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GCSE (9-1)

Examiners' report

MATHEMATICS

J560
For first teaching in 2015

J560/03 November 2019 series

Version 1

Contents

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 3 series overview

This calculator paper is the third of the three papers taken by Foundation candidates for the GCSE (9-1) Mathematics specification.

Candidates appeared secure with short processes, often numeric, but also with simple algebraic demands such as multiplying a number over a bracket. Generally, candidates had access to a calculator, but did not necessarily use it efficiently. Most had a ruler. They could list outcomes in a logical order and make use of simple percentages.

Candidates were much less secure when dealing with algebraic processes that demanded more than one step or that were used when problem solving. They also were challenged to give coherent reasons and explanations when justifying a result.

Candidates generally were unsure of the formulae for circumference and area of a circle. They also confused perimeter with area.

The accuracy of some candidate's drawing was outside the tolerance expected within the examination, both for drawing graphs and for images under a transformation.

Candidates were able to complete tree diagrams with reasonable facility but were unsure about how to use the diagrams.

Candidates continue to revert to using first principles when calculating percentages. This often involves non-calculator methods that are cumbersome and will not receive credit if an error occurs unless the processes are shown. 10% of £30 = £3 is not a process but 10% of £30 = 30 ÷ 10 = £3 is.

Many candidates attempted the majority of questions and attempted answers in most cases. Many candidates reached, and made some attempt to answer, the final question.

Question 1 (a) (i)

1 **(a)** Here are some types of number.

An even number	An odd number	A prime number	A square number	A cube number

From the list, write down the type of number being described.

(i) A number that does **not** divide exactly by 2. ..... **[1]**

This was usually well answered although "A prime number" was a popular wrong choice.

Question 1 (a) (ii)

(ii) A number that has no factors except itself and 1. ..... **[1]**

This was often correct.

Question 1 (b) (i)

(b) **(i)** Write down all the multiples of 4 between 21 and 29.

(b)(i) ..... **[1]**

The vast majority gained this mark with just a small number including an incorrect figure.

Question 1 (b) (ii)

(ii) Write down a common multiple of 4 and 6.

(ii) ..... **[1]**

Many candidates gained this mark but a few confused factor and multiple and gave 2 as the answer.

Question 1 (c)

(c) Insert brackets to make this calculation correct.

$4 - 1 \times 2 = 6$ **[1]**

This was often correct with a few candidates writing 4 ($-$ 1 $\times$ 2) = 6 or bracketing a single number.

Question 1 (d)

(d) Write 7% as a fraction.

(d) ..... **[1]**

This was often correct. A few candidates gave a decimal but the most common error was $\frac{7}{10}$.

Question 2

2 Work out.

$1.52\,\text{kg} + 80\,\text{g}$

Give your answer in kilograms.

..... kg **[2]**

This was not answered well by many candidates. There is clear misunderstanding about the relationship between units. Usually this consisted of 100 g to 1 kg. 2.82 was a common wrong answer but candidates also added 152 to 80 or gave 1.528 as the answer.

Question 3 (a)

3 **(a)** Round 32 629 to the nearest thousand.

(a) ..... **[1]**

This was very often correct. A few candidates wrote 30 thousand to gain the mark.

Question 3 (b)

(b) Round 32 629 to 1 significant figure.

(b) ..... **[1]**

Candidates found this much more difficult with fewer than half of candidates gaining the mark. A common wrong answer was 32 630, some gave 30 and other interesting variants were seen.

Question 4 (a)

4 A circle has radius 5 cm.

(a) Work out the circumference of the circle.

(a) ..... cm **[2]**

Neither part of Question 4 was well answered and less than half of all candidates gained both marks on either part. Knowledge of the formulae appeared to be sketchy. Candidates often confused radius with diameter.

In this part, candidates sometimes quoted both formulae and then chose the wrong one. Some attempted to use $2\pi r$ or πd but made errors in calculation.

Question 4 (b)

(b) Work out the area of the circle.

(b) ..... cm^2 **[2]**

In this part, it was not uncommon to see 25 as the answer, from 5^2. Candidates also evaluated $\pi^2 \times 5$ or $\pi^2 \times 5^2$.

Question 5

5 Dan thinks of a number.
He adds 3 and divides the result by 2.
His answer is 16.

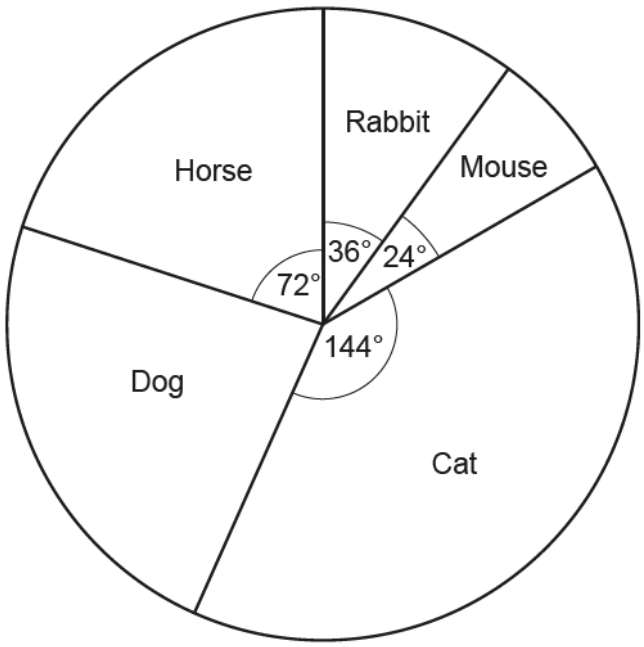
What number is Dan thinking of?

..... **[2]**

This was accessed by many candidates and around 90% gained at least one mark. The correct answer was common.

Question 6 (a)

6 30 students each own one pet.
The pie chart shows the proportion of each type of pet owned by the 30 students.



