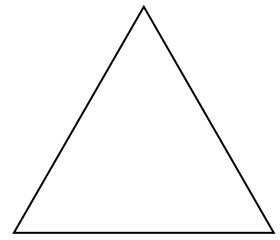
3 Here are a square and an equilateral triangle.

The length of a side of the square is  $x$  cm.

The length of a side of the equilateral triangle is 2 cm more than the length of a side of the square.



$x$  cm



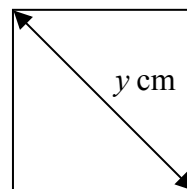
The perimeter of the square is equal to the perimeter of the equilateral triangle.

(a) Work out the perimeter of the square.

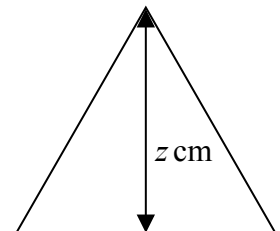
Here are the same square and the same equilateral triangle.

The length of the diagonal of this square is  $y$  cm.

The height of this equilateral triangle is  $z$  cm.



$x$  cm



(3)

(b) Which has the greater value,  $y$  or  $z$ ?

(4)

(Total for Question 3 is 7 marks)

4 Linda keeps chickens.  
She sells the eggs that her chickens lay.

She has 140 chickens.  
Each chicken lays 6 eggs a week.

Linda gives each chicken 100 g of chicken feed each day.  
The chicken feed costs £6.75 for a 25 kg bag.

Work out the cost of the chicken feed for every 12 eggs.

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**(Total for Question 4 is 5 marks)**

- 5 Bella invests £5000 in an account for two years.  
The account pays 3% compound interest per annum.

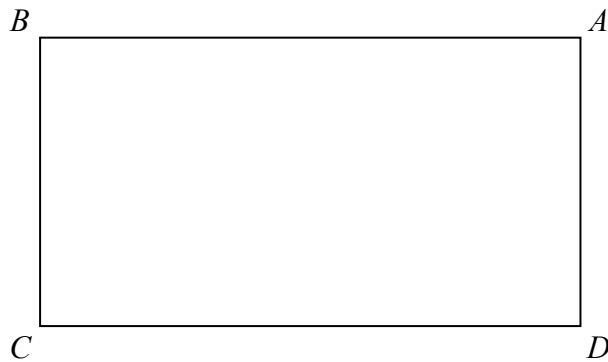
Bella has to pay 20% tax on the interest earned each year.  
This tax is taken from the account at the end of each year.

How much money will Bella have in her account at the end of the two years?

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**(Total for Question 5 is 4 marks)**

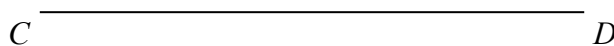
6 The diagram shows a rectangle  $ABCD$ .



In the space below, use a ruler and a pair of compasses to construct a right-angled triangle equal in area to the area of the rectangle  $ABCD$ .

You must show all your construction lines.

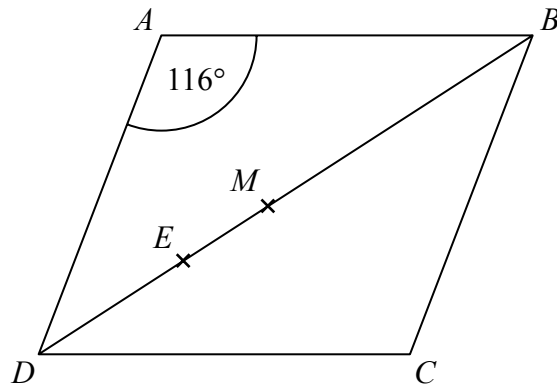
The base of the triangle, which is equal in length to the side  $CD$ , has been drawn for you.



**(Total for Question 6 is 3 marks)**



7



$ABCD$  is a rhombus.

$M$  is the midpoint of  $BD$ .

$E$  is the point on  $BD$  such that  $DE = CE$ .

Calculate the size of angle  $MCE$ .

(Total for Question 7 is 3 marks)

- 8 A school has a biathlon competition.  
Each athlete has to throw a javelin and run 200 metres.

(a) The points scored for throwing a javelin are worked out using the formula

$$P_1 = 16(D - 3.8)$$

where  $P_1$  is the number of points scored when the javelin is thrown a distance  $D$  metres.

- (i) Lottie throws the javelin a distance of 42 metres.  
How many points does Lottie score?

