

**GCSE (9-1)**

*Examiners' report*

# **MATHEMATICS**

**J560**

For first teaching in 2015

**J560/04 November 2018 series**

Version 1

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## Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

## Paper J560/04 series overview

Paper 4 is the first of three papers in the higher tier of the GCSE (9-1) Mathematics specification. There will be multi-stage and problem solving questions to answer.

### *Use of calculators*

In this paper it is expected that calculators will be used. It is important that accuracy is maintained in calculations and also with values which are transferred between processes.

The candidates' responses to the problem solving questions showed little improvement since the last examination series. They will do even better if they set out the work logically and continue with their 'first thought' approach which is usually always correct. Candidates who did well have learned the basic skills and methods thoroughly.

### *Most successful questions*

- Percentage profit, 2.03b (Q1)
- Proportion problems, 5.01d (Q2)
- Prime numbers and HCF, 1.02b & 1.02c (Q8b)
- Venn diagrams, 11.02c (Q9)
- Reading solutions from a graph, 6.03d (Q10)

### *Least successful questions*

- Construction and loci, 8.02d (Q7)
- Inverse proportionality, 5.02b (Q14)
- Solving quadratic equations, 6.03b (Q16)
- Equations of perpendicular lines, 7.02b (Q18)
- Similar shapes, 9.04c (Q19)

### Question 1

- 1 Shari buys a box of 60 candles for £125. She sells the candles for £2.25 each.

Calculate her percentage profit.

..... % [4]

Most candidates could find the actual profit of £10 but they were unable to find the percentage profit, with many using a figure of 135 rather than 125.

### Question 2(a)

- 2 Hector can run 400 metres in 66 seconds.

- (a) Use this information to show that he could run 5 kilometres in less than 14 minutes. [4]

The one stage which caused problems was converting the time from seconds to minutes or vice versa. There were some candidates who incorrectly used a conversion of 100 metres to a kilometre.

### Question 2(b)

- (b) Hector tries to run 5 kilometres in less than 14 minutes.

Give one reason why he might not achieve this.

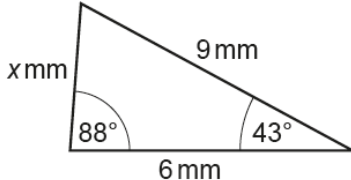
.....

..... [1]

This part was usually answered well as most candidates focussed on the lack of consistency over the longer distance.

### Question 3

3 Here is Mario's answer to a question.

<p>Question 3</p>  <p>Work out the value of <math>x</math>.</p>	<p>Answer</p> $x = \sqrt{9^2 - 6^2}$ $x = \sqrt{45}$ $x = 6.708 \text{ (3 d.p.)}$
--	---

Explain the error in Mario's method.

.....

..... [1]

This question was answered well although some candidates corrected the Pythagoras' statement and suggested that the two squares should be added.

### Question 4

4 Here are the interest rates for two bank accounts.

<p>Northern Savings Bank (NSB)</p> <p>2.5% per year <b>compound interest</b></p>	<p>Central Alliance Bank (CAB)</p> <p>2.7% per year <b>simple interest</b></p>
--	--

Mia puts £6400 in each account.

Calculate the difference in value between the two accounts after 8 years.  
Give your answer correct to the nearest penny.

£ ..... [6]

Many candidates worked out the compound interest correctly but then struggled to calculate the simple interest. Some repeated the compound interest calculation with a different interest rate.

## Question 5

- 5 Marcin buys 7 rulers and 15 crayons for £7.  
A ruler costs 12p more than a crayon.

Find the cost of one crayon.

cost of one crayon = ..... p [5]

Many candidates struggled to solve this question because they did not create a linear equation and solve it. Most tried to use trial and improvement but they did not use a systematic approach and did not know how close they were to the solution.