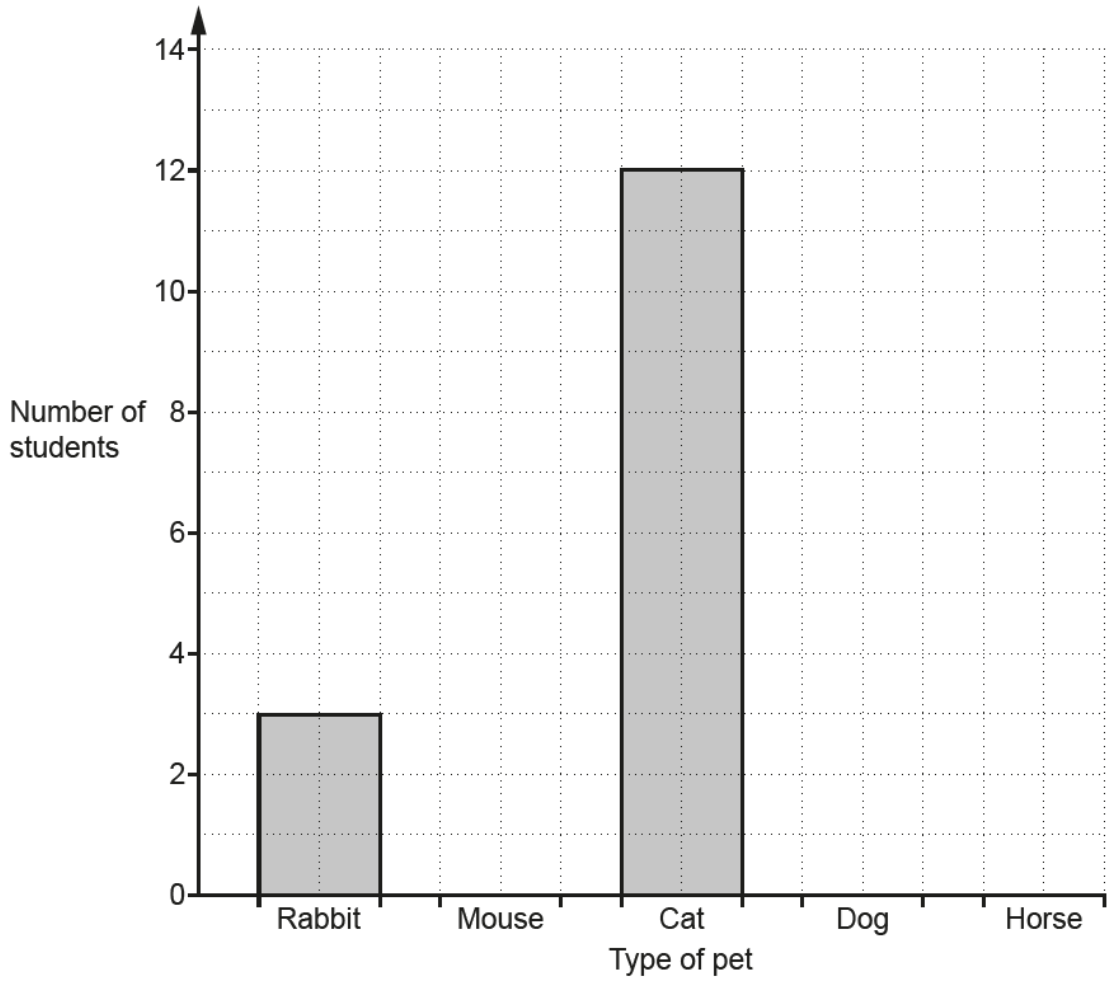
(a) Which type of pet is the mode?

(a) ..... **[1]**

This was often correct although each of the other animals appeared on a script somewhere.

Question 6 (b)

(b) Use the information in the pie chart to complete this bar chart.



[3]

Many candidates knew what they had to do but were hampered either by a lack of ruler and pencil or general accuracy. It was not uncommon to see lines straying away from the gridlines. Candidates must realise that precision is necessary when drawing.

Where a few candidates did not complete the chart they often gained a mark for showing 84° as the angle for Dog.

Question 7 (a)

7 Jenny has a five-sided **biased** spinner.
The sectors are coloured red, blue, green, yellow and white.
She spins the spinner 100 times.

The table shows the number of times the spinner lands on each colour.

Colour	Frequency
Red	28
Blue	38
Green	6
Yellow	0
White	28
Total	100

Jenny uses her data to estimate the probability of the spinner landing on each colour.

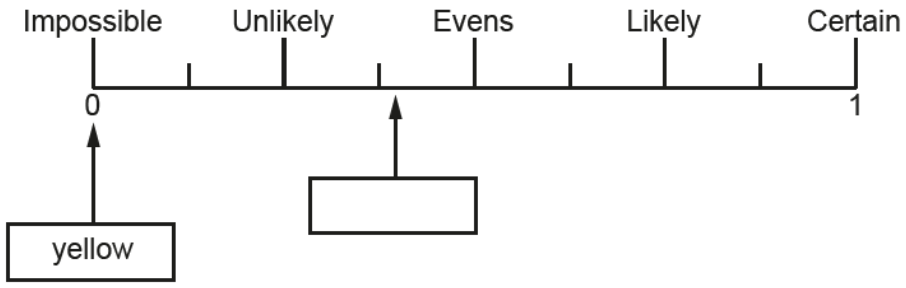
(a) Write down Jenny's estimate for the probability of landing on red.

(a) ..... **[1]**

This was often correct with around three quarters of candidates gaining the mark.

Question 7 (b) (i)

(b) Jenny then writes in some of the colours on this probability scale.



(i) Write the correct colour in the box. **[1]**

For some reason this was found to be very hard and only around a quarter of candidates gained the mark. The common wrong answer was "green".

Question 7 (b) (ii)

(ii) Explain why Jenny's estimate for the probability of landing on yellow cannot be the actual probability.

.....

.....

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

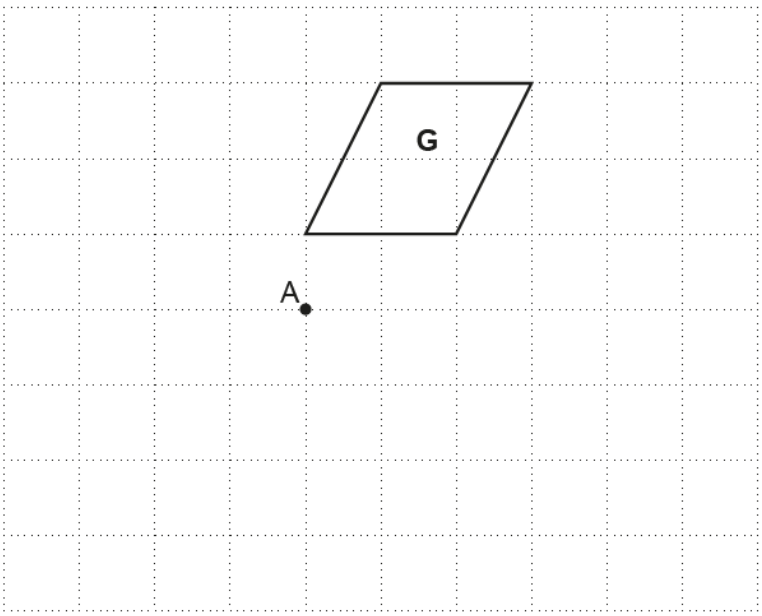
Candidates found it hard to express ideas clearly in responding to this demand. Fewer than half of the candidates gained the mark.

