Qualification Accredited

OCR
Oxford Cambridge and RSA

GCSE (9–1)

Exemplar Candidate Work

MATHEMATICS

J560
For first teaching in 2015

J560/06

Summer 2017 examination series

Version 1

Contents

Introduction

These exemplar answers have been chosen from the summer 2017 examination series.

OCR is open to a wide variety of approaches and all answers are considered on their merits. These exemplars, therefore, should not be seen as the only way to answer questions but do illustrate how the mark scheme has been applied.

Please always refer to the specification (http://www.ocr.org.uk/Images/168982-specification-gcse-mathematics-j560.pdf) for full details of the assessment for this qualification. These exemplar answers should also be read in conjunction with the sample assessment materials and the June 2017 Examiners' Report to Centres available on the OCR website http://www.ocr.org.uk/qualifications/.

The question paper, mark scheme and any resource booklet(s) will be available on the OCR website from summer 2018. Until then, they are available on OCR Interchange (school exams officers will have a login for this).

It is important to note that approaches to question setting and marking will remain consistent. At the same time OCR reviews all its qualifications annually and may make small adjustments to improve the performance of its assessments. We will let you know of any substantive changes.

Question 1(b)

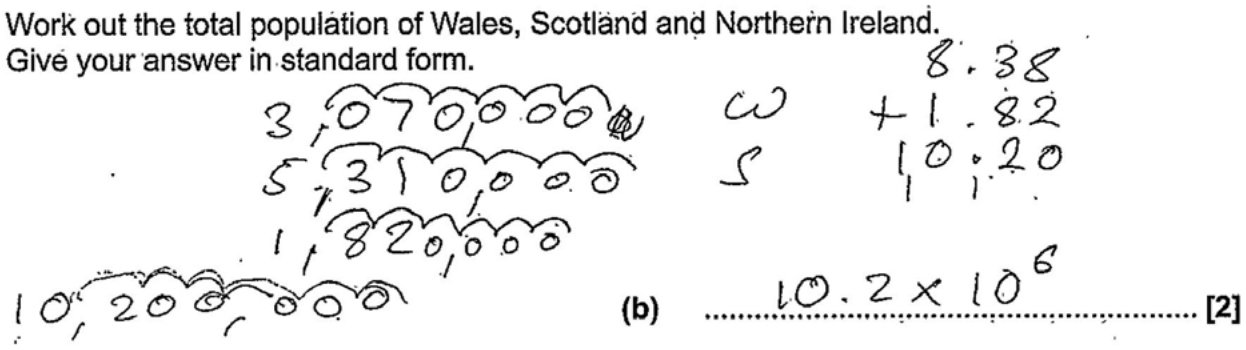
This table shows the populations of the four countries of the UK in 2012.
All values are given correct to 3 significant figures.

Country	Population
England	5.35×10^7
Wales	3.07×10^6
Scotland	5.31×10^6
Northern Ireland	1.82×10^6

Work out the total population of Wales, Scotland and Northern Ireland.
Give your answer in standard form.

(b) ..... [2]

Mark(s): 1



Examiner commentary

The answer is not in standard form but does start with the figures 102 and so scores B1.

Although there were no method marks available it is worth noting that the candidate has attempted the question twice and shows the two most common methods. On the left, each population has been rewritten in ordinary form before adding. On the right, they have summed the 3.07 and 5.31 in their head and then added 1.82. It is not clear which method led to their final answer but, even without it, either the 10,200,000 or the 10.20 would have scored the B1.

Candidates should generally be discouraged from leaving a choice of methods that lead to different answers.

Question 1(c)

This table shows the populations of the four countries of the UK in 2012.
All values are given correct to 3 significant figures.

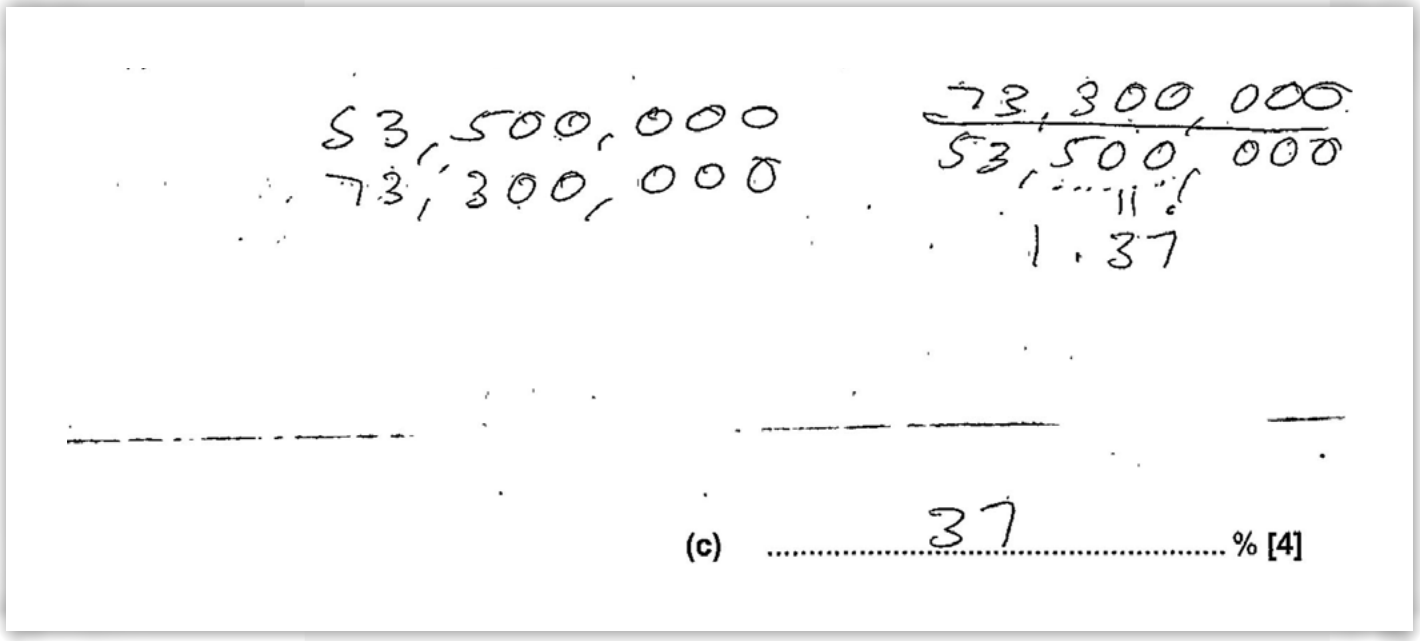
Country	Population
England	5.35×10^7
Wales	3.07×10^6
Scotland	5.31×10^6
Northern Ireland	1.82×10^6

The total population of the UK is predicted to reach 73.3 million in 2037.

Calculate the predicted percentage increase in the UK population from 2012 to 2037.
Give your answer correct to 2 significant figures.

(c) ..... % **[4]**

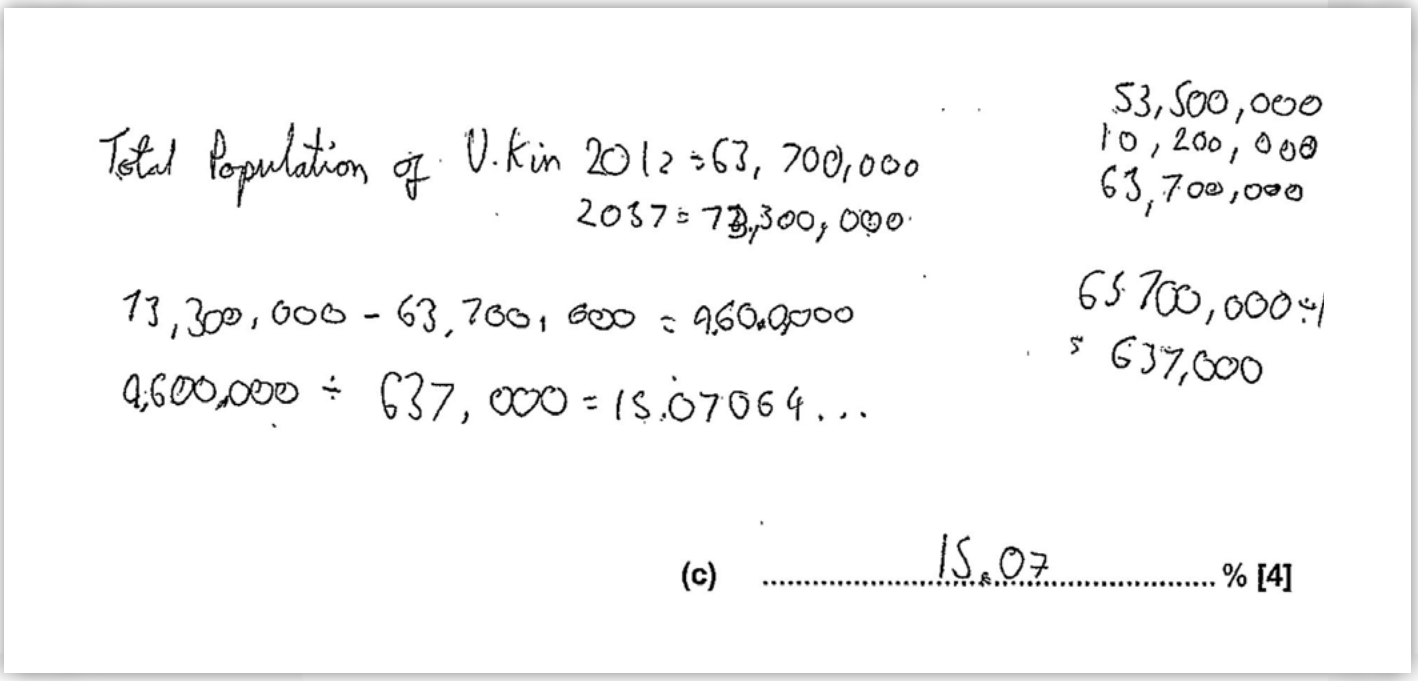
Exemplar 1 – Mark(s): 2



Examiner commentary

The candidate has used the 2012 population of England rather than that of the UK. This was a very common error. The response scores M1 for a valid percentage increase expression using their starting population. The evaluation to 1.37 was not required. The second mark is an M1dep for interpreting the answer to the division correctly as a percentage increase correct to 2 significant figures.

Exemplar 2 – Mark(s): 3



Examiner commentary

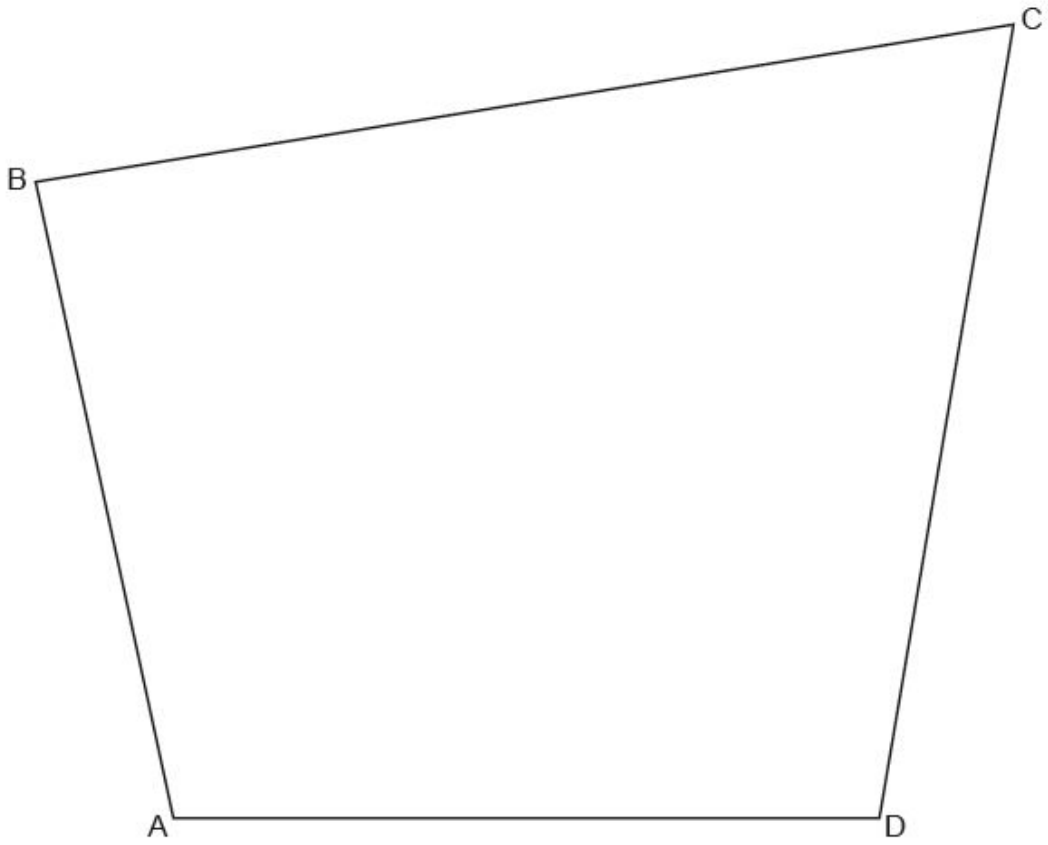
15.07, not from wrong working, scores B3. The working on the right shows the sum of the populations of Wales, Scotland and Northern Ireland (10,200,000 from part (b)) being added to that of England. In the third and fourth lines on the left and the adjacent working on the right, the candidate finds the population increase and then correctly turns this into a percentage increase.