### Exemplar 1

5 marks

let  $x_p$  = cost of a crayon

$x + 12$  = cost of a ruler

$$7(x + 12) + 15x = 700$$

$$7x + 84 + 15x = 700$$

$$22x = 616$$

$$x = \frac{616}{22} = 28p$$

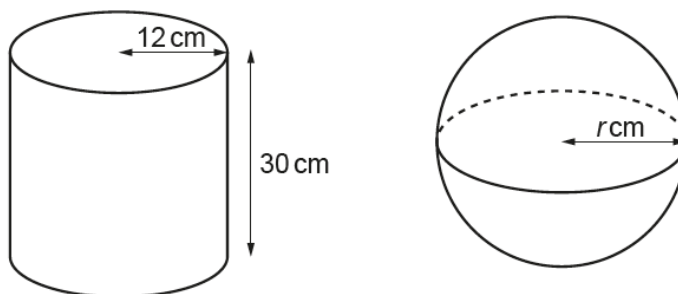
cost of one crayon = 28 ..... p [5]

This exemplar shows the method of using linear equations to find the correct solution.



### Question 6

6 The diagram shows a cylinder and a sphere.



The cylinder has radius 12 cm and height 30 cm.  
 The cylinder and the sphere have the same volume.

Work out the radius  $r$  cm of the sphere.

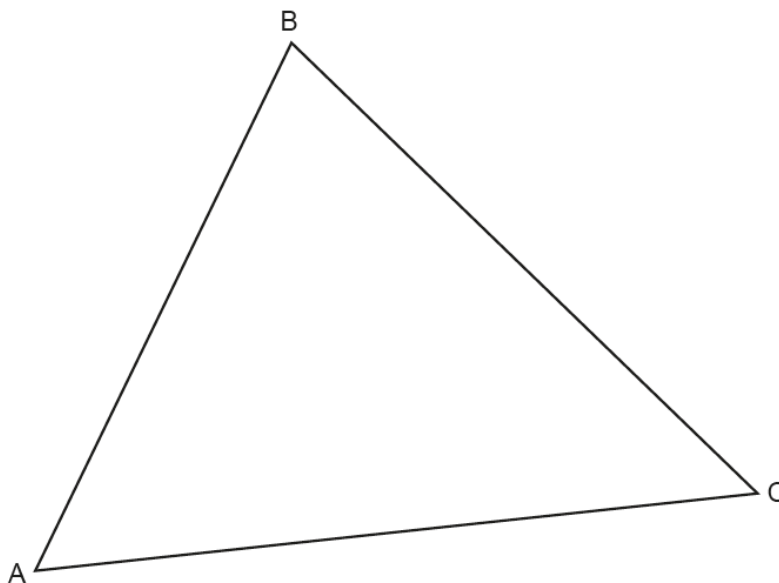
[The volume  $V$  of a sphere with radius  $r$  is  $V = \frac{4}{3}\pi r^3$ .]

..... cm [5]

The best attempts seen were from candidates who worked out the volume of the cylinder and then tried to find the radius of the sphere by using inverse operations. It would have helped to leave the values as multiples of  $\pi$  as this made the manipulation easier.

**Question 7(a)**

7 The diagram shows triangle ABC.



(a) Construct the bisector of angle BAC.

[2]

Many candidates did not know what an angle bisector was and few used the correct construction methods.

**Question 7(b)**

(b) Construct the perpendicular bisector of AC.

[2]

Many candidates knew how to bisect the line but they did not know how to construct the perpendicular bisector. Many bisectors were not perpendicular.

**Question 7(c)**

(c) Shade the region inside triangle ABC that is

- nearer to AC than to AB
- nearer to A than to C.

[1]

Candidates found this part difficult and they did not have the correct regions on their diagram.

**Question 8(a)(i)**

8 (a) Two numbers,  $P$  and  $Q$ , are written as products of their prime factors.

$$P = 2^5 \times 3^2 \times 5^3 \times 11 \qquad Q = 2^4 \times 3 \times 5^4 \times 7$$

(i) Find the lowest common multiple (LCM) of  $P$  and  $Q$ .