The incorrect answers often related to it being a biased spinner or that she had not done enough trials.

Many commented that "yellow" was not there but fewer that "yellow" was a colour on the spinner and so could be landed on.

Question 8 (a)

8 **(a)** Shape **G** is drawn on the grid.



Rotate shape **G** by 180° about the point A. **[2]**

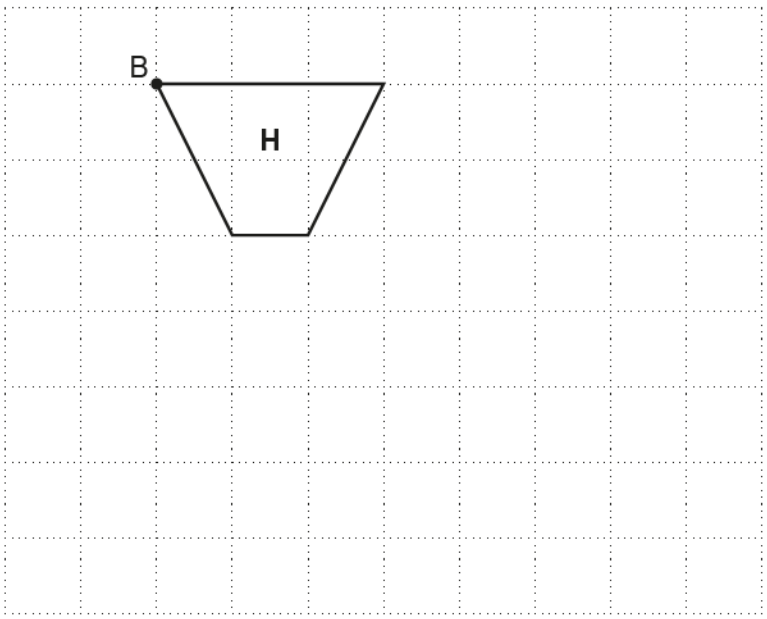
Many correct answers were seen but also many imprecise drawings.

Some thought that A was a vertex of the image but gained one mark if the drawing was precisely ruled.

Candidates need to plot points exactly on gridlines and not just near to them. A ruler also needs to be used.

Question 8 (b)

(b) Shape **H** is drawn on the grid.



Enlarge shape **H** with scale factor 2 and the centre of enlargement at point B. **[2]**

Many correct answers were seen but also many imprecise drawings.

Some correct sized and orientated drawings were seen that were in the wrong position. These gained one mark if correctly ruled.

Candidates need to plot points exactly on gridlines and not just near to them. A ruler also needs to be used.

Question 9

9 Tom buys a radio for £40.
Later he sells it and makes a profit of 20%.

Tom says

The ratio of the price I paid for the radio to the price I sold the radio is 5 : 6.

Show that Tom is correct. **[3]**

Around two thirds of candidates answered this question correctly. Many showed 40 and 48 but did not link these by a ratio to 5 and 6. Many candidates included in their work 11 as the sum of parts. Often they made no further progress.

Question 10 (a)

10 Nada is planning the colour scheme for her bedroom.

The colour of her carpet can be blue (B), grey (G) or red (R).
The walls can be painted yellow (Y), white (W) or pink (P).

(a) Complete the table to show all of the possible colour combinations she can make.
You may not need all the rows.

Carpet	Walls
B	Y

[2]

Many correct and well ordered lists were seen. Only a few candidates listed randomly and a few put colours in the wrong column.

Question 10 (b)

(b) Explain why it would **not** be mathematically correct to find the probability that Nada decides on a grey carpet and pink walls using this formula.

$$\frac{1}{\text{the total number of colour combinations}}$$

.....

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

Many candidates could not express their ideas clearly here and did not understand that probability is about random events. Fewer than a tenth of candidates observed that this was a personal choice and not a random selection.

Question 11 (a)

11 Multiply out.

(a) $3(x-2)$

(a) ..... **[1]**

This was often correct. The expected error of 3x – 2 was seen a number of times and some candidates worked out 3x – 6 and gave -3x as a final answer, which cost them the mark.

Question 11 (b)

(b) $2a(a+b)$

(b) ..... **[2]**

This was often correct and, if not, many gained a mark for $2a^2$ in their final answer.

Question 12 (a) (i)

12 (a) Find the value of

(i) $\sqrt[3]{216}$,

(a)(i) ..... **[1]**

This notation was clearly new to many candidates. Only around half of candidates gained the mark. Wrong answers were 44 (from $3 \times \sqrt{216}$), 44.1, $18\sqrt{6}$, 14.69, 3174 etc.

Question 12 (a) (ii)

(ii) 2^8.

(ii) ..... **[1]**

This was often correct with a few candidates answering 512.

Question 12 (b)

(b) The cube of 3 is added to the square root of 7.

Put a ring around the correct statement.

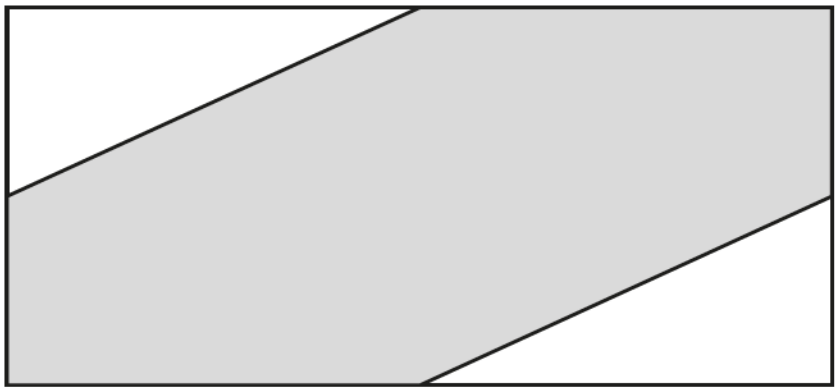
$\sqrt[3]{3} + 7^2$ $3^3 + 7^2$ $3^3 + \sqrt{7}$ $\sqrt[3]{3} + \sqrt{7}$

[1]

Around three quarters of candidates chose the correct option.