The final mark is not gained because the answer is not correct to 2 significant figures.

Question 2(b)

The scale drawing represents a park.

Scale: 1 cm represents 25 m



A new play area must be

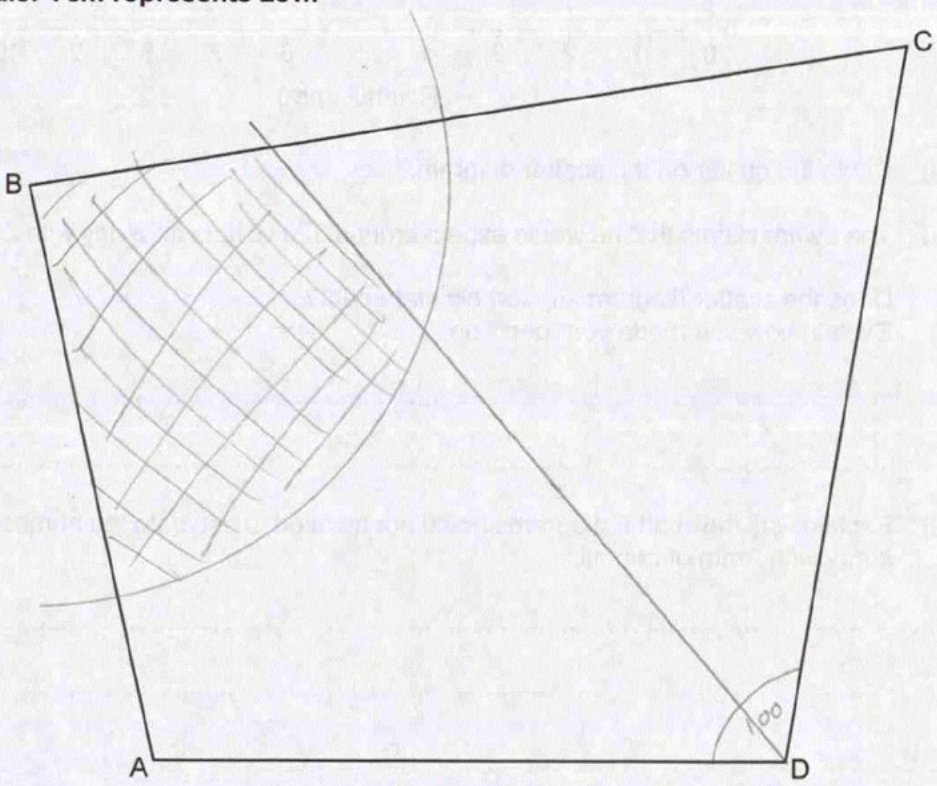
- no more than 150 m from B
- closer to AD than to CD.

Construct and shade the region where the play area can be positioned.
Show all your construction lines. **[5]**

Exemplar 1 – Mark(s): 4

The scale drawing represents a park.

Scale: 1 cm represents 25 m



A new play area must be

150 m = 6cm

- no more than 150 m from B
- closer to AD than to CD.

Construct and shade the region where the play area can be positioned.
Show all your construction lines. [5]

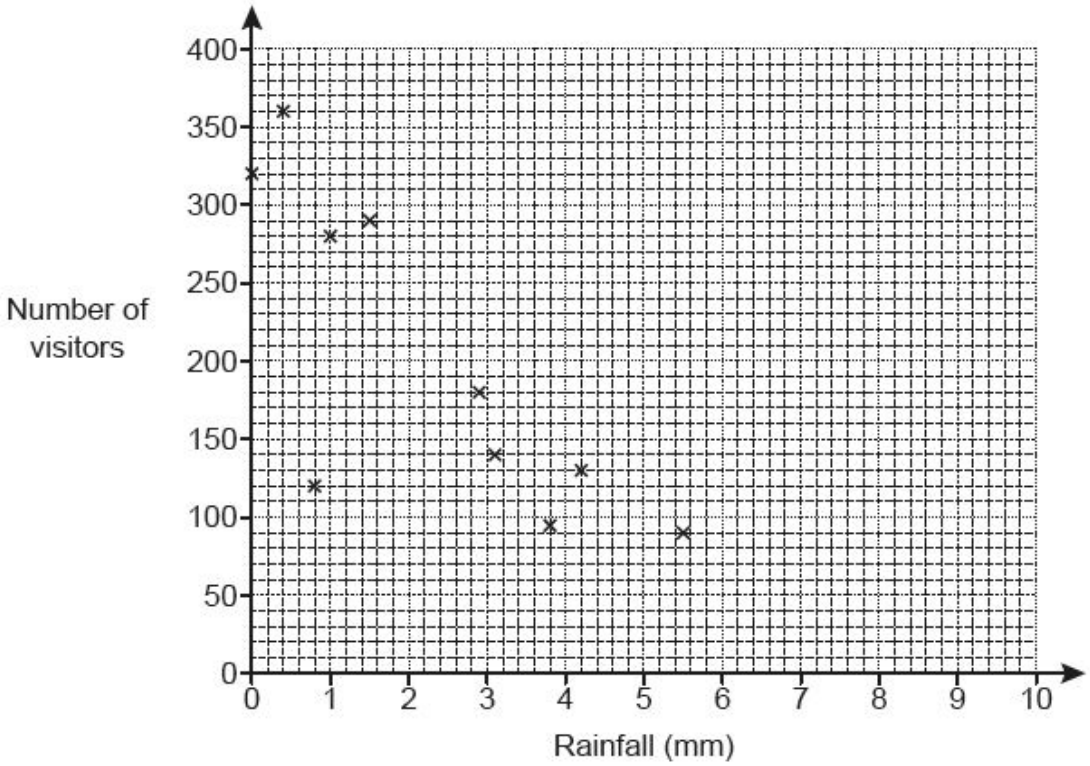
Examiner commentary

The candidate has drawn the correct arc, centre B with radius 6 cm, scoring 2 marks. There is a correct ruled bisector but there are no construction arcs, so B1. Having achieved at least one mark for each, the candidate can also score the mark for the correct region shaded.

Even if 0 marks had been scored for the construction, this candidate would have been awarded SC1 for the use of the scale as indicated beneath the diagram.

Question 3(a)(ii)

The owner of a tourist attraction records the amount of rainfall, in millimetres, and the number of visitors each day.
The results for 10 days are shown in the scatter diagram.



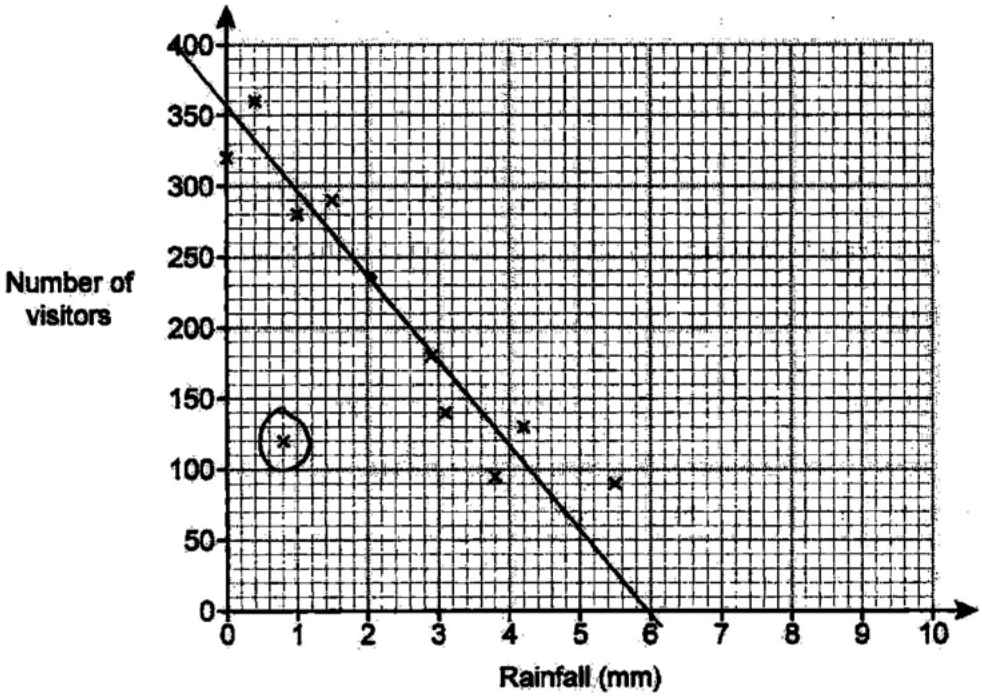
(ii) The owner claims that he would expect around 320 visitors on a day with 2 mm of rainfall.

Does the scatter diagram support his statement?
Explain how you made your decision.

.....

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

Exemplar 1 – Mark(s): 2



(ii) The owner claims that he would expect around 320 visitors on a day with 2 mm of rainfall.

Does the scatter diagram support his statement?
Explain how you made your decision.

no - line of best fit says it should be around 235 visitors [2]

Examiner commentary

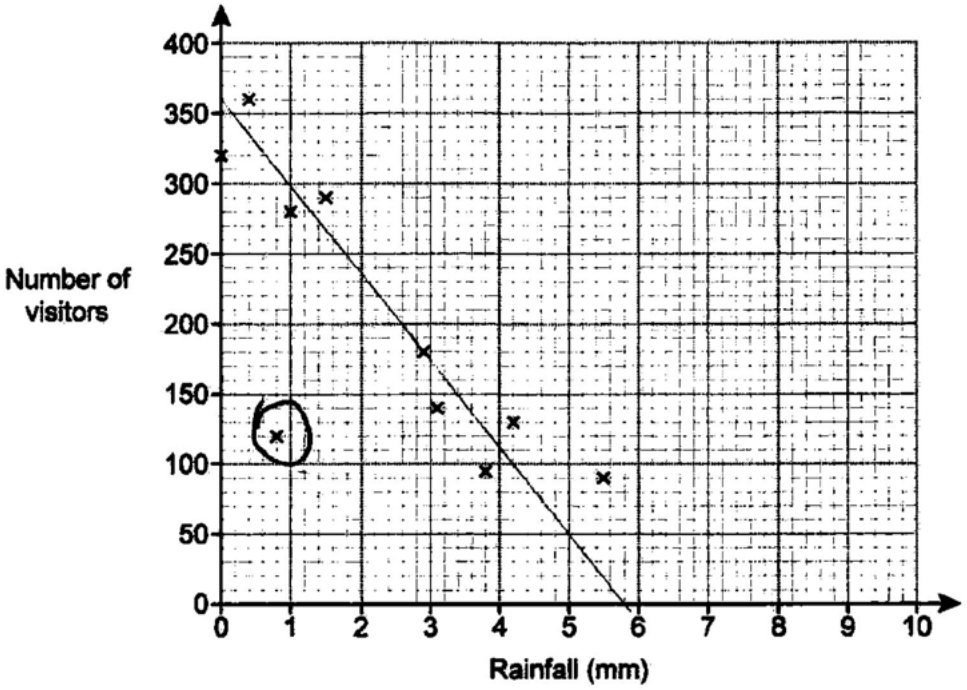
For 2 marks, candidates needed to give a correct supporting value and justification.

The exemplar is typical of the most frequently seen response that was worthy of 2 marks.

If using this approach, for 2 marks, candidates needed to suggest an acceptable number of visitors and reference a line or curve of best fit. There was no requirement to draw the line or curve, but candidates should be encouraged to draw them if that is what they are using. Adding vertical and horizontal lines to show readings are also advisable.

An acceptable value, such as 235, without the justification would have scored B1. Similarly, the line on its own would have scored B1.

Exemplar 2 – Mark(s): 2



(II) The owner claims that he would expect around 320 visitors on a day with 2 mm of rainfall.

Does the scatter diagram support his statement?
Explain how you made your decision.

No because there is a ~~positive~~ negative correlation between rain & number of visitors and about 1.5mm yields less than 300 so I would expect less than that [2]

Examiner commentary

For 2 marks, candidates needed to give a correct supporting value and justification.

The approach shown on this exemplar was sometimes seen from the higher achieving candidates. "1.5 mm yields less than 300" [visitors] is the supporting value and "negative correlation" is the justification. "Negative correlation" on its own would have scored B1.

The line of best fit is irrelevant in the marking of this candidate's response since their written explanation merits the 2 marks. In the absence of any written response, if the line is within the overlay provided to examiners it would have scored B1.