(a)(i) ..... [2]

Some candidates tried to find the highest common factor. Others used their calculators to find the actual two numbers and then tried to find the lowest common multiple, which is more difficult.

**Question 8(a)(ii)**

(ii) The number  $C$  is written as the product of its prime factors.

$$C = 2^3 \times 3 \times 5^2$$

Work out  $P \div C$ , leaving your answer as a product of powers of prime numbers.

(ii) ..... [2]

This part was answered much better than part (a)(i) as more candidates used the prime factors correctly and used the law of indices.

**Question 8(b)(i)**

(b) (i) Write 450 as a product of its prime factors.

(b)(i) ..... [3]

This is a standard question and most candidates knew how to attempt it. Drawing a factor tree proved to be the single most successful method.

**Question 8(b)(ii)**

(ii) Find the highest common factor (HCF) of 270 and 450.

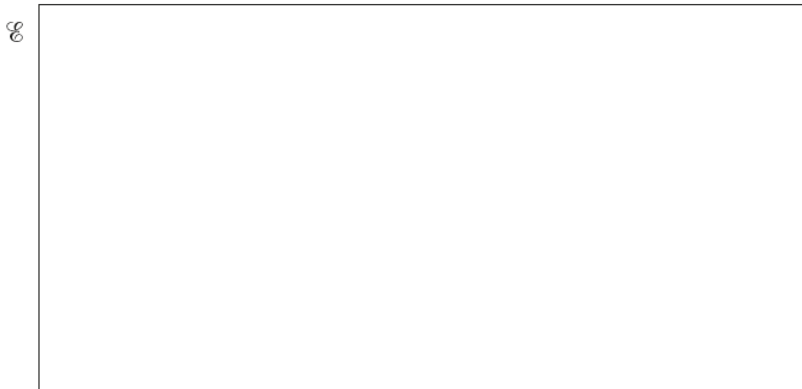
..... (ii) ..... [3]

Many candidates gave a common factor but few gave the highest common factor. Common incorrect answers were 3 and 9.

### Question 9(a)

- 9 72 children are asked whether they have a laptop or an iPad.
- 31 have a laptop.
  - 48 have an iPad.
  - 12 have both.
  - 5 have neither.

(a) Represent this information on a Venn diagram.



[3]

Most candidates knew how to complete a Venn diagram. The single most common error was not to subtract the 12 from both the 31 and the 48.

### Question 9(b)

(b) One of the children is chosen at random.

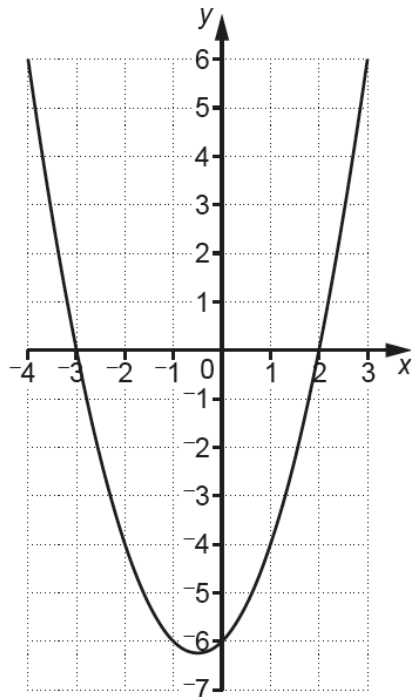
Write down the probability that they have an iPad but not a laptop.

(b) ..... [2]

Most candidates stated the denominator was 72. Many different values were seen for the numerator; and 48 was the most common value used.

**Question 10**

10 Here is the graph of  $y = x^2 + x - 6$ .



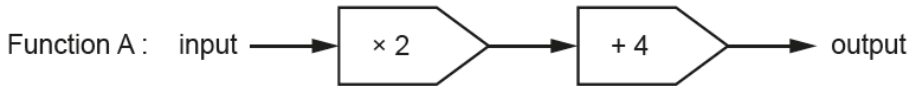
Use the graph to solve the equation  $x^2 + x - 6 = 0$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

Many correct responses were seen to this question. -2 was the most common incorrect response.