Question 13

13 The midpoints of the sides of a rectangle are joined by straight lines as shown.



Work out the percentage of the rectangle that is shaded.

..... % **[4]**

This was an interesting question and the responses to it varied considerably.

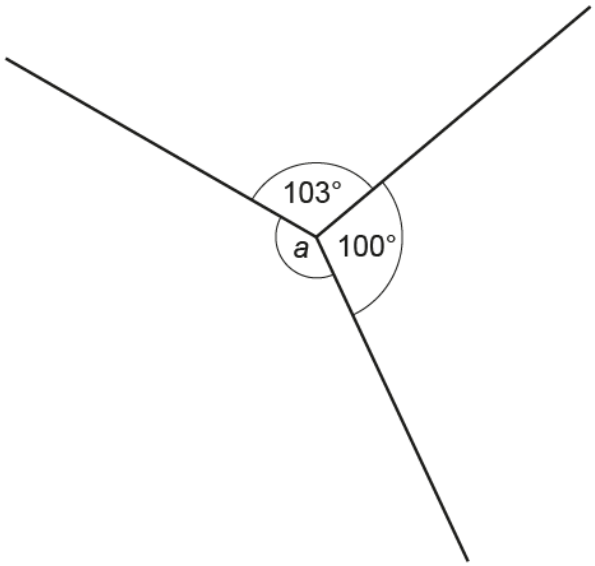
Some candidates went almost straight to the answer with little working. Others spent a lot of time calculating areas to reach 75%.

A sizeable number of candidates chose to subdivide the rectangle across the mid points. It should have been a short step from there to realising that the two unshaded triangles formed a quarter of the rectangle and so three quarters was shaded. However, many chose the more prosaic option of measuring and working out areas.

A regrettable number tried to use angle and sight of 270° and 360° was a clear indicator that wrong method had been used. Clearly many candidates did not understand the difference between direction and area.

Question 14 (a)

14 (a) Three lines meet at a point.



Not to scale

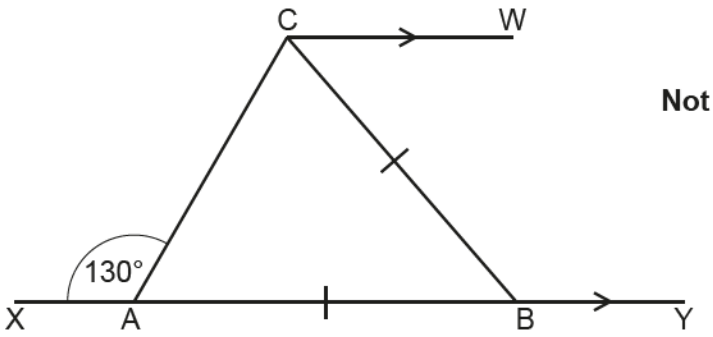
Work out the size of angle *a*.

(a) $a =$ ..... ° **[2]**

This was well answered with just a few candidates using 180° instead of 360°.

Question 14 (b) (i)

(b) XY and CW are parallel lines.
AB = CB.
Angle CAX = 130°.



Not to scale

(i) Complete this sentence.

Angle CAB = 50° because .....

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

Many correct answers were seen and around two thirds of the candidates gained the mark.

Question 14 (b) (ii)

(ii) Work out angle BCW.
Give a reason for each angle you work out.

(b)(ii) ..... ° **[4]**

This question revealed that many candidates do not understand the three letter convention for naming angles. Many misused it or did not use it in their answers referring, ambiguously, to angles by a single letter.

Some candidates did work out that angle BCW was 80° but the common errors were either 50° or 130°.

For those that found BCW to be 80°, many struggled to provide geometric reasons for the angles found along the way. Some did not identify the angle a reason referred to.

Candidates should be aware that terms such as F of Z angles are handy ways to remember but are not acceptable geometric terms.

Many candidates thought that all the angles in the triangle were 50° and a large number that the "base angles" were CAB and CBA.

Clearly candidates were not used to constructing a reasoned, geometric solution.

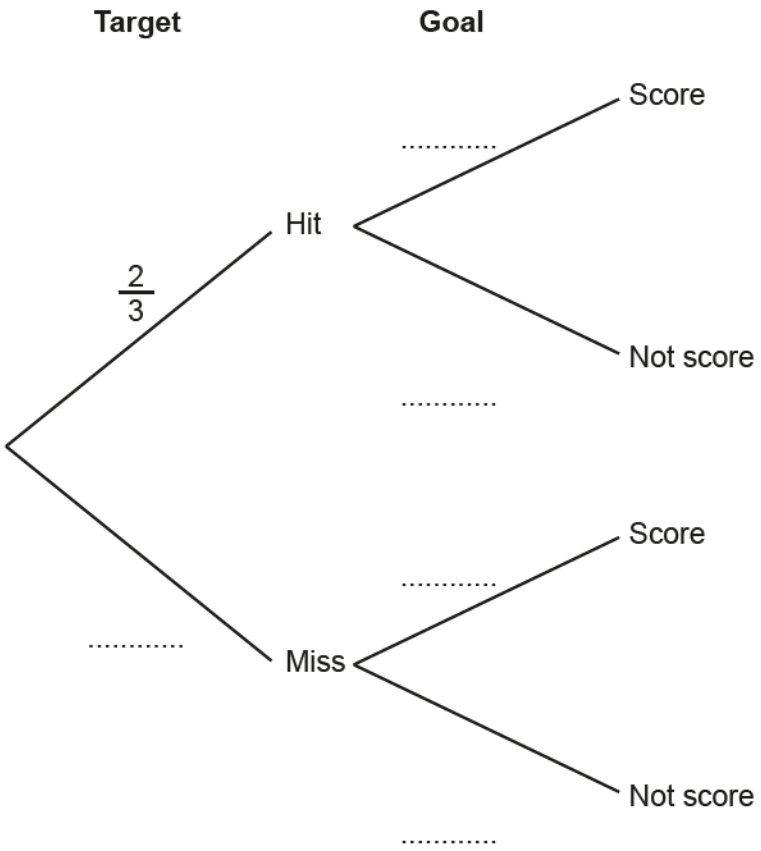
Question 15 (a)

15 Ryan shoots an arrow at a target. He then kicks a ball at a goal.

The probability that Ryan hits the target is $\frac{2}{3}$.

The probability that Ryan scores a goal is $\frac{3}{5}$.

(a) Complete the tree diagram.



[2]

Probabilities were often correctly placed on the first set of branches but less commonly on the second set.

Sometimes $\frac{3}{5}$ was placed on the lower of the first two branches.