Question 4

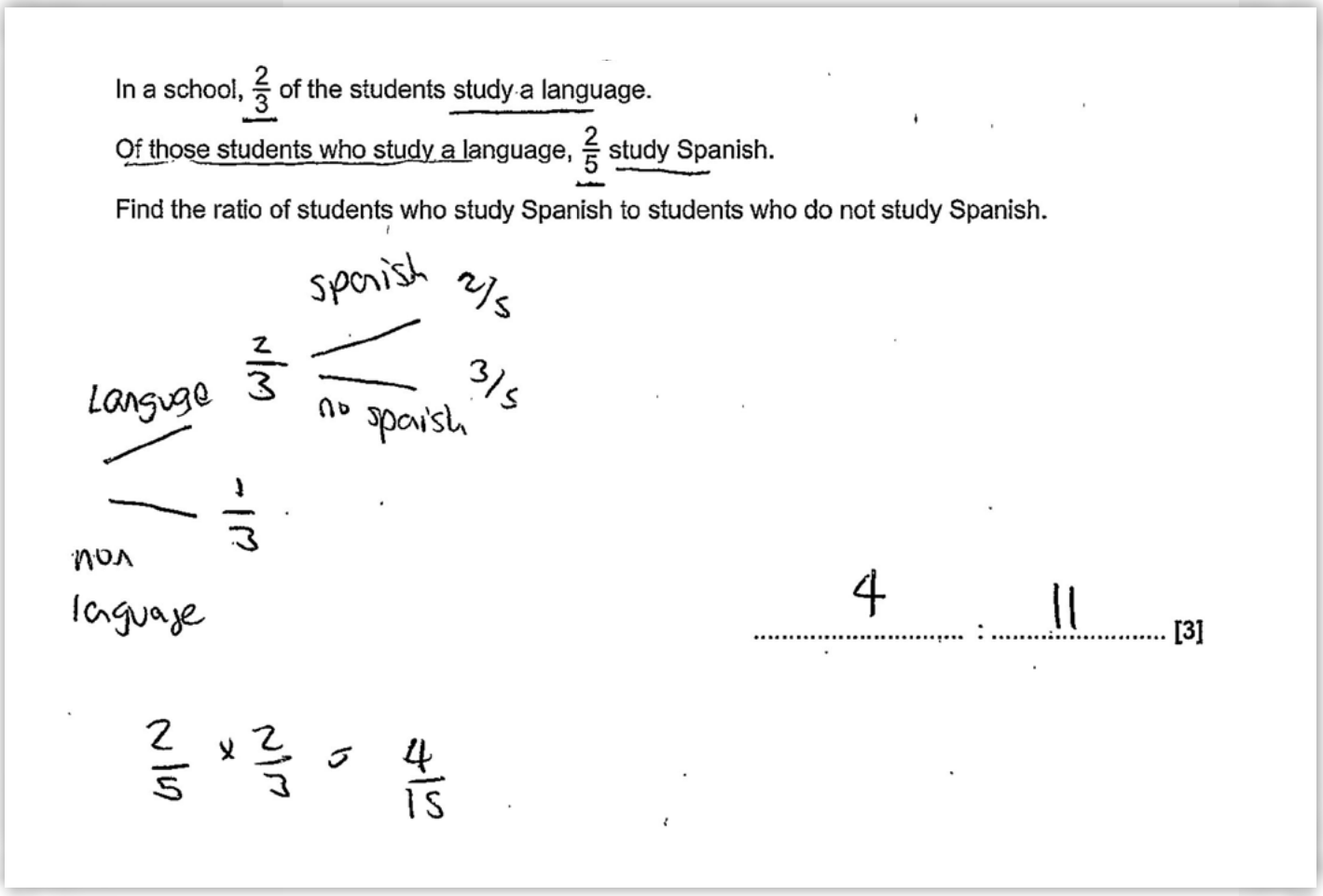
In a school, $\frac{2}{3}$ of the students study a language.

Of those students who study a language, $\frac{2}{5}$ study Spanish.

Find the ratio of students who study Spanish to students who do not study Spanish.

..... : ..... [3]

Exemplar 1 – Mark(s): 3

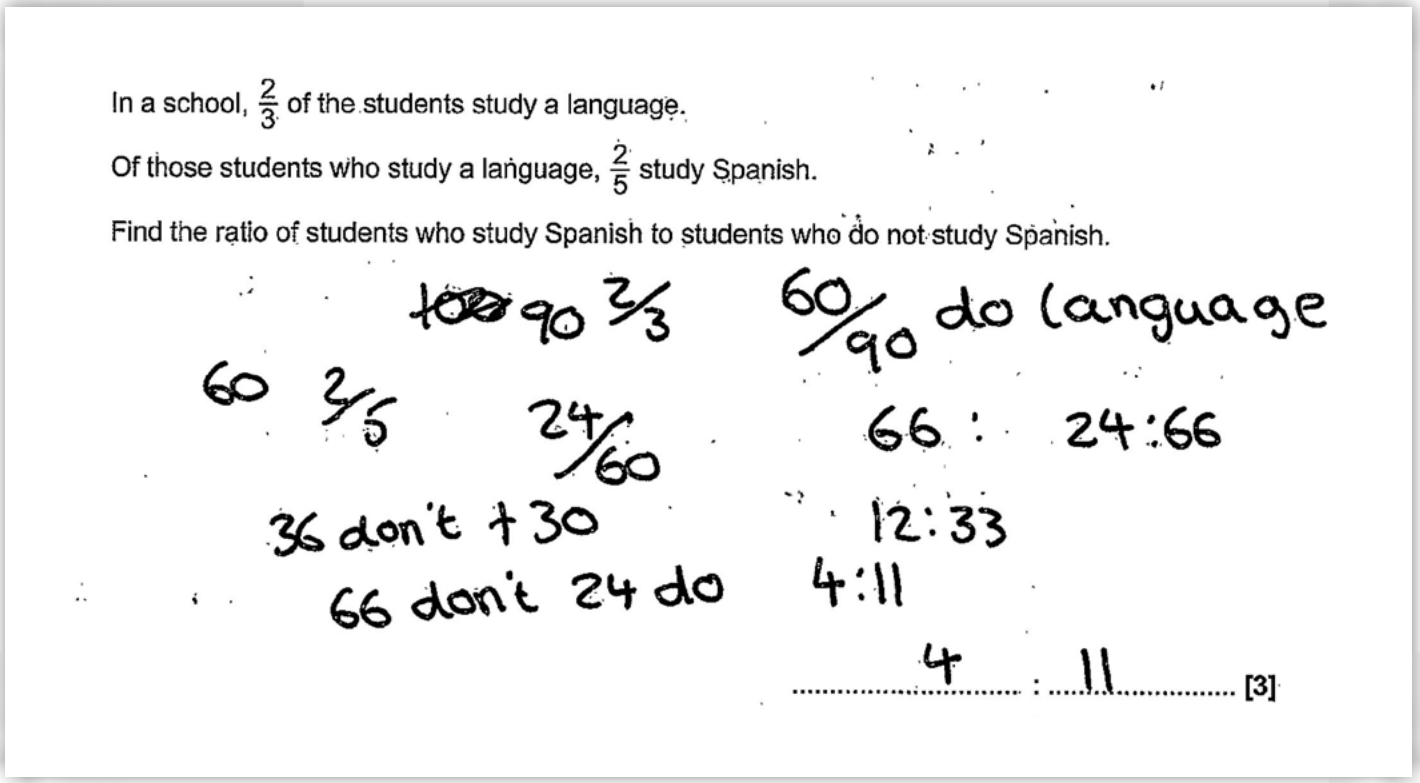


Examiner commentary

As here, using a tree diagram showed logic and often led to success.

However, most candidates did not use a table or diagram although many did obtain $\frac{4}{15}$. If this came from the product of $\frac{2}{3}$ and $\frac{2}{5}$ then 2 marks were scored; however, if it arose from $\frac{2}{3} - \frac{2}{5}$ then 0 marks were scored as this was not a valid method.

Exemplar 2 – Mark(s): 3


In a school, $\frac{2}{3}$ of the students study a language.

Of those students who study a language, $\frac{2}{5}$ study Spanish.

Find the ratio of students who study Spanish to students who do not study Spanish.

too 90 2/3 60/90 do language

60 2/5 24/60 66 : 24:66

36 don't + 30 12:33

66 don't 24 do 4:11

4 : 11 ..... [3]

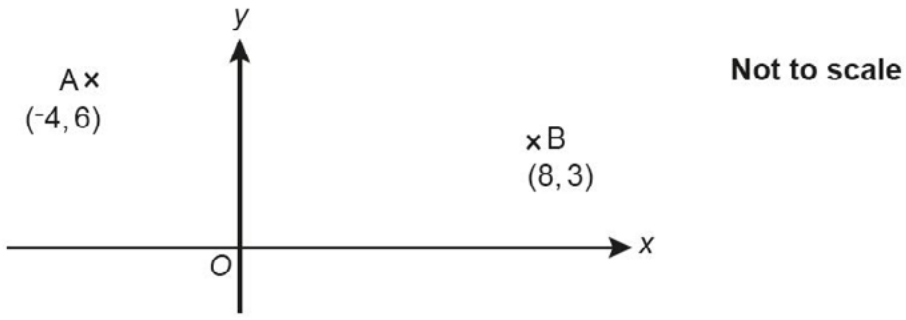
Examiner commentary

Another successful method was to decide on a starting number of students. Although the example here is not particularly well laid out, it can be seen that the candidate starts with 90 leading to 60 studying a language – this on its own would score B1. They then deduce 24 out of the 60 study Spanish for another mark. 24 out of the starting 90 is the equivalent of the $\frac{4}{15}$ in the previous example – both methods leading to 2 marks at this stage. Finally, the candidate writes the ratio 24 : 66 which they simplify to 4 : 11.

This was quite a popular method but unfortunately many candidates did not start with a common multiple of 3 and 5. This then led to decimals and inaccuracies.

Question 5(a)(i)

Point A has coordinates (-4, 6) and point B has coordinates (8, 3).



Not to scale

(a) (i) Find the gradient of line AB.

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

Mark(s): 2

$\frac{y-y_1}{x-x_1} = \frac{6-3}{-4-8} = \frac{3}{-12}$

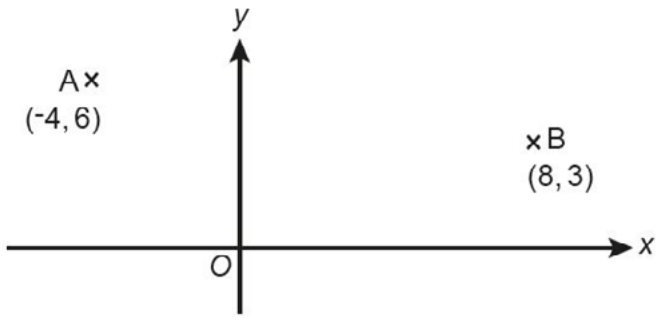
(a)(i) $-\frac{1}{4}$ **[2]**

Examiner commentary

Occasionally the negative sign was missing and this scored 1 mark. The most common error was to have the gradient inverted and this scored 0.

Question 5(a)(ii)

Point A has coordinates (-4, 6) and point B has coordinates (8, 3).

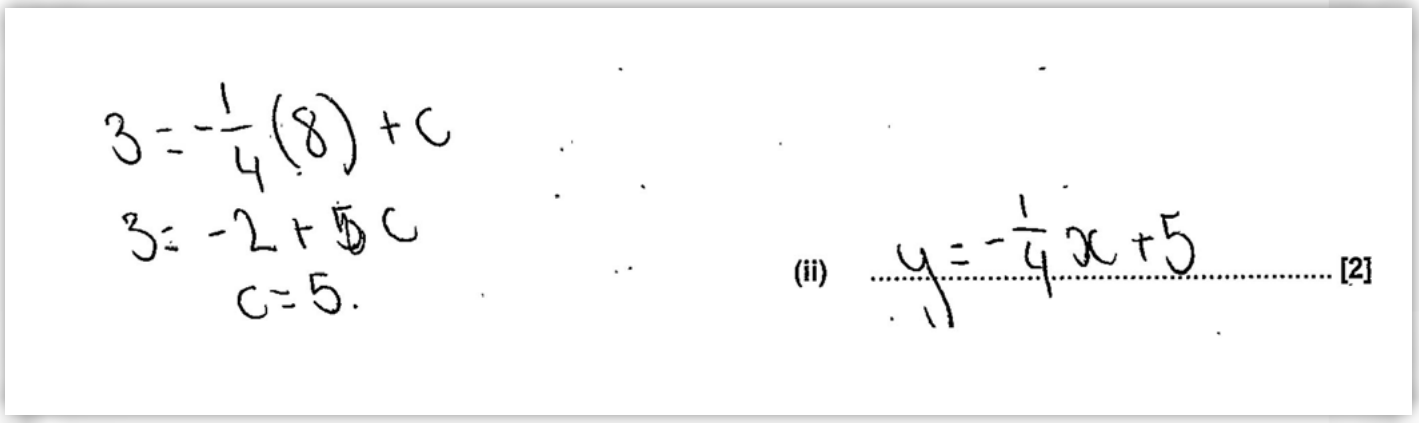


Not to scale

(ii) Find the equation of line AB.

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

Mark(s): 2



Examiner commentary

An M1 was available for substitution of one of the points into $y = $ *their* (a)(i) $x + c$, with 2 marks for a fully correct equation. Omitting "$y =$" in the answer would only have scored 1 mark.

Although some candidates were not able to produce a correct equation by this formal algebraic approach, the diagram facilitated a ratio or similar triangle method for finding the intercept. Seeing "+ 5" in the answer was thus quite common and scored M1.