### Question 11(a)

11 Here are two functions.



Composite function C is shown below.



(a) The output from function C is 54.

Work out the input.

(a) ..... [2]

Most of the incorrect attempts occurred where candidates did not use the diagram and reverse the functions. Those who gave the correct answer wrote the values on the diagram as they worked backwards.

### Question 9(b)

(b) The input to function C is  $x$ .

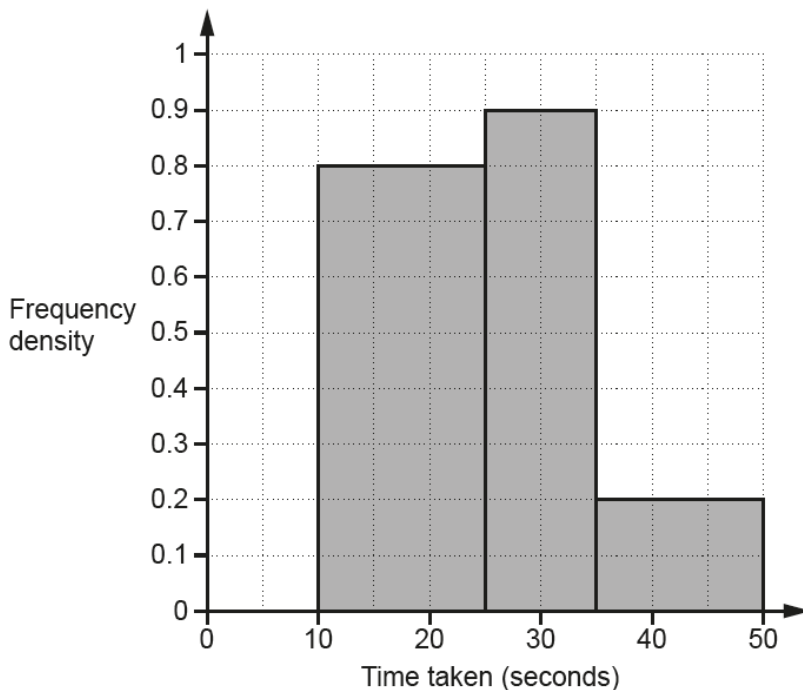
Find an expression, in terms of  $x$ , for the output from function C.

(b) ..... [2]

Most candidates wrote  $2x + 4$  as the output from function A but then usually worked out  $2x + 4 + 3x - 3$  i.e. they did not operate each function on the result of the previous one.

### Question 12

- 12 30 students completed a puzzle and their times were recorded. All of the students completed the puzzle in less than 50 seconds. The histogram shows information about some of their times.



Complete the histogram for those completing the puzzle in less than 10 seconds.

[5]

Most candidates did not know that the frequency was found by multiplying the frequency density by the group width. Some treated the group widths as the same.

## Question 13

13 Tenzin is given this question.

Factorise fully.

$$2x^2 + 6x$$

Here is his answer.

$$2x^2 + 6x = x(2x + 6)$$

Explain why Tenzin's answer is not correct.

.....  
..... [1]

Most candidates answered this correctly although some of these did not give a clear explanation; including an example with the explanation would have made it a lot clearer.



## Question 14

- 14  $y$  is inversely proportional to the square root of  $x$ .  
 $y$  is 40 when  $x$  is 9.

Find a formula linking  $x$  and  $y$ .

..... [3]

Most candidates struggled with this question. The common errors were in not producing an equation to begin with and not using the square root of  $x$ . A few used direct proportionality instead of inverse proportionality.