Worryingly, a number of probabilities greater than 1 were used on the diagram and in the following answers.

It is often useful for candidates to complete the products of each route through the tree, though this is seldom seen (and is not required to gain these marks).

Question 15 (b) (i)

(b) Find the probability that Ryan

(i) misses the target and does not score a goal,

(b)(i) ..... **[2]**

This was rarely correct with only just over a tenth of candidates gaining the mark. Many candidates added the required fractions. However, the addition often contained errors such as $\frac{2}{3} + \frac{3}{5} = \frac{5}{8}$.

Question 15 (b) (ii)

(ii) either hits the target or scores a goal or both.

(ii) ..... **[2]**

This was even less well done and no candidates appeared aware of the simple route of subtracting the previous probability from 1. Almost all attempts consisted of adding combinations of probabilities, which were almost universally pairs of added probabilities.

Question 16

16 Solve the simultaneous equations.

$$2x - y = 7$$
$$2x + y = 5$$

$x =$ .....

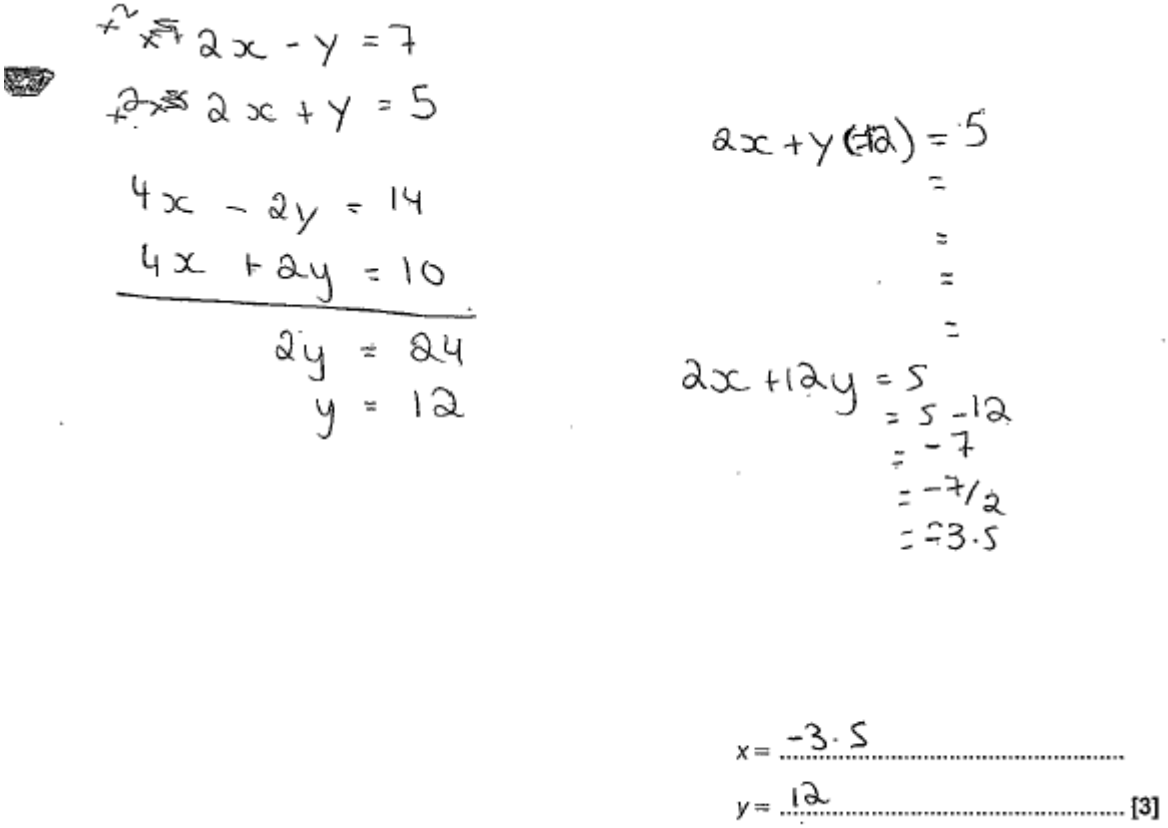
$y =$ ..... **[3]**

This was poorly done with only 16% accessing the question. A few candidates did appear to know a method to eliminate a variable but few could execute the method correctly.

Many tried a form of trial and improvement which was not often successful. A few gained a mark for finding a value for one variable and correctly substituting it into an equation and evaluating the result.

Many candidates could not deal with the +y and –y and made sign errors. Some tried to "solve" a single equation by adding or subtracting y from one side and just ignoring it on the other.