- (ii) Ingrid scores 584 points for throwing the javelin.  
Work out the distance that the javelin was thrown by Ingrid.

(4)

The points scored for running 200 metres are worked out using the formula

$$P_2 = 5(42.5 - T)^2$$

where  $P_2$  is the number of points scored when the time taken to run 200 metres is  $T$  seconds.

Suha scores 1280 points in the 200 metres.

(b) (i) Work out the time, in seconds, it took Suha to run 200 metres.

The formula for the number of points scored in the 200 metres should not be used for  $T > n$ .

- (ii) State the value of  $n$ .  
Give a reason for your answer.

(4)

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**(Total for Question 8 is 8 marks)**

**9** Triangle  $ABC$  has a right angle at  $C$ .

Angle  $BAC = 48^\circ$ .

$AB = 9.3$  cm.

Calculate the length of  $BC$ .

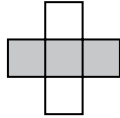
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**(Total for Question 9 is 3 marks)**

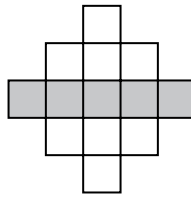
10 The diagrams show a sequence of patterns made from grey tiles and white tiles.



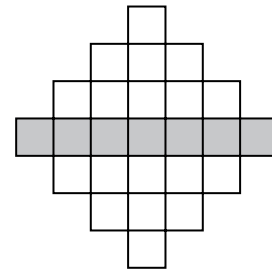
Pattern 1



Pattern 2



Pattern 3



Pattern 4

The number of grey tiles in each pattern forms an arithmetic sequence.

(a) Find an expression, in terms of  $n$ , for the number of grey tiles in Pattern  $n$ .

(2)

The **total** number of grey tiles and white tiles in each pattern is always the sum of the squares of two consecutive whole numbers.

(b) Find an expression, in terms of  $n$ , for the **total** number of grey tiles and white tiles in Pattern  $n$ .

Give your answer in its simplest form.

(3)

- (c) Is there a pattern for which the total number of grey tiles and white tiles is 231?  
Give a reason for your answer.

(2)

The total number of grey tiles and white tiles in any pattern of this sequence is always an odd number.

- (d) Explain why.

(2)

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**(Total for Question 10 is 9 marks)**

**11** Alfred studies animal populations on an island.

The size of an animal population at the start of 2014 was 2500.

The size of this animal population increases exponentially.

Alfred assumes that the rate of increase is 20% per year.

(a) Using his assumption, work out the size of this animal population at the start of 2009.

(3)

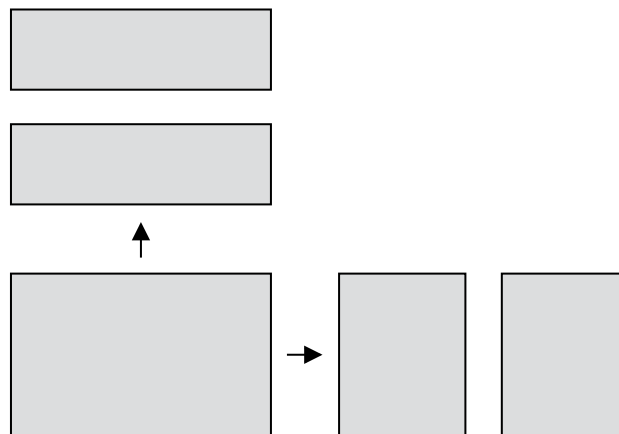
(b) Alfred's assumption is too high. Explain how your answer to part (a) is affected.

(1)

**(Total for Question 11 is 4 marks)**

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- 12 A rectangular sheet of paper can be cut into two identical rectangular pieces in two different ways.