## Exemplar 1

3 marks

$$y \propto \frac{1}{\sqrt{x}}$$

$$y = k \frac{1}{\sqrt{x}} \quad ; \quad 40 = k \frac{1}{\sqrt{9}} \quad ; \quad k = 40\sqrt{9} \quad ;$$

$$k = 120$$

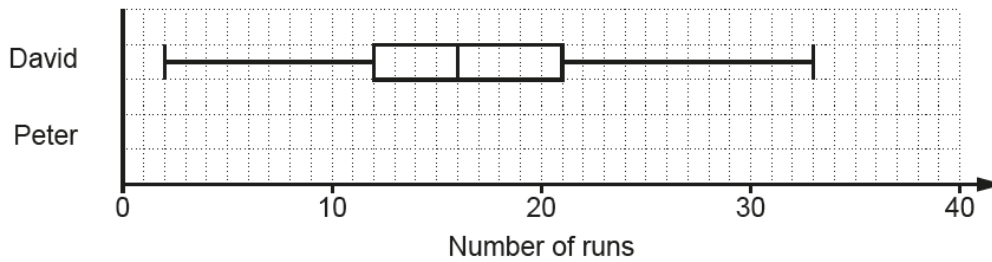
$$y = \frac{120}{\sqrt{x}}$$

$$y = \frac{120}{\sqrt{x}} \dots\dots\dots [3]$$

This exemplar shows how to set out the working for this question and the correct use of equations.

**Question 15(a)**

15 The box plot shows the distribution of the runs scored by David in some cricket matches.



(a) Another player, Peter, has

- a median score of 26
- a highest score of 39
- a lowest score of 8
- a lower quartile of 14
- an inter-quartile range of 18.

Show the distribution of Peter's scores as a box plot on the diagram above.

**[2]**

Most candidates showed the lowest score (8), the lower quartile (14) and the highest score (39). However, common errors included showing the median as 18 and the higher quartile as 26.

**Question 15(b)(i)**

(b) Decide whether David or Peter best satisfies each of these questions. Give a reason for each of your decisions.

(i) Who scored more runs on average?

..... because .....  
 ..... **[1]**

This part was answered better but there was the use of the word 'average' rather than median.

**Question 15(b)(ii)**

(ii) Whose scores were more consistent?

..... because .....  
 ..... **[1]**

This part was also answered well but the reason was sometimes incorrect. Candidates must refer to the information given and use that in their responses.

### Question 16

16 Solve by factorisation.

$$2x^2 - 19x - 33 = 0$$

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

Many candidates could not factorise this quadratic expression as the coefficient of the  $x^2$  term was not 1. Not many candidates were seen using an appropriate technique, such as attempts with brackets or using a table.

### Question 17

17 Here are the first four terms of a quadratic sequence.

2      15      34      59

The  $n$ th term is  $an^2 + bn + c$ .

Find the values of  $a$ ,  $b$  and  $c$ .

$a = \dots\dots\dots$

$b = \dots\dots\dots$

$c = \dots\dots\dots$  [4]

Most candidates knew how to find the second difference and then found the value of  $a$ . However, most did not have a method to find the values of  $b$  and  $c$ .

### Exemplar 1

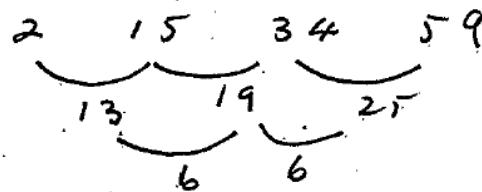
4 marks

17 Here are the first four terms of a quadratic sequence.

2      15      34      59

The  $n$ th term is  $an^2 + bn + c$ .

Find the values of  $a$ ,  $b$  and  $c$ .



$a + b + c = 2$        $3 + 4 + c = 2, c = -5$

$3a + b = 13$        $9 + b = 13 \quad b = 4$

$2a = 6$        $a = 3$

$T_n = 3n^2 + 4n - 5$

$a = \dots\dots\dots 3 \dots\dots\dots$

$b = \dots\dots\dots 4 \dots\dots\dots$

$c = \dots\dots\dots -5 \dots\dots\dots$  [4]

This exemplar shows one method to find the values of  $b$  and  $c$ .