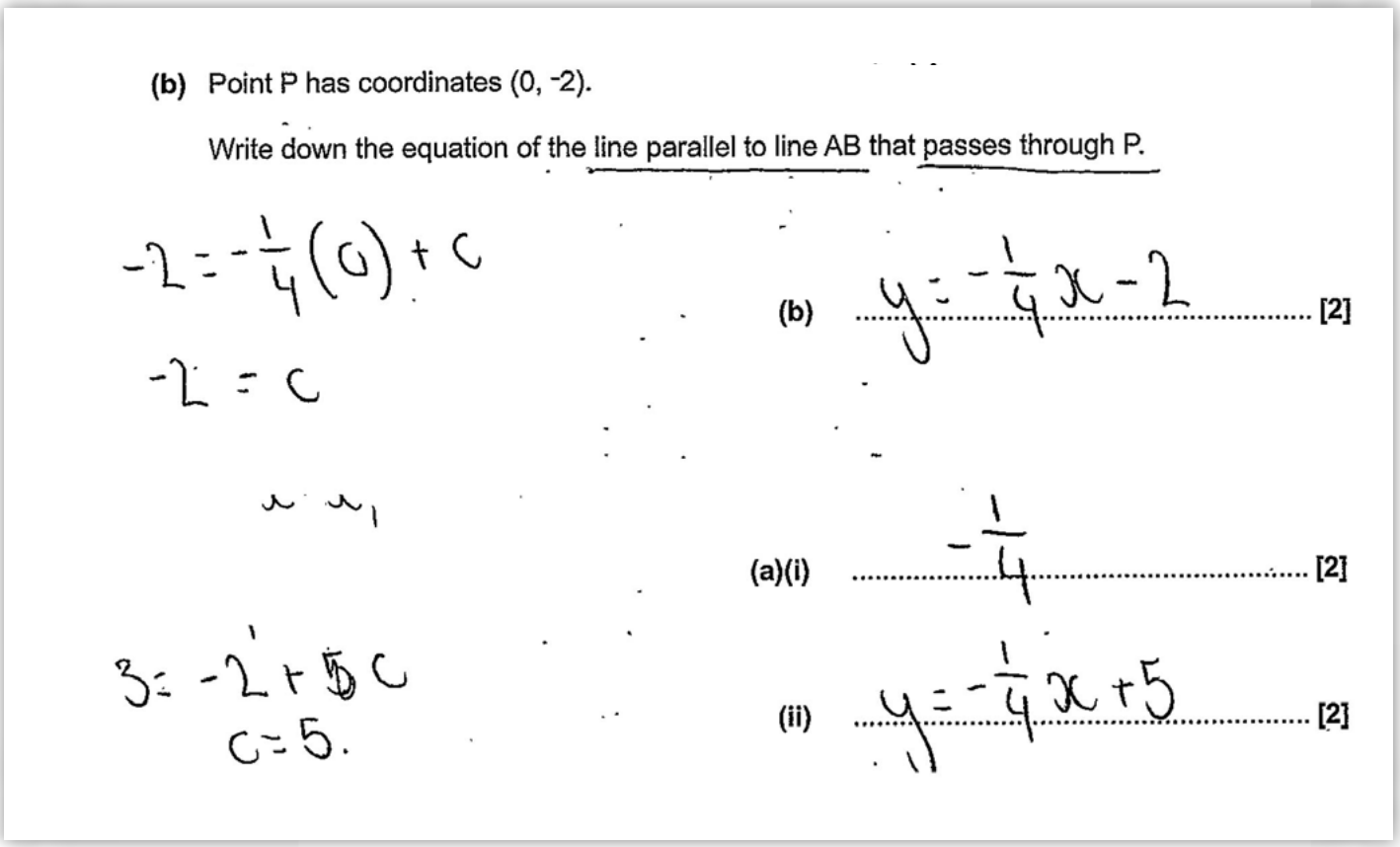
Question 5(b)

Point P has coordinates (0, -2).

Write down the equation of the line parallel to line AB that passes through P.

(b) ..... [2]

Mark(s): 2

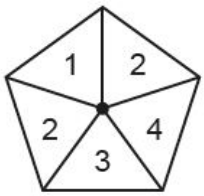


Examiner commentary

Generally, candidates who scored well across the paper were able to just write down the equation and to see working, as here, was unusual. The candidate's gradient from (a)(ii) was followed through for the $y = mx$ part of the equation but the "$+c$" was required to be "– 2" to score 2 marks.

Question 6(a)(i)

This is a fair 5-sided spinner.



Ciara spins the spinner twice and records the product of the two scores.

(i) Complete the table.

First spin

Second spin	x	1	2	2	3	4
	1	1				
	2			4		
	2					
	3					
	4				12	

[2]

Mark(s): 2

(i) Complete the table.

First spin

Second spin	x	1	2	2	3	4
	1	1	2	2	(3)	4
	2	2	4	4	(6)	8
	2	2	4	4	(6)	8
	3	(3)	(6)	(6)	(9)	(12)
	4	4	8	8	(12)	16

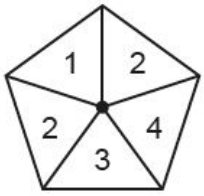
[2]

Examiner commentary

Apart from the occasional slip, candidates responses to this question were rarely incorrect.

Question 6(a)(ii)

This is a fair 5-sided spinner.



Ciara spins the spinner twice and records the product of the two scores.

(ii) Find the probability that the product is a multiple of 3.

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

Mark(s): 2

(ii) Find the probability that the product is a multiple of 3.

$\frac{9}{25}$

(a)(ii) $\frac{9}{25}$ ..... **[2]**

Examiner commentary

Nearly all candidates had a denominator of 25.

Most also had a numerator of 9, although occasionally the 3×3 entry may have been counted twice to give a numerator of 10.

Answers expressed in words, such as "9 out of 25", or ratios were not accepted.

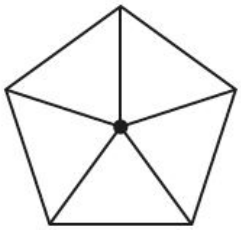
Question 6(b)

Ciara makes a different fair 5-sided spinner.
She spins the spinner twice and records the product of the two scores.

Ciara says

The probability that the product is negative is 0.48.

Write numbers on the spinner below so that Ciara's statement is correct.



[3]

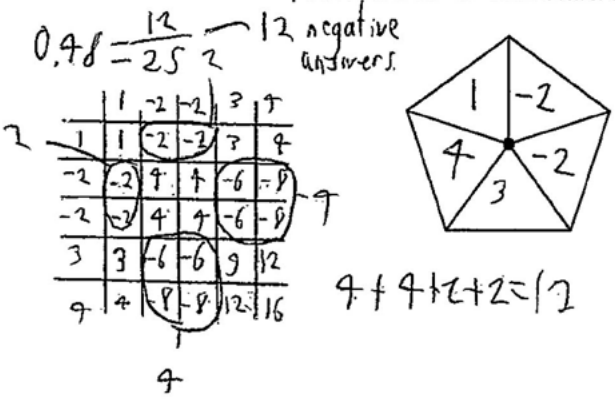
Exemplar 1 – Mark(s): 3

Ciara makes a different fair 5-sided spinner.
She spins the spinner twice and records the product of the two scores.

Ciara says

The probability that the product is negative is 0.48.

Write numbers on the spinner below so that Ciara's statement is correct.



Examiner commentary

Any set of five non-zero numbers comprising of two positive and three negative values or three positive and two negative values produced a correct response.

Most candidates just completed the spinner with five values, without showing any working, and usually scored 3 marks, or 1 mark if they included a zero.

The candidate's response above is a particularly full solution, showing the deduction that 0.48 is $\frac{12}{25}$ and thus "12 negative answers" are needed. That on its own scored 1 mark. The candidate then showed their working and checked their answers in table form.

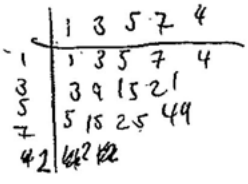
Exemplar 2 – Mark(s): 1

(b) Ciara makes a different fair 5-sided spinner.
She spins the spinner twice and records the product of the two scores.

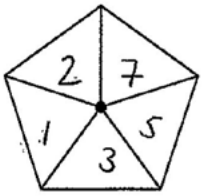
Ciara says

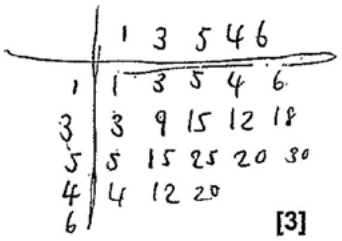
The probability that the product is negative is 0.48.

Write numbers on the spinner below so that Ciara's statement is correct.



3 5
2 4





$0.48 = \frac{12}{25}$ need odd

$\frac{12}{25}$

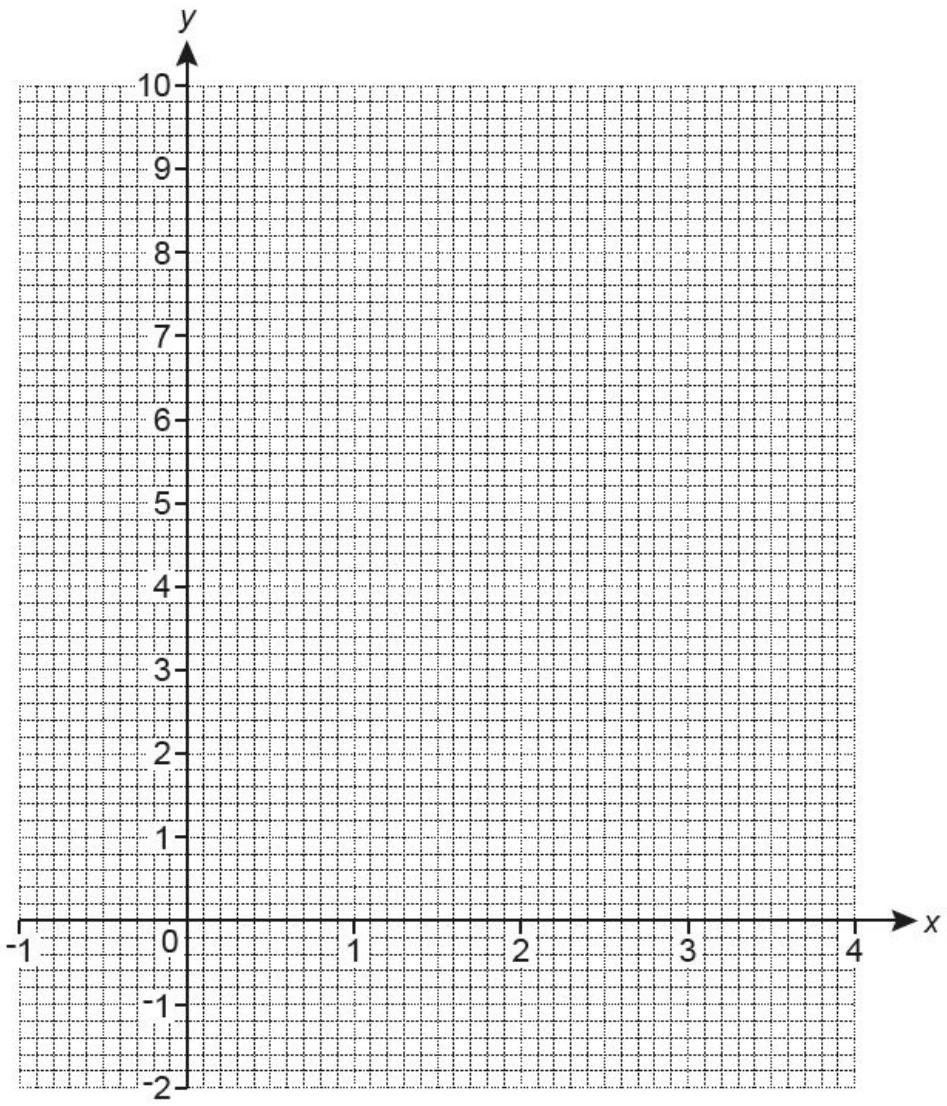
[3]

Examiner commentary

This candidate's spinner is incorrect. Had they recognised the need to include even one negative value then they would have scored the second M1 mark. However, they did make progress through converting 0.48 to $\frac{12}{25}$ and thus scored 1 mark.

Question 7(b)

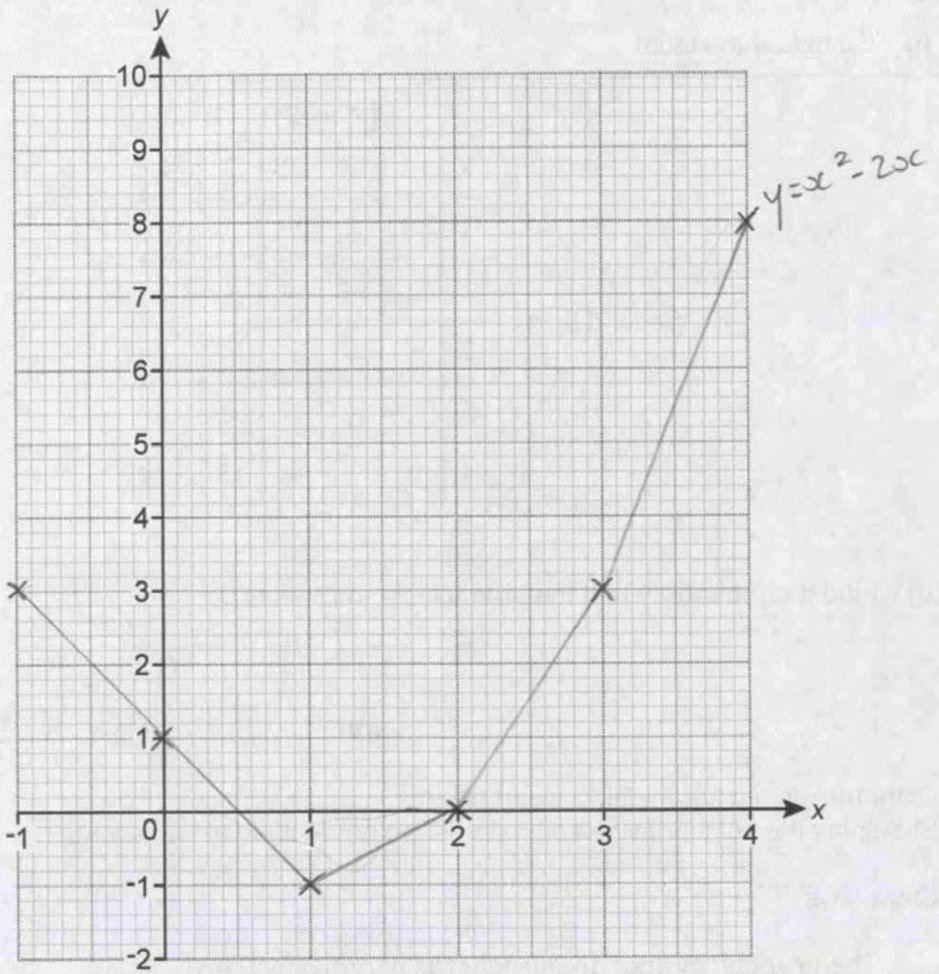
Draw the graph of $y = x^2 - 2x$ for $-1 \leqslant x \leqslant 4$.