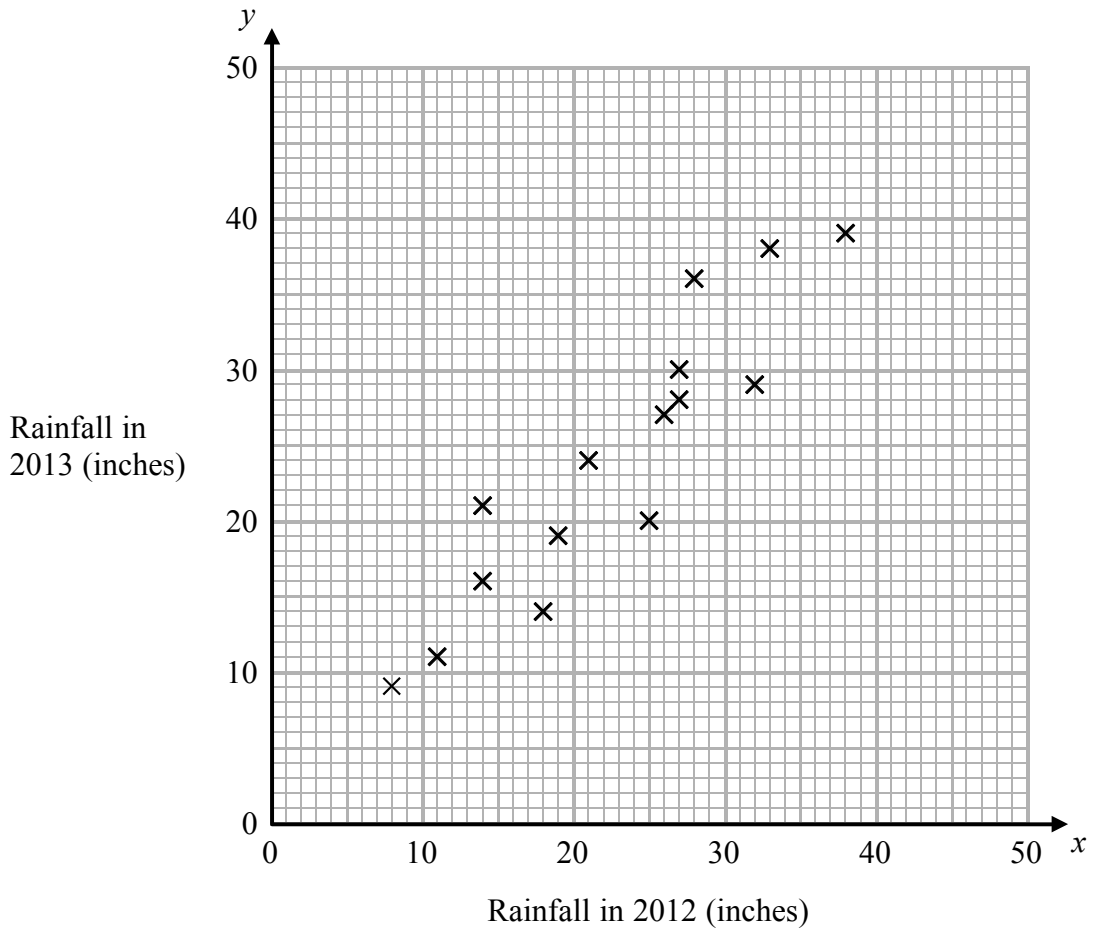
When the original sheet of paper is cut one way, the perimeter of each of the two pieces is 50 cm.

When the original sheet of paper is cut the other way, the perimeter of each of the two pieces is 64 cm.

What is the perimeter of the original sheet of paper?

(Total for Question 12 is 5 marks)

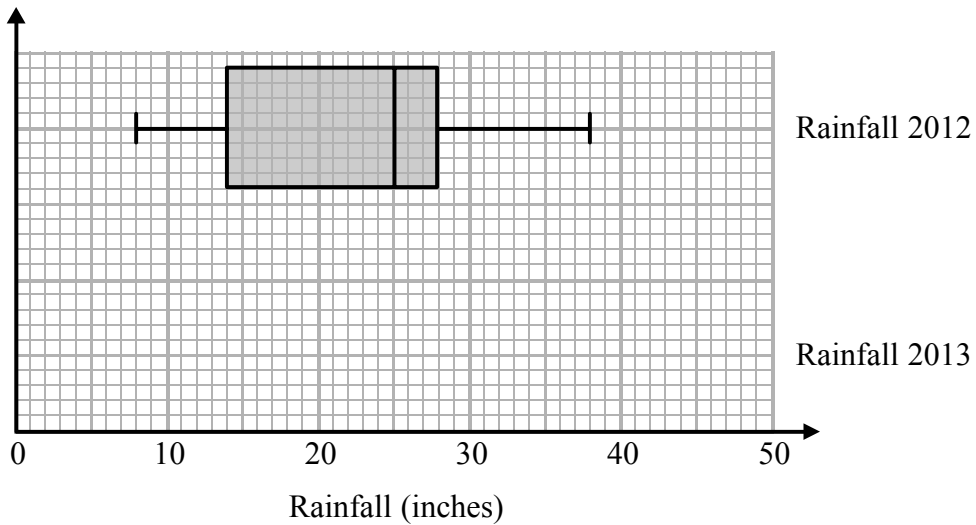
- 13 The scatter graph gives information about the rainfall, in inches, in 2012 and the rainfall, in inches, in 2013 for each of 15 countries.