### Question 18

18 P is the point (0, -1) and Q is the point (5, 9).

Find the equation of the line through P that is perpendicular to the line PQ.

..... [5]

Only a few candidates knew how to find the gradient of a line given two points on that line. Very few then knew the rule to find the gradient of a perpendicular line.

### Question 19

19 Two cylinders, A and B, are mathematically similar.

Cylinder A has volume  $2400\text{ cm}^3$  and height 12 cm.  
Cylinder B has volume  $750\text{ cm}^3$ .

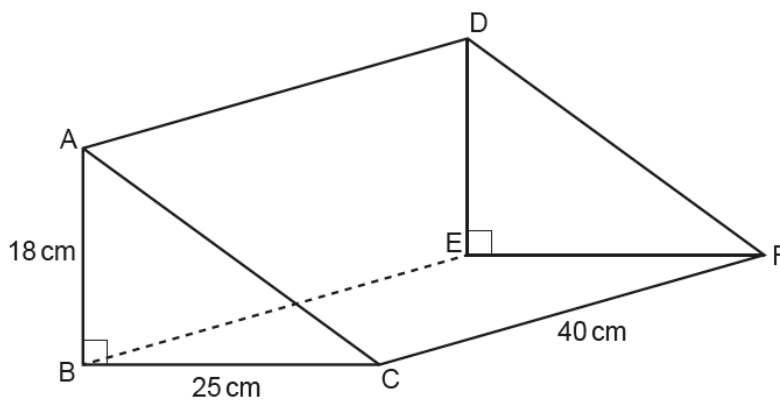
Find the height of cylinder B.  
Give your answer correct to an appropriate degree of accuracy.

.....cm [5]

Some candidates were able to calculate the scale factor between the two volumes, however very few knew how to then find the scale factor between the lengths. Many candidates attempted to find the radius of cylinder A first.

### Question 20

20 The diagram shows a right-angled triangular prism ABCDEF.



Calculate angle AFB.

..... ° [6]

Many candidates did not know which angle was required and did not draw the correct triangle. Some attempted to use triangle ABC. Most did not find the length of either BF or AF.

### Question 21(a)

21 The number of gannets on an island is assumed to follow this exponential growth model.

$$N = 0.45 \times 1.07^x$$

$N$  is the number of gannets, in thousands.  
 $x$  is the number of years after 1<sup>st</sup> January 2010.

(a) Complete the table for  $N = 0.45 \times 1.07^x$ .