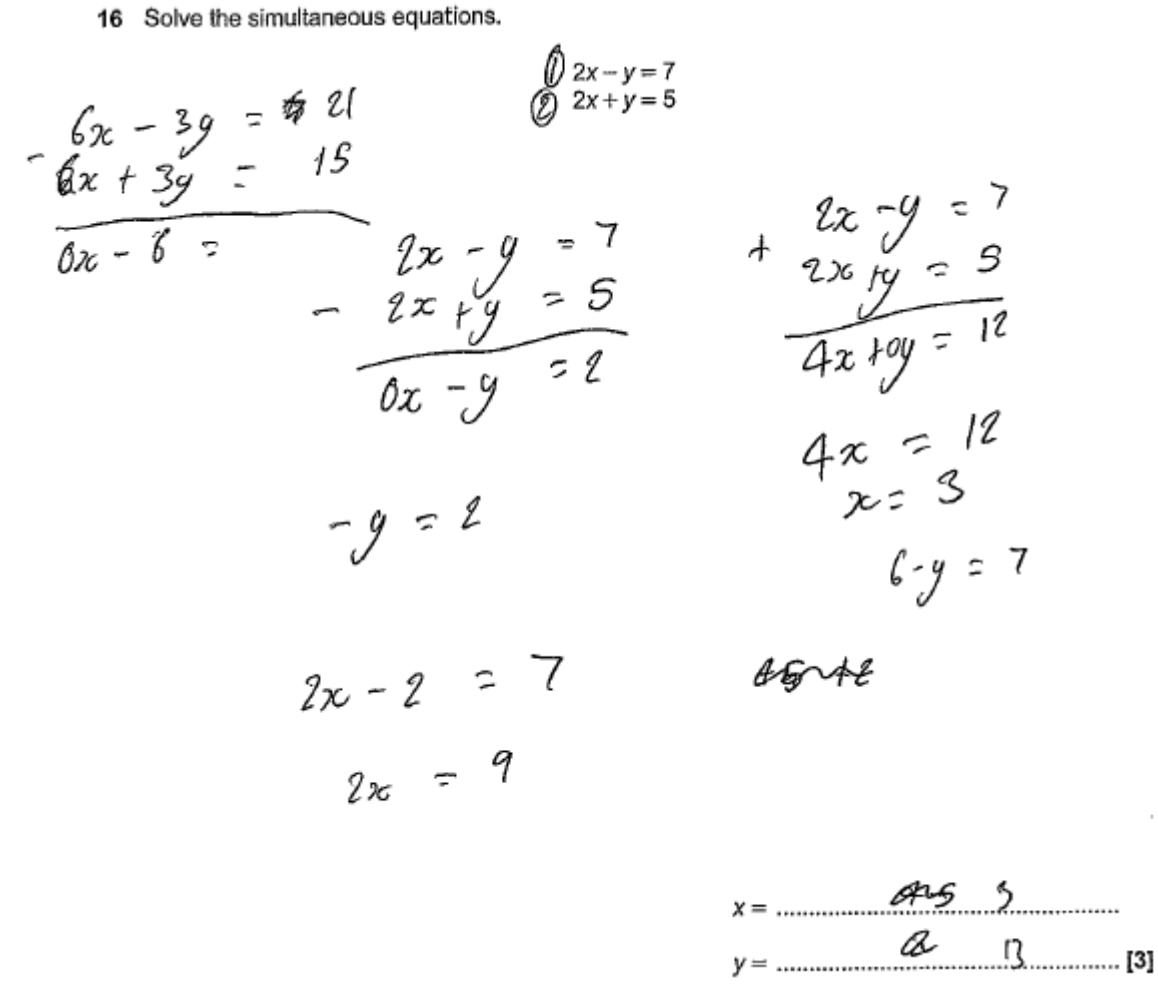
Exemplar 1



This exemplar demonstrates the work of a candidate with some idea about solving simultaneous equations. The first process, seen on the left, might be an attempt to add the equations that have been unnecessarily doubled. However, whether added or subtracted, the candidate has made two errors and scores 0 marks for this. They have a value from this process for y and attempt to substitute this into an equation but the substitution is incorrect as they write 12y rather than 12.

Candidates should be encouraged to say whether they are adding of subtracting equations and need practise in doing this.

Exemplar 2



In this exemplar the working on the right leads to the answer and so this is marked by the examiner. Candidates should cross out unused or unwanted working.

The candidate makes a good start and finds the correct value for x scoring M1 and B1. However, they are unable to solve the equation 6 – y = 7 and have an incorrect value for y.

Question 17

17 Two model cars, **A** and **B**, are in a race.
They start together on the starting line.
Assume each car travels at a constant speed.

Car **A** takes 30 seconds to complete each lap of the track.
Car **B** takes a whole number of seconds to complete each lap of the track.
The two cars next cross the starting line together 150 seconds after the start of the race.

Find the **four** possible times that car **B** could take to complete one lap.

You may find this information helpful.

$150 = 2 \times 3 \times 5 \times 5$
$30 = 2 \times 3 \times 5$

.... seconds **[5]**

In this problem solving question, many candidates did not appear able to make use of the information given to them.

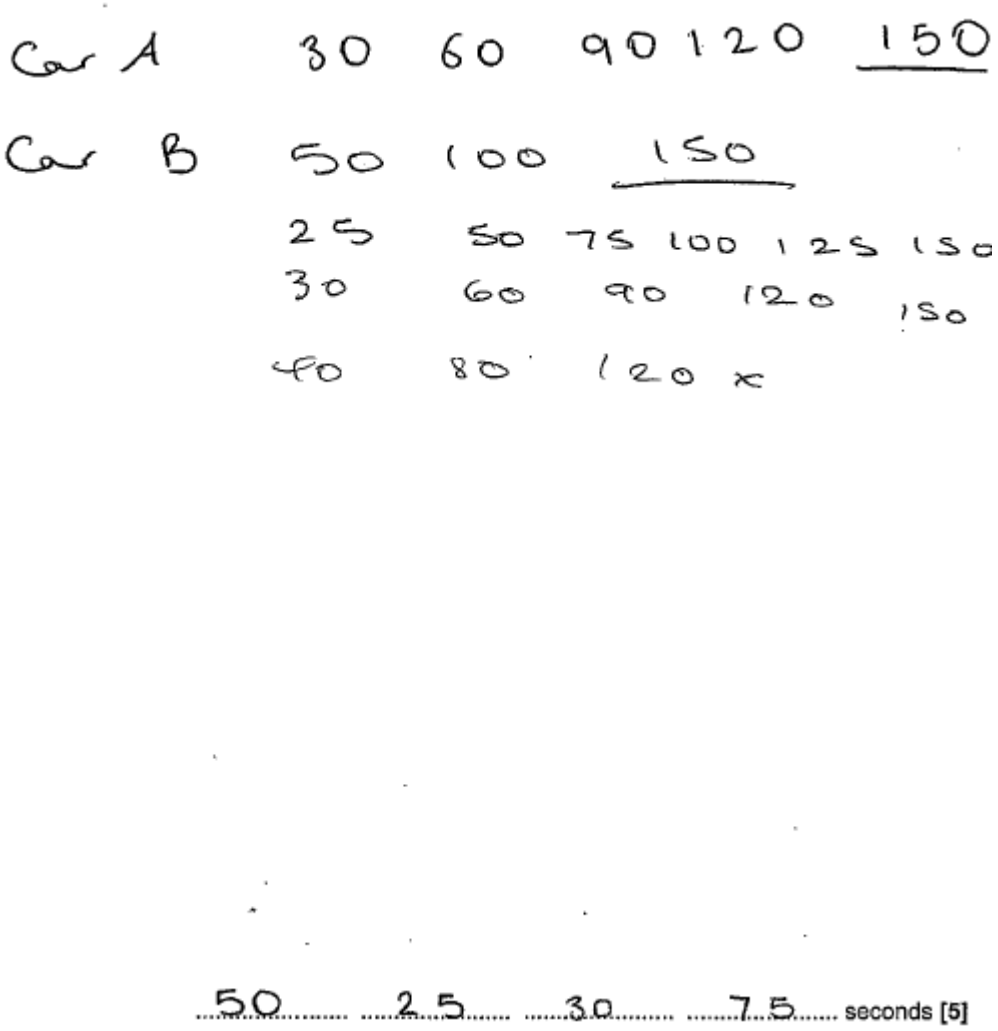
A few did note that car A would complete 5 laps but many answers appeared not to come directly from the information and there were no clear strategies to refer to.