(Source: data.worldbank.org)

The box plot for the rainfall in 2012 for the 15 countries is drawn on the grid below.

- (a) On the same grid, draw the box plot for the rainfall in 2013 for the 15 countries.



(3)



(b) Compare the distributions of the rainfall in the 2 years.

(2)

**(Total for Question 13 is 5 marks)**

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- 14 The quantity of heat,  $H$  calories, delivered by an electric current,  $I$  amps, acting for  $t$  seconds to heat an amount of water is given by the formula

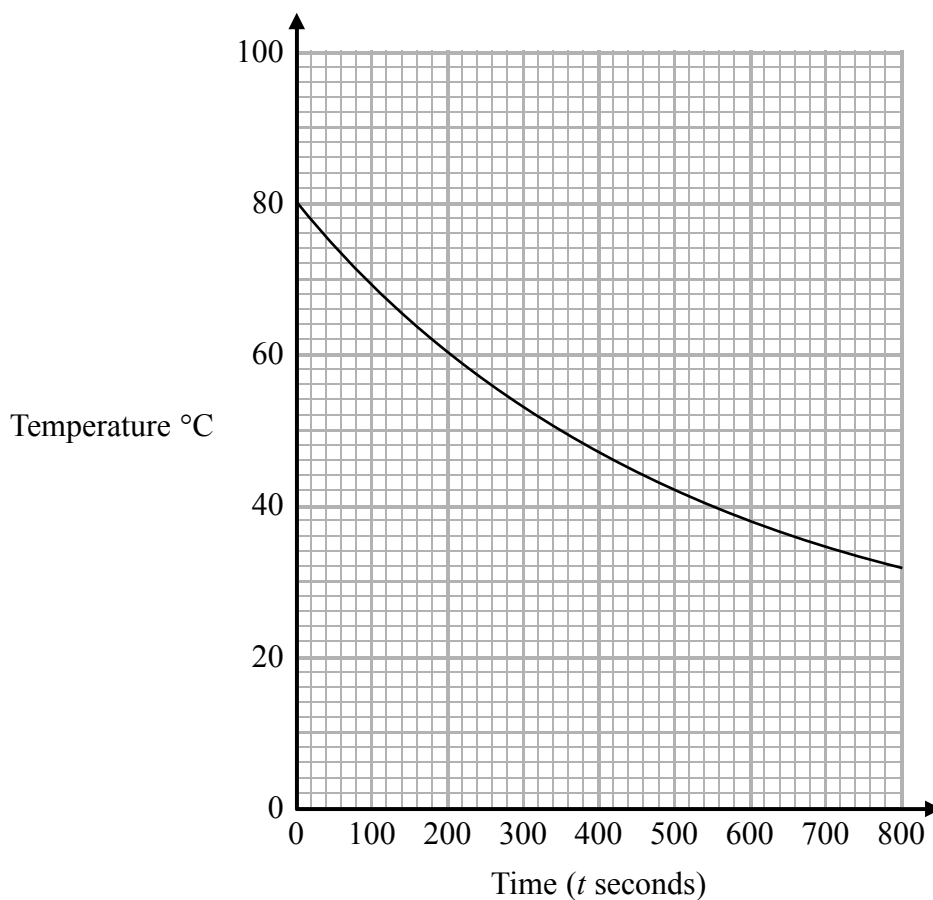
$$H = atI^2 - b$$

where  $a$  and  $b$  are constants.

- (a) Rearrange the formula to make  $I$  the subject.

(2)

The graph gives information about the variation in the temperature, in  $^{\circ}\text{C}$ , of an amount of water that is allowed to cool from  $80^{\circ}\text{C}$ .



- (b) (i) Work out the average rate of decrease of the temperature of the water between  $t = 0$  and  $t = 800$ .