[2]

Exemplar 1 – Mark(s): 1

(b) Draw the graph of $y = x^2 - 2x$ for $-1 \leqslant x \leqslant 4$.

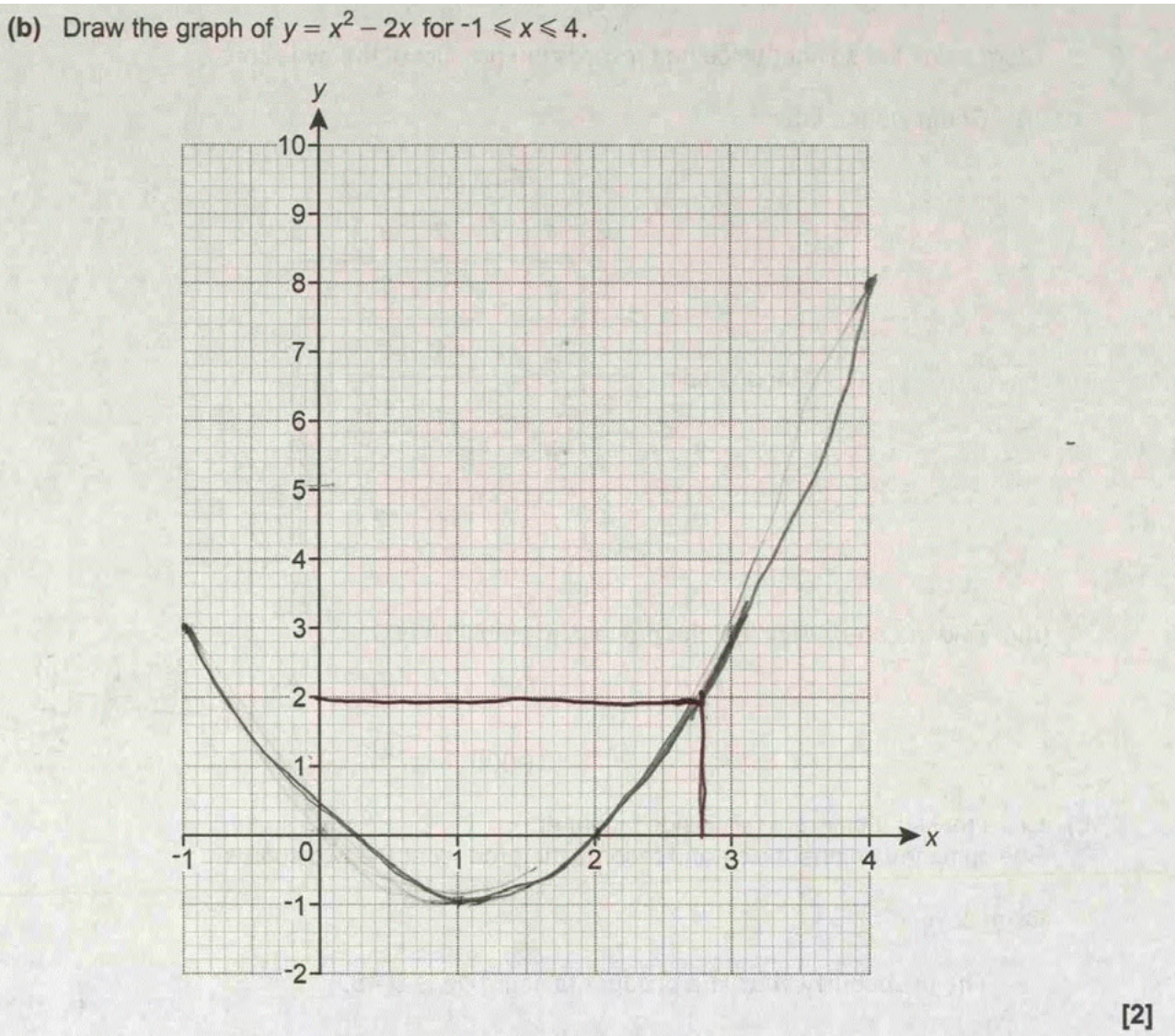


[2]

Examiner commentary

The candidate has plotted at least four correct points and so scores 1 mark. An incorrect point has been plotted at (0, 1). The points have been joined by straight line segments, so even if this point had been plotted at (0, 0), the response would still only score the 1 mark.

Exemplar 2 – Mark(s): 1



Examiner commentary

The candidate has plotted at least four correct points. The missing point is at (0, 0) and so the curve is inaccurate here. Thus, just 1 mark for the points. If the curve had passed through (0, 0), the response would have been of sufficient quality to score 2 marks. The multiple lines at about $x = 1.25$ would have been condoned.

The line $y = 2$ is part of the candidate's response to part (c).

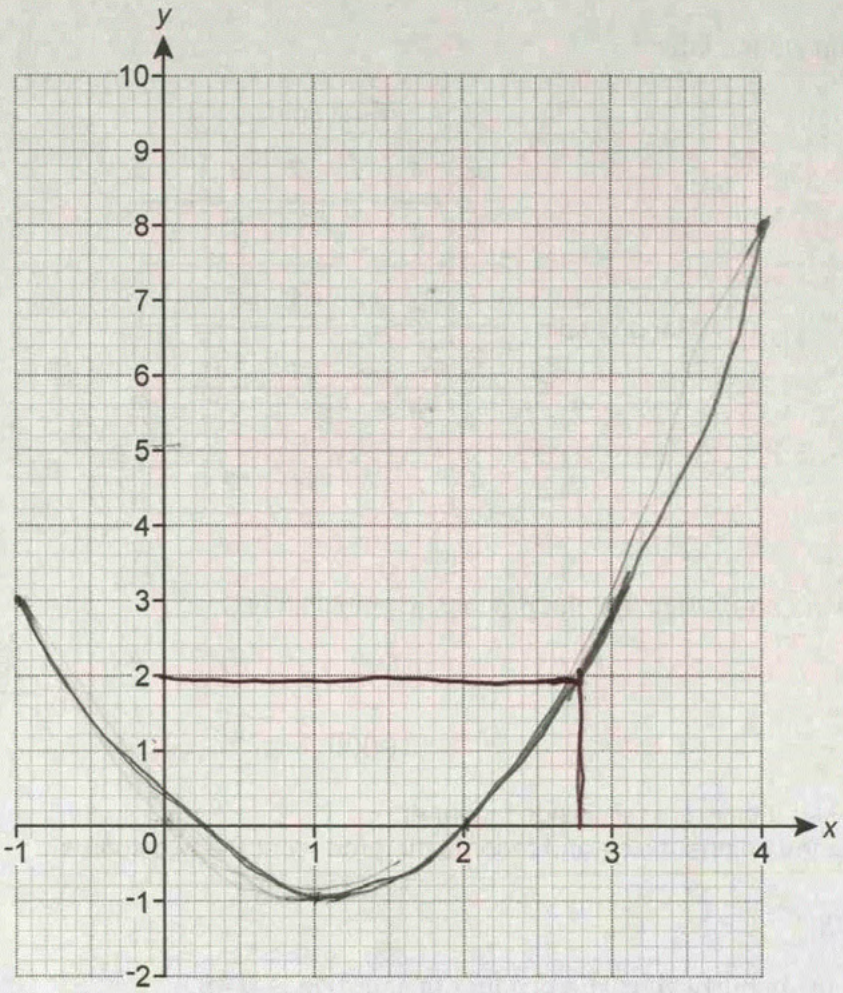
Question 7(c)

Use your graph to solve $x^2 - 2x = 2$.

(c) ..... [2]

Mark(s): 1

(b) Draw the graph of $y = x^2 - 2x$ for $-1 \leqslant x \leqslant 4$.



[2]

(c) Use your graph to solve $x^2 - 2x = 2$.

(c) 2.8 [2]

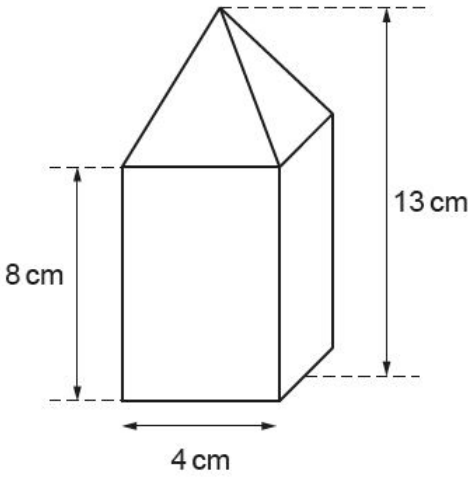
Examiner commentary

This candidate only found one solution on their graph and so scored 1 mark.

It is good practice for candidates to show how they are using their graph to solve an equation.

Question 8

The object below is made from a square-based pyramid joined to a cuboid.



The base of the cuboid and the base of the pyramid are both squares of side 4 cm.
The height of the cuboid is 8 cm and the total height of the object is 13 cm.
The total mass of the object is 158 g.

The cuboid is made from wood with density 0.67 g/cm^3.
The pyramid is made from granite.

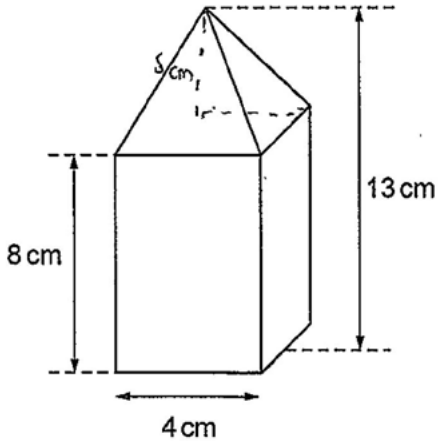
Calculate the density of the granite.

[The volume of a pyramid is $\frac{1}{3}$ × area of base × perpendicular height.]

..... g/cm^3 **[5]**

Exemplar 1 – Mark(s): 5

The object below is made from a square-based pyramid joined to a cuboid.



The base of the cuboid and the base of the pyramid are both squares of side 4 cm.
The height of the cuboid is 8 cm and the total height of the object is 13 cm.
The total mass of the object is 158 g.

The cuboid is made from wood with density 0.67 g/cm^3.
The pyramid is made from granite.

Calculate the density of the granite.

[The volume of a pyramid is $\frac{1}{3}$ × area of base × perpendicular height.]

Total = 158
Cuboid = 85.76
Pyramid = 72.24

Cuboid = 4 × 4 × 8 = 128
128 × 0.67 = 85.76

158 − 85.76 = 72.24

$\frac{1}{3}$ × area of base × perpendicular height

$\frac{1}{3}$ × 16 × 5 = 26.6

72.24 ÷ 26.6 = 2.709

2.709 = density of granite

2.709 ..... g/cm^3 **[5]**

Examiner commentary

The candidate has a correct answer supported by valid working and scores full marks.

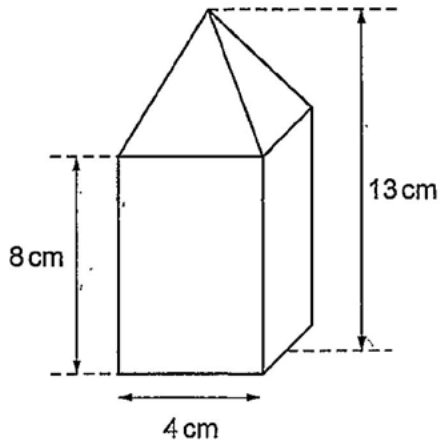
Although not perfect in its layout and presentation, lacking words like "mass" and "volume" and units at each stage, it is fairly typical of the better responses. The use of words in multi-step problems should be encouraged as it is good practice and can help the examiner follow the candidate's line of reasoning rather than being presented with various, and often jumbled, calculations.

Here, top right, the volume of the cuboid is attempted (1 mark), which is then multiplied by 0.67 to find the mass (1 mark). On the left, the mass of the pyramid is then found as 72.24. Underneath, the volume of the pyramid is attempted (1 mark). Their mass of the pyramid is then divided by their volume (1 mark) to produce the correct answer (1 mark).

Some candidates rounded prematurely, leading to an answer out of tolerance, and so scored 4 marks out of 5.

Exemplar 2 – Mark(s): 3

8 The object below is made from a square-based pyramid joined to a cuboid.



The base of the cuboid and the base of the pyramid are both squares of side 4 cm.
The height of the cuboid is 8 cm and the total height of the object is 13 cm.
The total mass of the object is 158 g.