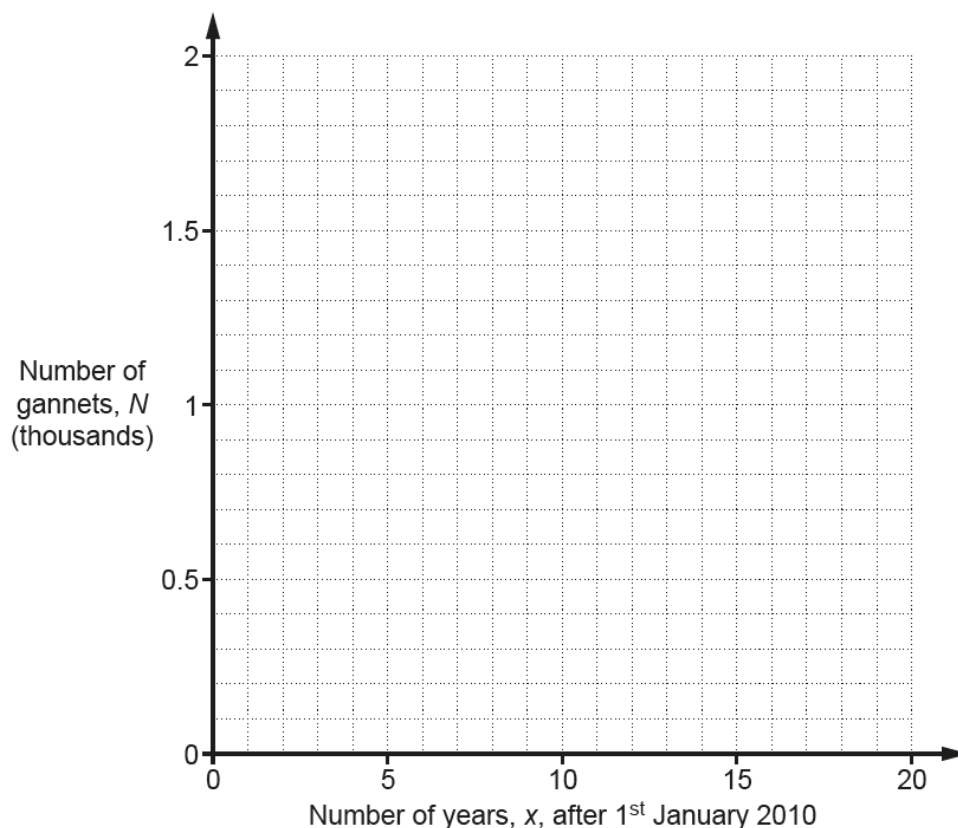
$x$	0	5	10	15	20
$N$	0.45	0.63		1.24	

[2]

This part was generally answered correctly with few incorrect values seen. However, there was some incorrect rounding.

### Question 21(b)

(b) Draw the graph of  $N = 0.45 \times 1.07^x$ .



[2]

Some plotting was inaccurate and some candidates used straight line segments to join their points.

**Question 21(c)**

(c) Use the graph to find **the year** when the gannet population is predicted to reach 1000.

(c) ..... [2]

Many candidates did not give the year, they gave the number of years it would take after 1st January 2010 so 11 or 12 were the most common answers seen.

### Question 22

22 In a village the ratio of males to females is 2:1.

40% of the people in the village are right-handed males.  
25% of the people in the village are right-handed females.

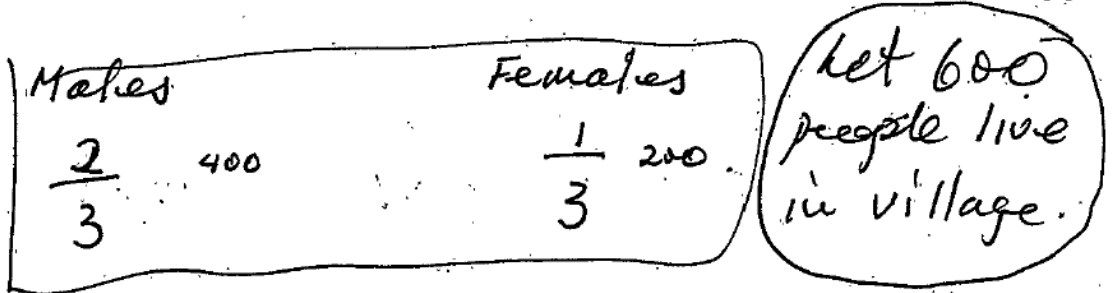
Show that the proportion of females who are right-handed is greater than the proportion of males who are right-handed. [6]

It was envisaged that candidates would use a table or a tree diagram to show this information. However, most candidates produced a page of calculations which was difficult to follow. The best attempts came from candidates who based their figures on a population of 300, 100 female and 200 male. The number of right-handed females was 75 and the number of right-handed males was 120. From these figures the required proportions could be easily obtained.

#### Exemplar 1

6 marks

[6]



Right handed 40% 25%

	MALE	FEMALE	TOTAL
RIGHT HANDED	240	150	390
LEFT HANDED	160	50	210
	400	200	600

Proportion of right handed females =  $\frac{150}{200} = \frac{3}{4} = 0.75 = 75\%$   
 " " " " " " males =  $\frac{240}{400} = \frac{3}{5} = 0.6 = 60\%$

END OF QUESTION PAPER

75% greater than 60% so it is true!

This exemplar shows the method of using a table and a convenient population size to show the information clearly and to make the question easier to solve.

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