The instantaneous rate of decrease of the temperature of the water at time  $T$  seconds is equal to the average rate of decrease of the temperature of the water between  $t = 0$  and  $t = 800$ .

- (ii) Find an estimate for the value of  $T$ .  
You must show how you got your answer.

(4)

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**(Total for Question 14 is 6 marks)**

15 (a) Prove that the recurring decimal  $0.\dot{1}\dot{5}$  has the value  $\frac{5}{33}$

(2)

(b)  $x = \frac{1}{2^{183} \times 5^{180}}$

Show that, when  $x$  is written as a terminating decimal, there are 180 zeros after the decimal point.

(2)

The reciprocal of any prime number  $p$  (where  $p$  is neither 2 nor 5) when written as a decimal, is always a recurring decimal.

A theorem in mathematics states

*The period of a recurring decimal is the least value of  $n$  for which  $p$  is a factor of  $10^n - 1$*

Hugo tests this theorem.

He uses his calculator to show that 37 is a factor of  $10^3 - 1$

Hugo then makes this statement,

“The period of the recurring decimal equal to the reciprocal of 37 is 3 because 37 is a factor of  $10^3 - 1$ . This shows the theorem to be true in this case.”

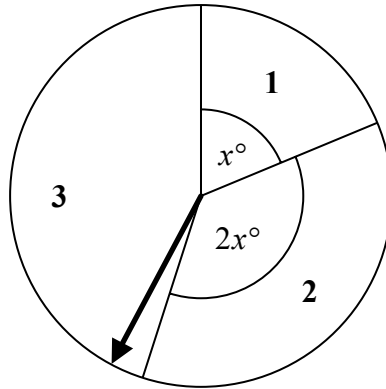
(c) Explain why Hugo’s statement is incomplete.

(2)

**(Total for Question 15 is 6 marks)**

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16



Here is a spinner.

When the arrow is spun once, a 1 or a 2 or a 3 can be scored.

Bill is going to spin the arrow twice.

He will work out his total score by adding the two scores he gets on the two spins.

The probability that he will get a total score of 4 is  $\frac{16}{81}$

Assuming that the thickness of the three lines between the sectors may be ignored,

Work out the value of  $x$ .

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(Total for Question 16 is 5 marks)

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**TOTAL FOR PAPER IS 80 MARKS**

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### Higher Tier Paper 3 – Calculator

Question	Working	Answer	Mark	AO	Notes
1		€48 or £42.86	P  P  A	3.1c  3.1c  1.3a	P1 for a correct process, using the lower rate, to find the amount by changing their money separately, e.g. $300 \times 1.04 \times 2 (= 624)$ P1 for a correct process, using the higher rate, to find the amount by changing their money together, e.g. $300 \times 2 \times 1.12 (= 672)$ resulting in two values to compare A1 for 48 euros or £42.85 or £42.86 if converted to sterling, units must be clear
2		$\frac{1}{6}$ $\frac{5}{36}$ $\frac{25}{36}$	B  B  M  A	1.2  1.3a  1.3b  1.3b	B1 oe  B1 oe  M1 for $1 - \frac{1}{6} - \frac{5}{36}$ or $\left(1 - \frac{1}{6}\right) \times \left(1 - \frac{1}{6}\right)$ A1 oe  OR  M1 for 1 – “(i)” – “(ii)”  A1 ft provided answer is less than 1

Question	Working	Answer	Mark	AO	Notes
3 (a)	$4x = 3x + 6$ $x = 6$ $4 \times 6$	24 (cm)	P	3.1b	P1 for translating the problem into an algebraic equation, e.g. $x + x + x = x + 2 + x + 2 + x + 2$ oe P1 for collecting terms and solving for $x$ oe A1 24 cao
3 (b)	$y^2 = 6^2 + 6^2$ $y = \sqrt{72}$ $z^2 = 8^2 - 4^2$ $z = \sqrt{48}$	$y > z$ with reason	P M M C	2.3a 1.3b 1.3b 2.1a	P1 for interpreting information, e.g. numerical values for sides on square and triangle M1 for a correct method to find $y$ or $z$ M1 for a correct method to find $y$ and $z$ C1 conclusion based on at least P1 consistent with candidate's figures for $y$ and $z$ or $y^2$ and $z^2$
4		38p	P P P P A	3.1d 3.1d 3.1d 3.1d 1.3b	P1 for a correct first step, e.g. $140 \times 6 (= 840$ eggs per week) P1 for a correct process to find the weight of feed per week, e.g. $100 \times 140 \times 7 (= 98000$ g or 98 kg) P1 for a correct method to find the weekly cost, e.g. $6.75 \div 25 \times "98" (= £26.46)$ P1 for completing the process to find the cost of feed required for 12 eggs, e.g. $(2646 \div 840) \times 12 = 37.8$ p A1 for 37.8p or 38p oe