The cuboid is made from wood with density 0.67 g/cm^3.
The pyramid is made from granite.

Calculate the density of the granite.

[The volume of a pyramid is $\frac{1}{3}$ × area of base × perpendicular height.]

area of cuboid: $4 \times 8 = 32 cm^2$
volume of cuboid: $4 \times 4 \times 8 = 128 cm^3$

$128 \times 0.67 = 85.76$.

Density of cuboid = 85.76
$158 - 85.76 = 72.24$ M2

volume of pyramid: $4 \times 5 \times \frac{1}{3} = 6.6$

$72.24 \div 6.6 = 10.945$.
M1

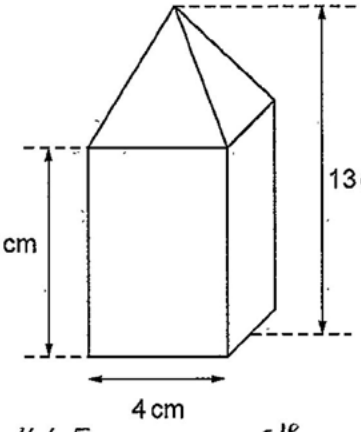
10.945 g/cm^3 [5]

Examiner commentary

Here, the use of words helps the examiner follow the candidate's line of reasoning. Working down the left-hand side, they find the volume of the cuboid, and then its mass (although incorrectly labelled "density of cuboid", the working still scores 2 marks). On the right, they make an invalid attempt to find the "volume of pyramid" (0 marks). They are then clearly calculating their mass of the pyramid divided by their volume of the pyramid (1 mark).

Exemplar 3 – Mark(s): 2

8 The object below is made from a square-based pyramid joined to a cuboid.

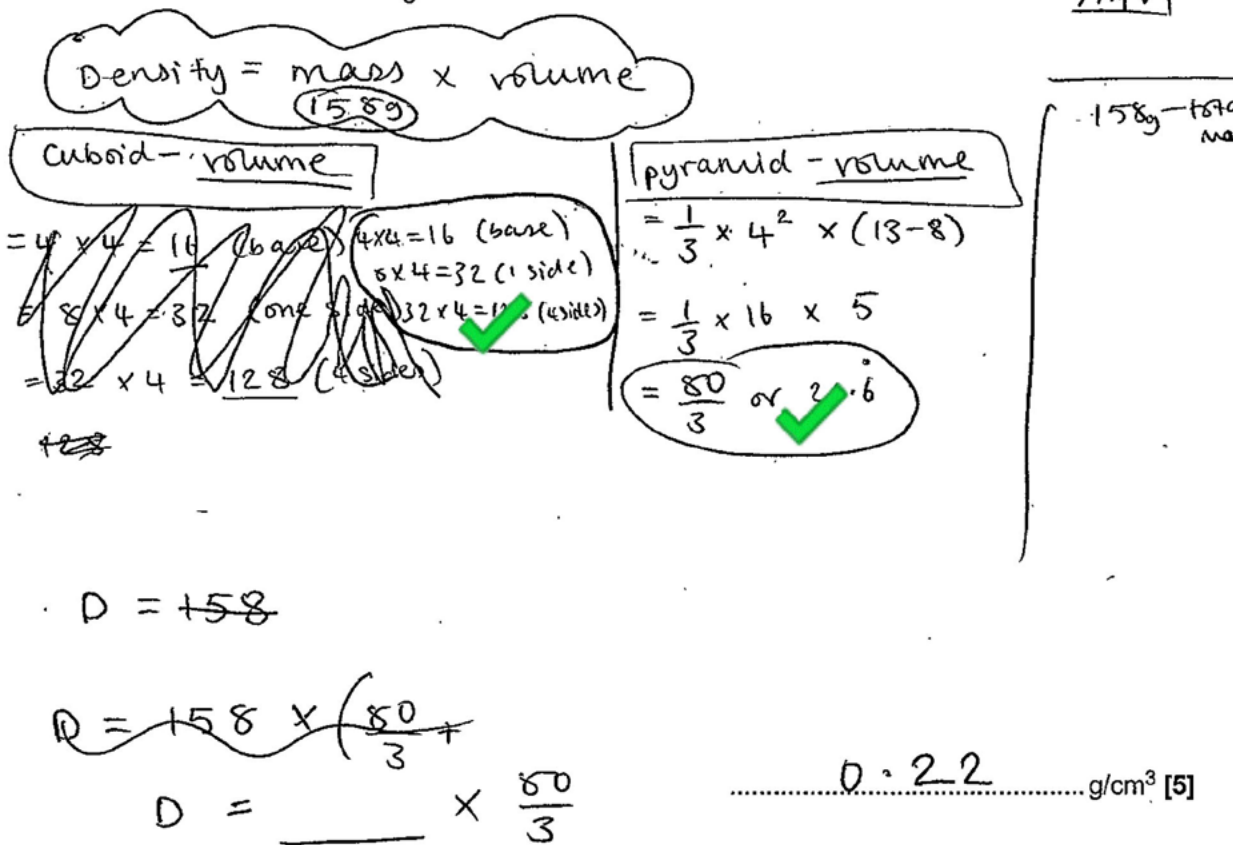


The base of the cuboid and the base of the pyramid are both squares of side 4 cm.
The height of the cuboid is 8 cm and the total height of the object is 13 cm.
The total mass of the object is 158 g.

The cuboid is made from wood with density 0.67 g/cm^3.
The pyramid is made from granite.

Calculate the density of the granite.

[The volume of a pyramid is $\frac{1}{3}$ × area of base × perpendicular height.]

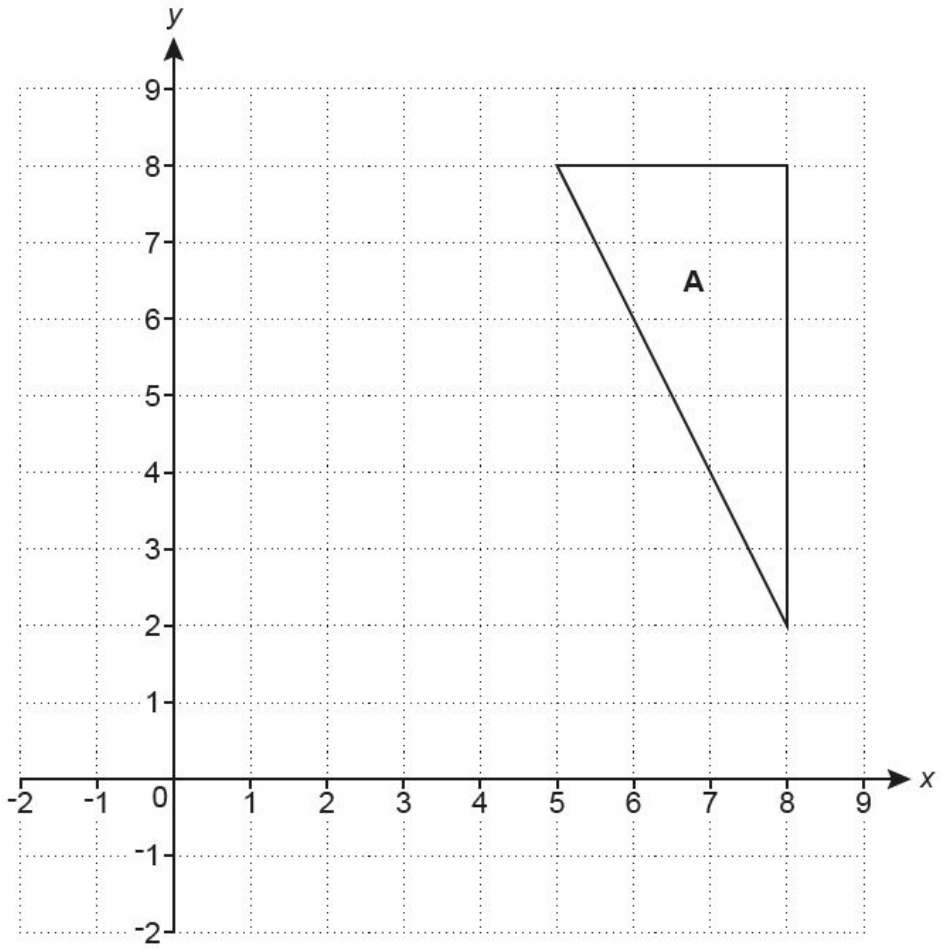


Examiner commentary

There is much irrelevant or incorrect work here. However, the candidate has provided some helpful words that draw attention to the fact that they have found the volume of the cuboid (1 mark) and the volume of the prism (1 mark).

Question 9(a)

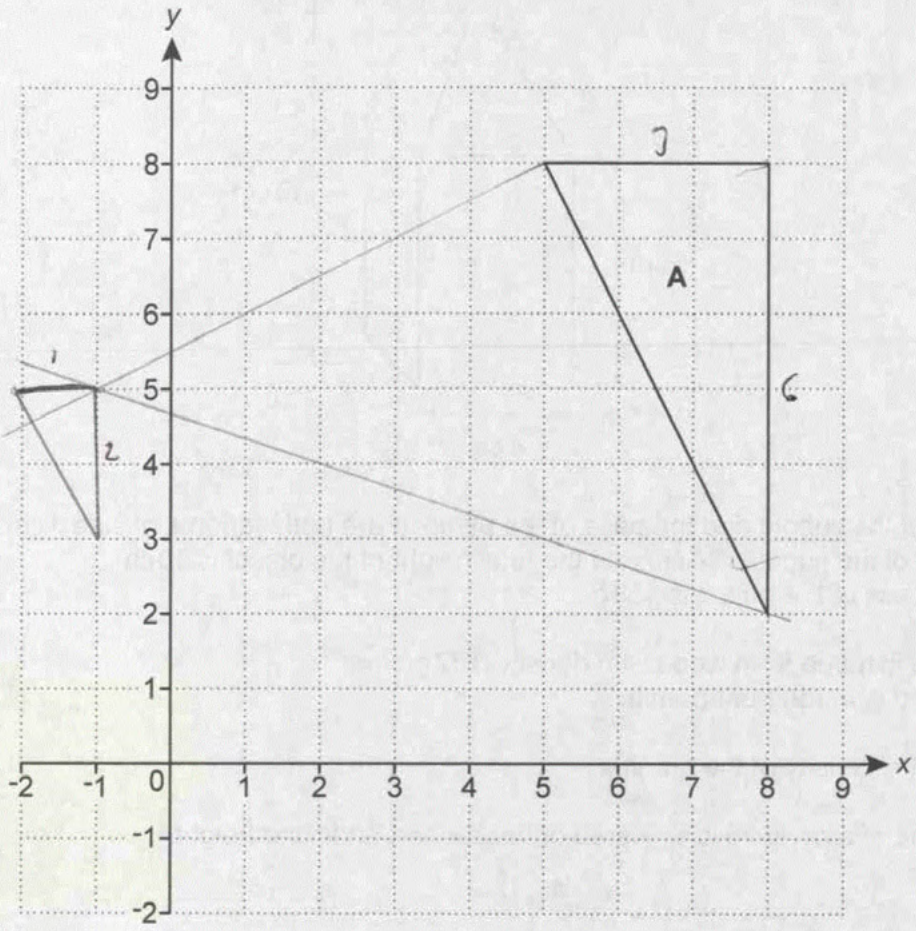
Triangle **A** is drawn on the grid.



Enlarge triangle **A** with scale factor $\frac{1}{3}$ and centre of enlargement (-1, 5). **[3]**

Mark(s): 2

Triangle **A** is drawn on the grid.



Enlarge triangle **A** with scale factor $\frac{1}{3}$ and centre of enlargement (-1, 5). **[3]**

Examiner commentary

This was the most common wrong location for the image, with the top right vertex being placed at the centre of enlargement. An enlargement with the correct scale factor but in the wrong location scored 2 marks.

Ray lines were often used. In the absence of their triangle this response would have scored 0, but if the third ray line had been shown then 1 mark would have been awarded.

It is a good idea to show ray lines but they need to be drawn carefully, since inaccurate lines sometimes led to incorrect triangles.

Question 9(b)(ii)

Prism P and prism Q are similar.

The ratio of the surface area of prism P to the surface area of prism Q is 1 : 3.

(ii) The volume of prism Q is 86 cm^3.

Calculate the volume of prism P.