Exemplar 3

Car A = 30 seconds for 1 lap
= 150 seconds for 5 laps

This exemplar is included to show the quite rare scoring of 1 mark for identifying 5 laps with car A.

Exemplar 4



This is one of the more successful candidate's work but shows no use of the provided information. The candidate has not included 150 in the answer and has incorrectly given 30 as a solution.

Question 18 (a)

18 (a) Write down the multiplier for an increase of 140%.
Give your answer as a decimal.

(a) ..... **[1]**

Only 3% of candidates gave the correct answer. The common error was 1.4 although 140 and 1.14 were also often seen.

Question 18 (b) (i)

(b) Ali invests £1500 in October.
The investment increases in value by 10% in November.
It then decreases in value by 20% in December.

Ali says

10% – 20% = –10%, so the £1500 has lost exactly 10% of its value.

(i) Explain what Ali has done wrong.

.....

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

Around a fifth of candidates gave a convincing and correct answer. Most said that he should have worked it out and some that you could not have a negative percentage.

A few realised that the percentages quoted were not of the same amount and some could express this clearly.

Question 18 (b) (ii)

(ii) Work out the correct percentage loss.

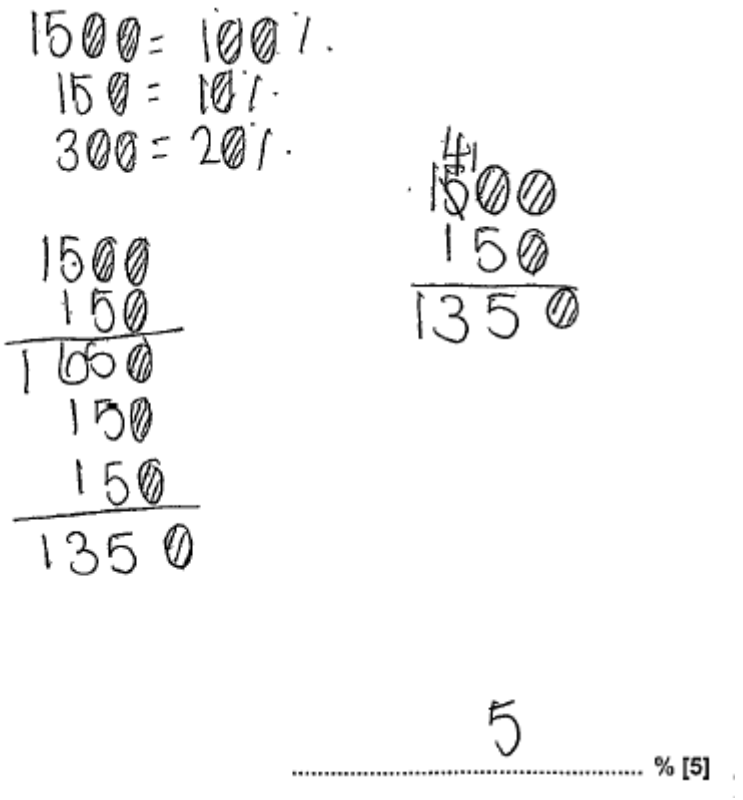
..... % **[5]**

Around a third of candidates could access this question. Almost all of them did not use efficient methods but worked out the answer in stages. A sizeable number of these candidates used non calculator methods and not multipliers.

Many could increase £1500 by 10% to earn one mark. However, a common error was to then find 20% of £1500, rather than £1650, and subtract £300 from £1650.

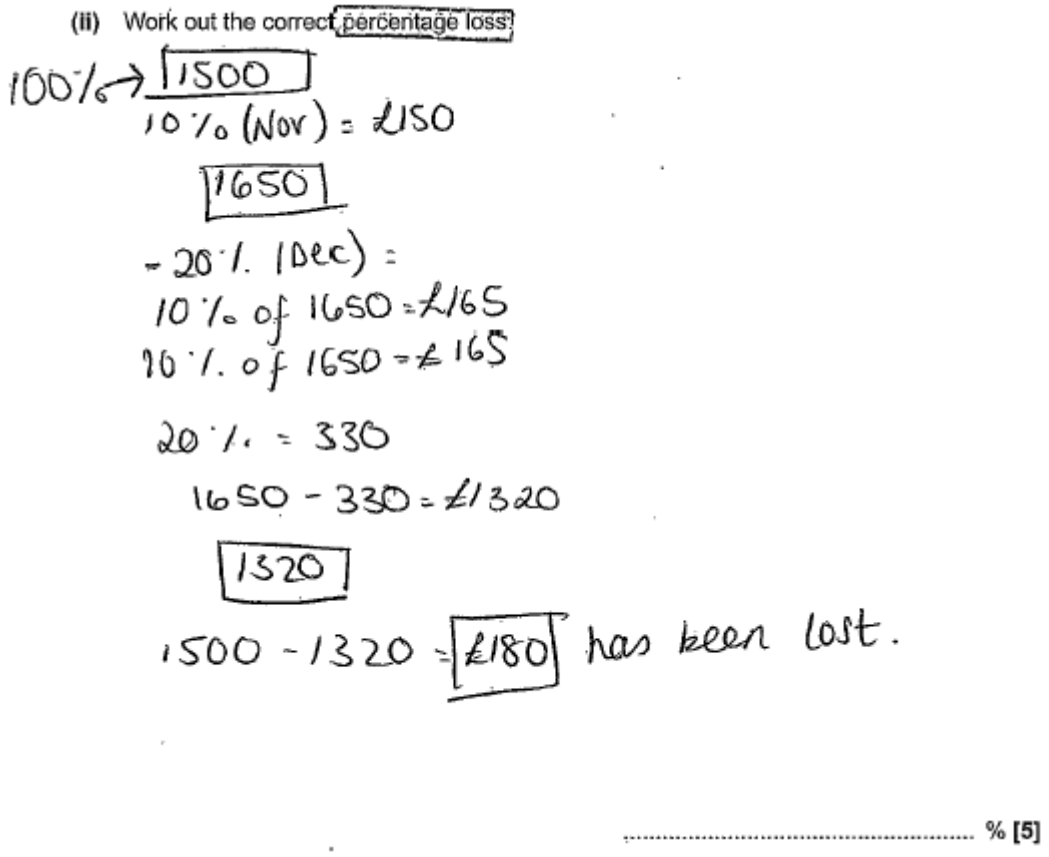
Those candidates who found the correct loss of £180 were unsure how to change this figure to a percentage loss.