Question	Working	Answer	Mark	AO	Notes
5		£5242.88	P	3.1d	P1 for a correct first step in the process, e.g. $5000 \times 0.03 (= 150)$ or $3 \times 0.8 = 2.4\%$
			P	3.1d	P1 for a correct process in finding the effect of the 20% tax on interest (i.e. "150"), e.g. $"150" \times 0.8 (= 120)$ or $5000 \times 1.024$
			P	3.1d	P1 (dependent on previous P marks) for a fully complete and correct process to find balance after 2 years, e.g. $(5000 + "120") + (5000 + "120") \times 0.03 \times 0.8$ or $5000 \times (1.024)^2$
			A	1.3b	A1 cao
6		A correct right- angled triangle constructed	P	2.3a	P1 for a construction of a right angle at C or D (construction arcs must be seen)
			P	2.3b	P1 (indep) for the correct height of the triangle drawn or shown
			P	2.3b	P1 for a fully correct constructed triangle

Question	Working	Answer	Mark	AO	Notes
7		26°	P	3.1b	P1 for a correct process that leads to angle <i>EDC</i> , e.g. $(180^\circ - 116^\circ) \div 2$ P1 for a correct process that leads to angle <i>MCE</i> , e.g. $(58^\circ - 32^\circ)$ A1 cao
8		611.2	M	1.3a	M1 for $16 \times (42 - 3.8)$ A1 for 611 (accept 611.2)
		40.3 m	A	1.3a	
			M	1.3b	M1 for a fully correct method to find distance by applying the correct inverse operations in the correct order
			A	1.3b	A1 for 40.3 m
8		26.5	M	1.3b	M1 for a fully correct method to find Time by applying the correct inverse operations in the correct order A1 for 26.5
		42.5 seconds with correct reason	A	1.3b	P1 for a recognition that $42.5 - T \geq 0$
			P	3.1c	C1 for 42.5 and a statement that this will lead to an increasing number of points the slower you get oe
			C	2.4a	

Question	Working	Answer	Mark	AO	Notes
9	$9.3 \times \sin 48^\circ$	6.911 cm	P	2.3a	P1 for process to decide which trig function to use from description  M1 $9.3 \times \sin 48^\circ$ A1 awrt 6.91cm
10 (a)		$2n - 1$	P	2.1a	P1 for process to deduce nth term from information given, e.g. $2n + k$ oe  A1 for $k = -1$
10 (b)		$2n^2 - 2n + 1$	P	2.3a	P1 starts process for at least first 3 pattern numbers by looking for sums of squares, e.g. 1st: $1 = 0 + 1$ , 2nd: $5 = 4 + 1$ 3rd: $13 = 9 + 4$ or begins to make a difference table at least as far as second differences
			P	2.2	P1 for process that leads to identification of $n^2$ and $(n - 1)^2$ or to identification of $2n^2$ from a difference table A1 $2n^2 - 2n + 1$
			A	1.3b	
10 (c)		No with a clear correct reason given	P C	2.4a 2.4a	P1 for an attempt to solve the equation $2n^2 - 2n - 230 = 0$ or evaluating $2n^2 - 2n + 1$ when $n = 11$ and 12 C1 for No and evidence, e.g. 11.2.... or 221 and 265