(b)(ii) ..... cm^3 **[3]**

Exemplar 1 – Mark(s): 3

Q is surface area is 3x bigger

$k^2 = 3$

$k = \sqrt{3}$

$k^3 = 3\sqrt{3}$

(b)(ii) 16.55 cm^3 **[3]**

$\frac{86}{3\sqrt{3}} = 16.550770772$

↓

2DP

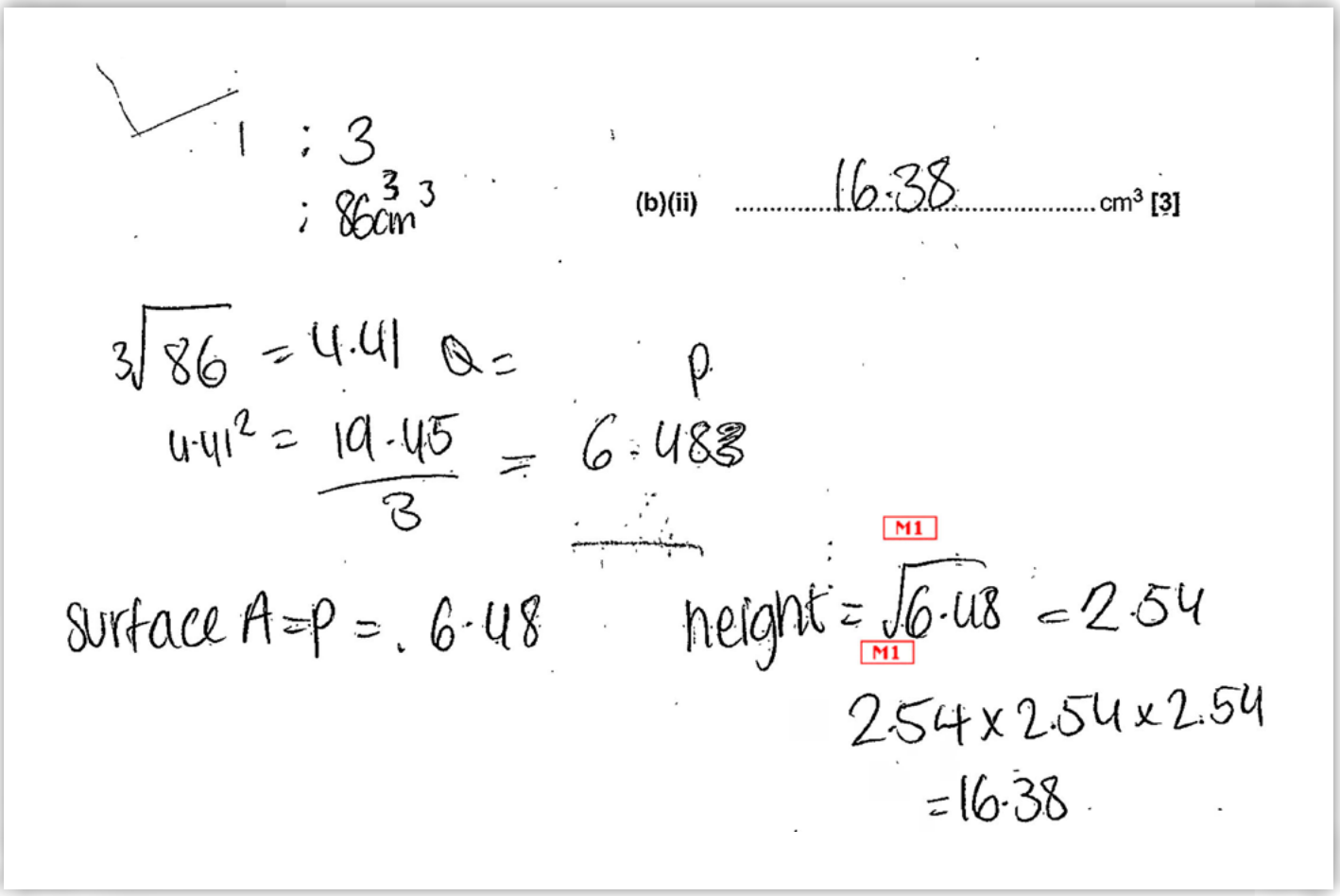
16.55

Examiner commentary

Few candidates were able to make any progress with this question.

This is a rare example of a concise, well presented solution.

Exemplar 2 – Mark(s): 2



Examiner commentary

Whilst most candidates scored 0 and had little idea of scale factors, a few made progress by making an assumption that the "prism" was a cube. Although not necessarily true, it enabled them to demonstrate knowledge of length/area/volume scale factors. Here, based on the volume of the cube being 86 cm^3, they find its dimension and then the area of one face. They then apply the area scale factor and square root to find the dimension of the smaller cube. Finally, they cube this dimension to get the volume of the smaller cube.

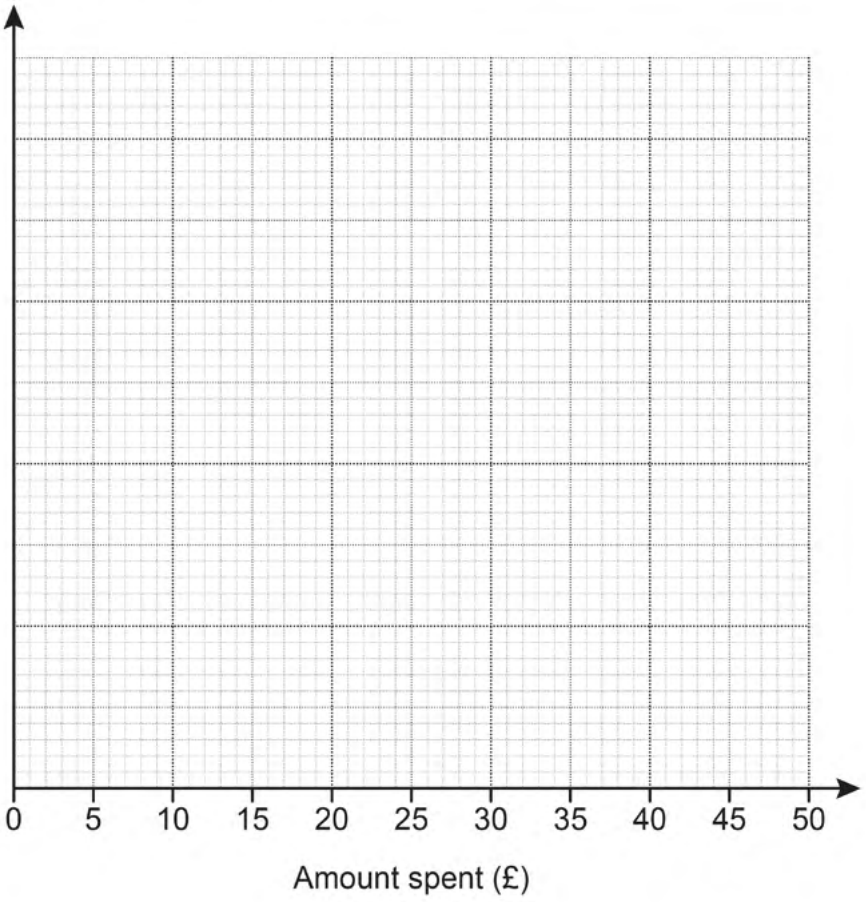
Overall, this is equivalent to the more efficient 3 mark example. If this candidate had maintained full accuracy in their working they would have obtained the correct answer and also scored 3 marks.

Question 10(a)

Ana records the amount of money spent by 140 customers in her shop on one day.

Amount spent (£a)	Frequency
$0 < a \leqslant 5$	35
$5 < a \leqslant 10$	42
$10 < a \leqslant 15$	20
$15 < a \leqslant 20$	18
$20 < a \leqslant 30$	14
$30 < a \leqslant 50$	11

(a) Draw a histogram to represent this information.



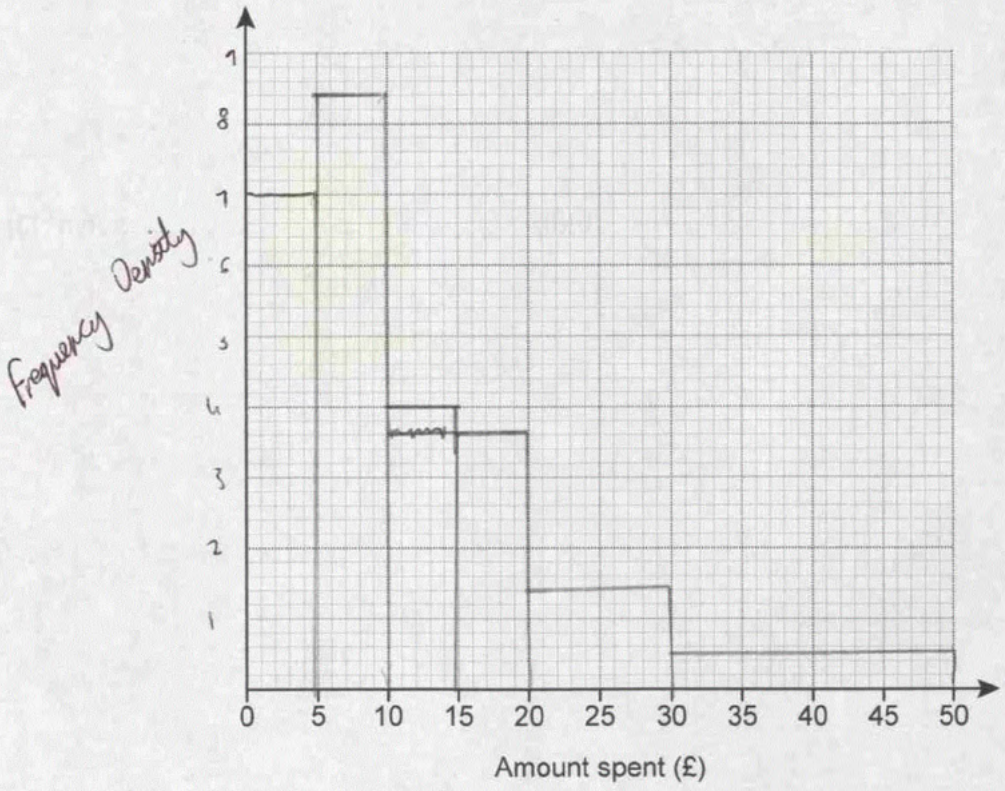
[4]

Exemplar 1 – Mark(s): 4

10 Ana records the amount of money spent by 140 customers in her shop on one day.

Amount spent (£a)	Frequency	Freq density
$0 < a \leqslant 5$	35	7
$5 < a \leqslant 10$	42	8.4
$10 < a \leqslant 15$	20	4
$15 < a \leqslant 20$	18	3.6
$20 < a \leqslant 30$	14	1.4
$30 < a \leqslant 50$	11	0.55

(a) Draw a histogram to represent this information.



[4]

Examiner commentary

This is a nicely presented full mark response.

Candidates should be encouraged to write down their frequency densities in case they make errors in drawing the histogram.

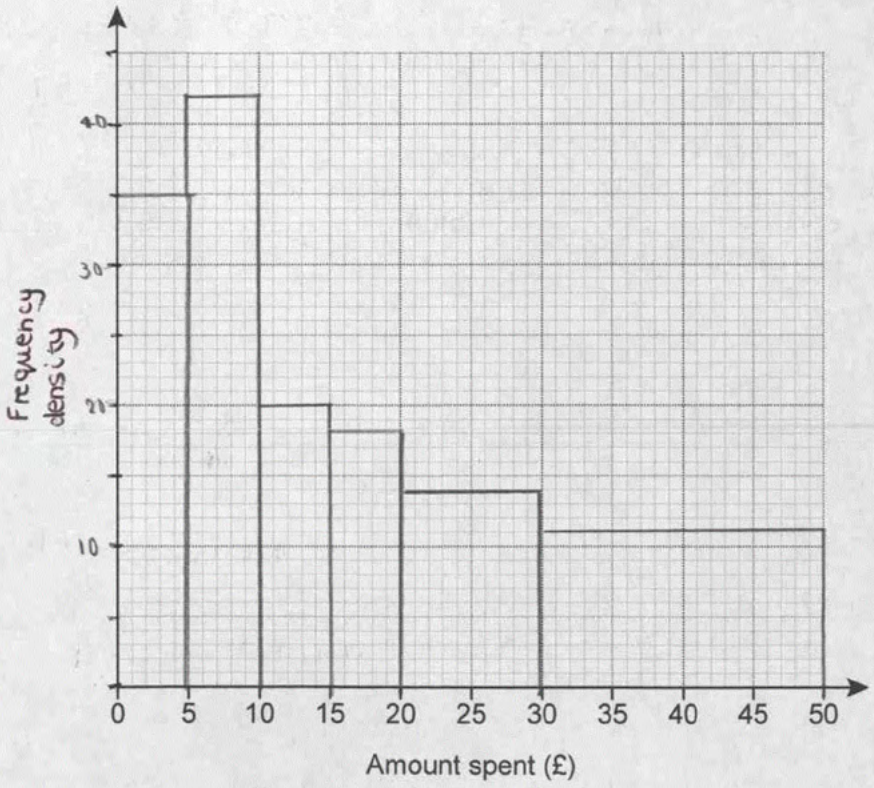
Candidates who scored 3 out of 4 usually omitted to label the vertical axis.

Exemplar 2 – Mark(s): 1

10 Ana records the amount of money spent by 140 customers in her shop on one day.

Amount spent (£a)	Frequency
$0 < a \leqslant 5$	35
$5 < a \leqslant 10$	42
$10 < a \leqslant 15$	20
$15 < a \leqslant 20$	18
$20 < a \leqslant 30$	14
$30 < a \leqslant 50$	11

(a) Draw a histogram to represent this information.



[4]

Examiner commentary

Lower achieving candidates usually merely plotted frequencies. If they produced bars of correct widths, then 1 mark was scored. There was no credit for such candidates labelling their vertical axis as "frequency density" when no such calculation had been attempted.

Question 10(b)

Ana wants to offer a discount to the customers who spend the most money in her shop.

Voucher Save 10% when you spend more than £…

She wants to give the discount to approximately 25% of her customers.

Suggest a suitable amount of money for Ana to use on her voucher.
Justify your decision.