Exemplar 5



This exemplar shows the inefficient use of percentage calculation employed by many candidates. All this work to do 1500 □ 1.1 and score 1 mark.

Exemplar 6

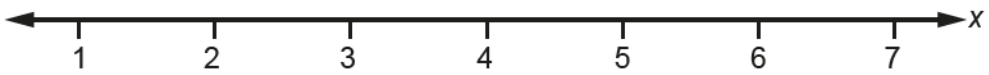


This candidate also employs inefficient method but not quite so protracted as in the previous example. They correctly raise 1500 by 10% and reduce 1650 by 20% and even find the value of the difference correctly. However, they have no method to find a percentage reduction.

These protracted methods carry a time penalty in that they absorb time that could be spent answering other questions.

Question 19

19 Solve $3x - 5 \geqslant 10$.
Show your solution on the number line.



[4]

This was the first of the questions in common with the Paper 6. It was found difficult by the candidates.

Many candidates did not have a clear method for solving inequalities and many resorted to a form of trial and improvement.

Some candidates found x = 5 and put a mark on the number line, scoring 1 mark in the process.

There was some doubt about filled or solid circles and lines and arrows.

A common wrong answer was an empty circle over 3 and a filled circle over 5 with a line between them. These numbers were presumed to be taken from the left hand side of the inequality.

Question 20

20 Amrit's income is 32% more than Bethan's income.
Amrit and Bethan's combined income is £54 868.

Calculate Amrit's income.

£ ..... **[5]**

In this second question that was common with Paper 6 candidates again found it hard to make progress. Many halved the amount and then tried to find 32% of the half. Often little progress was made. In most cases, long methods were again used to find percentages.

Question 21

21 Jacob, Amelie and Reuben each roll a fair six-sided dice.
What is the probability that all three roll a number less than 3?

Give your answer as a fraction in its simplest form.

..... **[3]**

In this common question, a number of candidates gained a mark for showing the probability $\frac{2}{6}$ or its equivalent. For candidates who attempted to go further, it was not uncommon to see $\frac{2}{6}+\frac{2}{6}+\frac{2}{6}=\frac{6}{18}$ and were unaware that $\frac{2}{6}=\frac{6}{18}$.

Question 22

22 The diagram shows two rectangles, A and B.

Rectangle A has a width of 25 cm and a height of 12 cm.
The width of rectangle B is three times the height of rectangle B.

The area of rectangle A is equal to the area of rectangle B.

Find the perimeter of rectangle B.

..... cm **[5]**

This problem solving question was also common with Paper 6.

Many candidates gained a mark for correctly working out the area of a rectangle as 300 cm^2. However, many did not seem to have an effective method to find the dimensions of B and very few attempted to use algebra. Most adopted trial and improvement and a few gained a mark for finding a perimeter using dimensions in which one was three times the other.

Some confused perimeter and area.

Question 23

23 Kay invests £1500 in an account paying 3% **compound** interest per year.
Neil invests £1500 in an account paying r% **simple** interest per year.

At the end of the 5th year, Kay and Neil's accounts both contain the same amount of money.

Calculate r.
Give your answer correct to 1 decimal place.

$r =$ ..... **[6]**

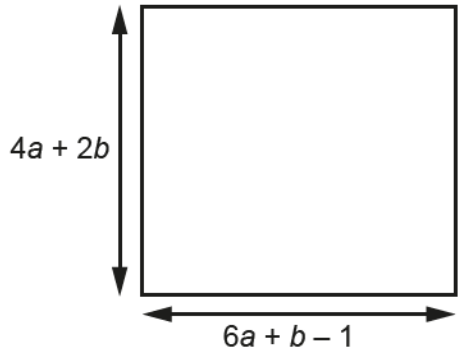
In this final common question it was pleasing to see a number of candidates gaining three marks for working out the amount of compound interest. A few of these candidates used multipliers but many used long methods, including finding 1% and then 3%.

A common error was to treat the compound interest as simple interest and so 3% was found and multiplied by 5.

Question 24

24 In this question, all lengths are in centimetres.

Here is a square.



Not to scale

Find the length of one side of the square when $b = 4$.

..... cm **[6]**

This final problem solving question revealed some very poor algebraic skills and an uncertainty about how to construct a rout through the information.

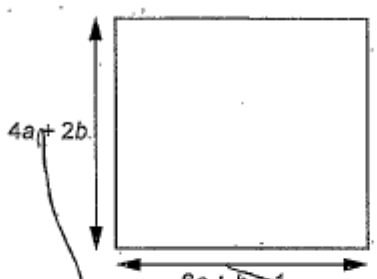
Very few candidates equated the expressions for the sides.

Many wrote 4a + 2b = 4a + 8 = 12a. Some wrote 4a + 8 and "solved" this to give x = 2. Similar errors were made the other expression.

A number of candidates used trial and improvement and, in a very few cases, reached the solution.

Some found a = 2.5 and gave this as their answer, even when they had worked out the length of a side as 18 cm.

Exemplar 7



Find the length of one side of the square when $b = 4$.

$4a + 2 \times 4$

$4a + 8$

$12a$

$6a + 4 - 1$

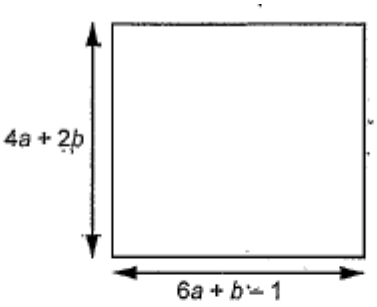
$6a + 3$

$9a$

12a ..... cm [6]

This exemplar shows the two expressions being considered side by side but never equated. It also shows the poor use of algebraic processes so often seen in responses.

Exemplar 8



Not to scale

$6a + b - 1$

$-1.8 + 4 - 1$

Find the length of one side of the square when $b = 4$.

$4a + 2b = 6a + b - 1$

$4a + 8 = 6a + 4 - 1$

$4a + 8 = 6a + 3$

$-1 \quad -1$

$4a + 7 = 6a + 4$

$-6a \quad 7 = 10a + 4$

12

$10a + 7 = 4$

$a = -0.3$

$4a + 2b$

$-1.2 + 8$

$4a + 2b$

$6a + b - 1$

$2a = 2$

$a = 1$

6.8 cm [6]

END OF QUESTION PAPER

This candidate has equated the two expressions and substituted 4 correctly to earn M2. However, they then make errors in the solution of the resulting equation.

At the end, a clear substitution of the incorrect value for a is shown in one of the expressions to earn a further M1.

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