Question	Working	Answer	Mark	AO	Notes
10 (d)		Complete explanation	P	2.4a	P1 for an argument in words or using symbols, e.g. in any two consecutive numbers one is even and one is odd and the square of an even number is even and the square of an odd number is odd The sum of an odd and an even number is odd C1 conclusion with a correct complete argument
11 (a)	$2500 = P \times 1.20^5$ $P = 2500 \div 1.20^5 = 1004.69$	1005	P M A	3.1c 1.3a 1.3a	P1 for process to translate problem into algebraic form, e.g. $2500 = P \times 1.20^5$ M1 $P = 2500 \div 1.20^5$ A1 1005
11 (b)		Correct explanation	C	3.5	C1 for an explanation eg the original population size will be greater
12	Let $h$ and $w$ be the dimensions of the original rectangle $h + 2w = 50$ $2h + w = 64$ $w = 12, h = 26$ Perimeter = $2 \times 12 + 2 \times 26$	Correct explanation 76 cm	P  P P A	3.2  3.1d 3.1d 3.1d 1.3b	P1 for correct process to set up equations, e.g. $\frac{h}{2} + \frac{h}{2} + w + w = 50$ and $\frac{w}{2} + \frac{w}{2} + h + h = 64$ P1 for correct process to find value of one variable P1 for correct process to find value of other variable P1 for correct process to find numerical value of perimeter, e.g. $2 \times (12 + 26)$ A1 cao

Question	Working	Answer	Mark	AO	Notes										
13 (a)	<table border="1"> <tr><td>Lv</td><td>9</td></tr> <tr><td>Lq</td><td>16</td></tr> <tr><td>M</td><td>24</td></tr> <tr><td>Uq</td><td>30</td></tr> <tr><td>Uv</td><td>39</td></tr> </table> <div style="border: 1px solid black; width: 30px; height: 20px; margin-left: 100px; text-align: center;">2013</div>	Lv	9	Lq	16	M	24	Uq	30	Uv	39		P P C	2.3a 2.3a 2.3b	P1 for process to interpret diagram, e.g. identify any quartile P1 for further interpretation in order to draw box plot with at least three correct from Lv, Lq, M, Uq, Uv C1 for fully correct box plot
Lv	9														
Lq	16														
M	24														
Uq	30														
Uv	39														
13 (b)		Correct comparisons	C C	2.3b 2.3b	C1 ft for a correct comparison in context of central tendency C1 ft for a correct comparison in context of any measure of spread										
14 (a)	$H = atI^2 - b$ $\frac{H + b}{at} = I^2$	$I = \sqrt{\frac{H + b}{at}}$	M A	1.3b 1.3b	M1 $\frac{H + b}{at} = I^2$ A1 cao (accept $\pm$ )										
(b)(i)	$\frac{80 - 32}{800}$	0.06 °C/second	P	3.1a	P1 for process to use graph to find gradient, e.g. $\frac{80 - 32}{0 - 800}$										
(ii)	Draw a tangent to the curve with a gradient of -0.06 (see diagram at the end)	350 seconds	A P A	1.3a 2.3a 1.3a	A1 accept -0.06 °C/second P1 for process to interpret parallel lines on diagram A1 340 - 360										

Question	Working	Answer	Mark	AO	Notes
15 (a)	$x = 0.\dot{1}5$ $100x = 15.\dot{1}5 \quad \therefore 99x = 15$ $\therefore x = \frac{15}{99} = \frac{5}{33}$	Shown	M  A	1.3b  1.3b	M1 for a complete method  A1 fully correct working
15 (b)	$\frac{1}{2^{183} \times 5^{180}} = \frac{1}{8} \times \frac{1}{10^{180}}$ $= 0.125 \times 10^{-180}$	Shown	P  P	2.2  2.2	P1 for a correct process to find that 180 comes from $2^{180}$ and $5^{180}$  P1 for complete process with correct working to show that the number of zeros is 180
15 (c)		Reasons	P  P	2.5a  2.5a	C1 He has not shown that the period is 3  C1 He has omitted to show that 37 is neither a factor of $10^2 - 1$ nor of $10^1 - 1$
16		40	P  P	3.1d  3.1d	P1 for identifying probabilities, e.g. prob of '1' = $\frac{x}{360}$ , prob of '2' = $\frac{2x}{360}$ , prob '3' = $1 - \frac{3x}{360}$  P1 for a correct process to set up a quadratic equation, e.g. $2 \times \frac{x}{360} \times \left(1 - \frac{3x}{360}\right) + \left(\frac{2x}{360}\right)^2 = \frac{16}{81}$



Question	Working	Answer	Mark	AO	Notes
			P	3.1d	P1 for a correct process that leads to a 3-term quadratic, e.g. $2x^2 - 720x + 25600 = 0$
			M	1.3b	M1 for a correct method to solve the quadratic equation, e.g. $(2x - 80)(x - 320) (=0)$
			P	3.3	P1 selection of $x = 40$ (from solutions $x = 40$ or $x = 320$ )

Question 14 (b)(ii)