..... [4]

Exemplar 1 – Mark(s): 4

$\frac{140}{4} = 35$

Top 35 customers

$15 < x \leqslant 20$ ← Top 10 customers in

$11 + 17 = 25$

$35 - 25 = 10$

$\frac{10 \text{ customers}}{3.6 \text{ freq. den.}} = 2.\dot{7}$

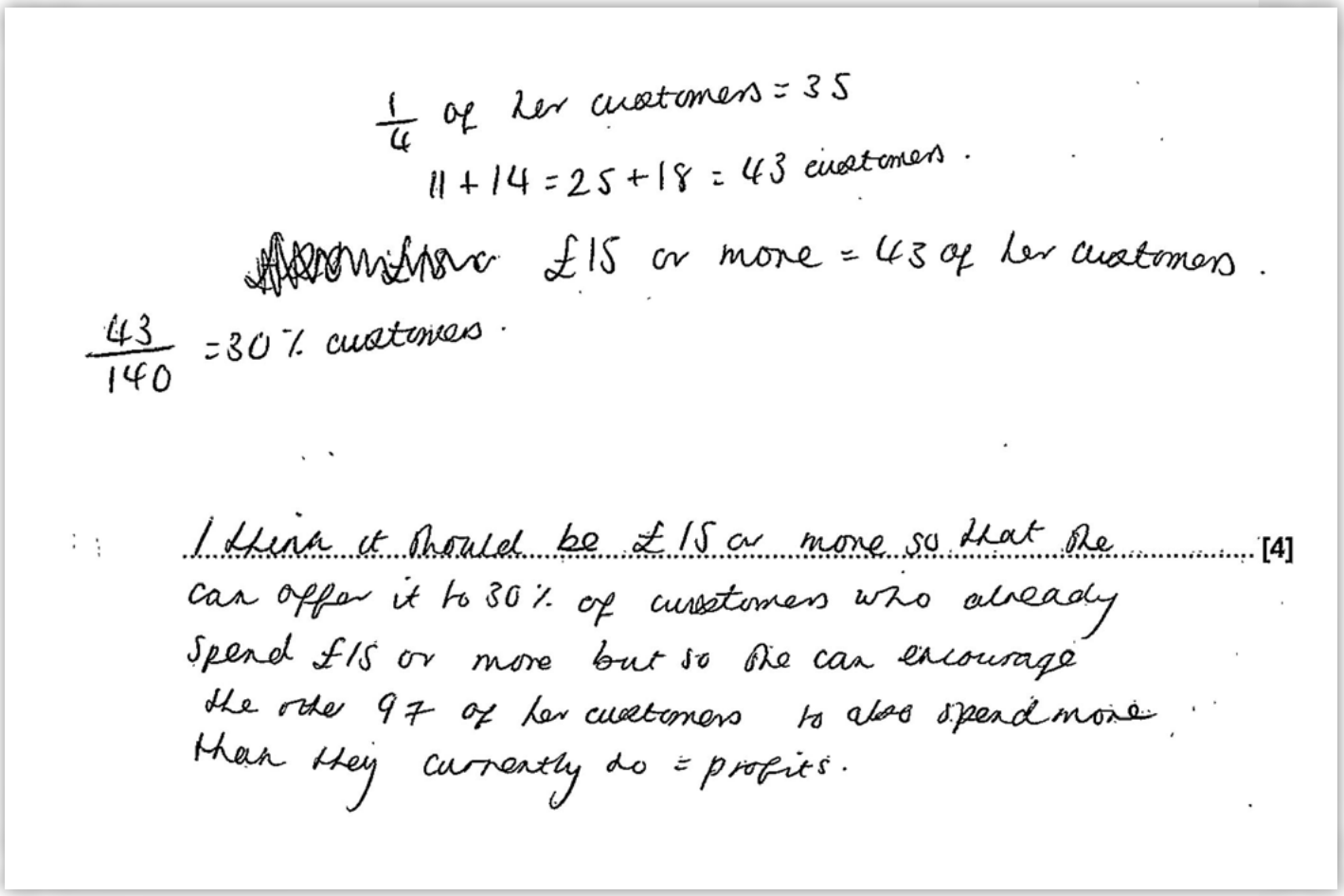
$20 - 2.\dot{7} = 17.\dot{2} \approx 17$

£17 covers the top 25% of customers. [4]

Examiner commentary

The candidate scores 1 mark for working out 25% of 140 and 1 mark for identifying that the amount of money required lies in the interval $15 < a \leq 20$. An answer between £17 and £18 is better and merits the third mark. The final mark is for the justification of this identified value, and here there is good evidence where the frequency of the $15 < a \leq 20$ interval (10) is divided by the frequency density (3.6). The candidate is working from the upper end of the interval and correctly subtracts the answer to the division from 20. The question is phrased as "approximately 25%" and so an exact answer is not appropriate and the candidate even realises this in rounding their answer to £17.

Exemplar 2 – Mark(s): 2



Examiner commentary

Most candidates scored the 1 mark for working out 25% of 140. Although not strictly in the interval $15 < a \leq 20$, the common answer of £15 was accepted for the second mark.

Question 11

Sunil makes 7.5 litres of soup, correct to the nearest 0.5 litre.
He serves the soup in 300 ml portions, correct to the nearest 10 ml.
24 people order this soup.

Does Sunil definitely have enough soup to serve the 24 people?
Show how you decide.

..... [4]

Exemplar 1 – Mark(s): 4

Sunil makes 7.5 litres of soup, correct to the nearest 0.5 litre.
He serves the soup in 300 ml portions, correct to the nearest 10 ml.
24 people order this soup.

Does Sunil definitely have enough soup to serve the 24 people?
Show how you decide.

upper bound - most possibly required = 305ml served
lower bound - least possibly made = 7.25L made

1L = 1000ml

$\frac{305}{7250} = \frac{7250}{305} = 23.\dot{7} < 24$

He does not definitely have enough to serve all 24. [4]

Examiner commentary

This is a nice concise response, showing the correct bounds, calculation, comparison and conclusion. It shows evidence for each of the four marks. The candidate chose to do the calculation "minimum amount made ÷ maximum portion size" to work out the number of portions and compared this against 24 people. 1 mark each for the correct limits (305 and 7250), 1 mark for an appropriate calculation and the final mark for the correct comparison and conclusion.

Exemplar 2 – Mark(s): 4

11 Sunil makes 7.5 litres of soup, correct to the nearest 0.5 litre.
He serves the soup in 300 ml portions, correct to the nearest 10 ml.
24 people order this soup.

Does Sunil definitely have enough soup to serve the 24 people?
Show how you decide.

UB	N	LB
7.75L	7.5L	7.25L
305ml	300ml	295ml

$305 \times 24 = 7320\text{ml} = 7.32\text{L}$

$7.25 < 7.32$

No he doesn't definitely have enough soup $7.25 < 7.32$ [4]

Examiner commentary

It was common to see both the upper and lower bounds of each value. This candidate has presented the information very clearly, whereas many scripts consisted of a jumble of figures and calculations.

Here, the candidate has extracted the appropriate bounds to use and has chosen to work out the maximum amount of soup needed for 24 people. This is then compared with the minimum amount made.

Exemplar 3 – Mark(s): 2

Sunil makes 7.5 litres of soup, correct to the nearest 0.5 litre.
He serves the soup in 300 ml portions, correct to the nearest 10 ml.
24 people order this soup.

Does Sunil definitely have enough soup to serve the 24 people?
Show how you decide.

7.5l UB= 7.55L
LB= 7.45l

300mL UB= 305 ml
LB= 295 mL

LB = 7.45 / 0.305
= 7450 / 305
= 24.4

UB = 7.55 / 0.295
= 7550 / 295
= 25.5

yes she has enough yes [4]

Examiner commentary

The award of 2 marks was very common.

This candidate scores 1 mark for one correct relevant bound (305) and 1 mark for the appropriate calculation "amount made ÷ portion size".

The candidate has a conclusion "yes" but no comparison. In any case, the values used in the calculation are not both correct and so the final mark for the comparison and conclusion would not have been awarded.

Question 12

y is inversely proportional to the square of x.

Complete the table.

x	10	6	
y	9		4

[4]

Exemplar 1 – Mark(s): 4

y is inversely proportional to the square of x.

Complete the table.

x	10	6	15
y	9	25	4

[4]

$y \propto \frac{1}{x^2}$

$y = \frac{k}{x^2}$

$9 = \frac{k}{10^2}$

$9 = \frac{k}{100}$

$9 = \frac{900}{100}$

$k = 900$

$y = \frac{900}{6^2}$

$y = 25$

$4 = \frac{900}{x^2}$

$4x^2 = 900$

$x^2 = \frac{900}{4}$

$x^2 = 225$

$x = 15$

Examiner commentary

This is a very detailed and clear approach. The answers are correct, so 4 marks.

Had only one answer been correct then they would have scored 3 marks.

The left-hand side on its own would score M1, either for $y = \frac{k}{x^2}$ or for 900, whilst the $4x^2 = 900$ statement, for example, would score M2.

Exemplar 2 – Mark(s): 1

y is inversely proportional to the square of x.

Complete the table.

x	10	6	4
y	9	~~9~~ 5	4

[4]

$y \propto \frac{1}{x^2}$

$y = \frac{k}{x^2}$

$9 = \frac{k}{10^2}$

$9 = \frac{k}{100}$

$0.09 = k$

Examiner commentary

The candidate scores 1 mark for $y = \frac{k}{x^2}$. There was no follow through from an incorrect value of k.

Exemplar 3 – Mark(s): 0

y is inversely proportional to the square of *x*.

Complete the table.

x	10	6	22·5
y	9	15	4

[4]

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

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

$9 = \frac{k}{10}$

$k = 9 \times 10$

$k = 90$

$y = \frac{k}{6}$

$y = \frac{90}{6}$

$y = 15$

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

$4 = \frac{k}{x}$

$4 = \frac{90}{x}$

$\times x$

$4x = 90$

$\div 4$

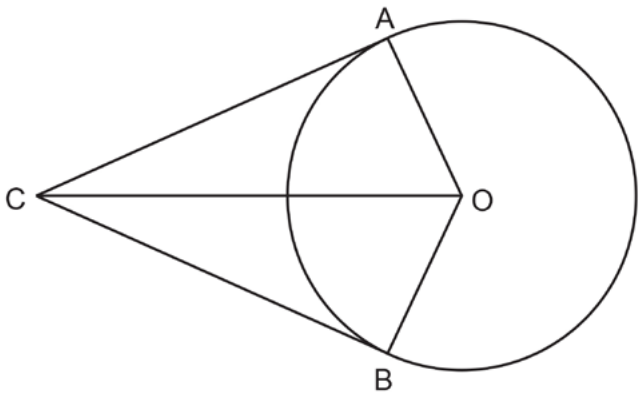
$x = 22.5$

Examiner commentary

This candidate clearly understands the method they should be using but unfortunately they have not answered the question. This was not treated as a misread and there was no follow through since they have simplified the question.

Question 13

A and B are points on the circumference of a circle, centre O.
CA and CB are tangents to the circle.



Not to scale

Prove that triangle OAC is congruent to triangle OBC.

.....

.....

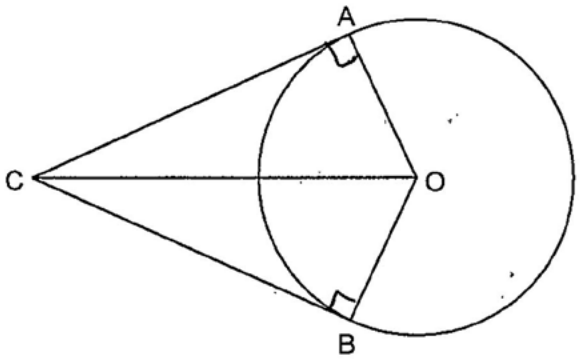
.....

.....

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

Exemplar 1 – Mark(s): 4

A and B are points on the circumference of a circle, centre O.
CA and CB are tangents to the circle.



Not to scale

Prove that triangle OAC is congruent to triangle OBC.

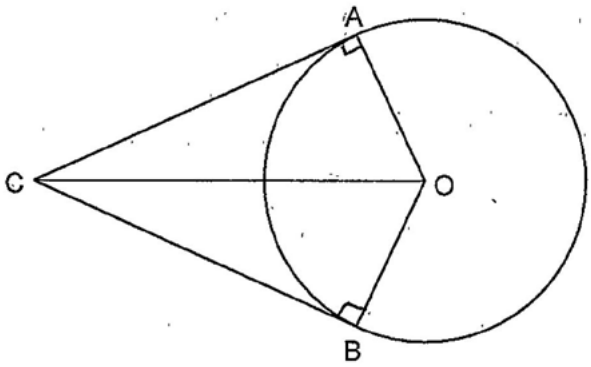
$\hat{OAC}$ OA = OB because they are both radii the
tangents to the circle. $C\hat{A}O = C\hat{B}O = 90°$
because a tangent that meets the radius
at the circumference has
a 90° angle. OAC and OBC share the
line CO which is also as their
hypotenuse so they are congruent
due to the RHS rule as they
are both right angled triangles,
have an equal side and share a
hypotenuse. [4]

Examiner commentary

The response has three correctly referenced and justified statements that support the RHS conclusion, so full marks. The pairs of sides/angles needed to be referenced using letters, as here – markings on the diagram were not accepted for the award of 3 or 4 marks.

Exemplar 2 – Mark(s): 1

A and B are points on the circumference of a circle, centre O.
CA and CB are tangents to the circle.



Not to scale

Prove that triangle OAC is congruent to triangle OBC.

OBC and OAC are ~~right angles~~ both right angles.
OC ~~has~~ is a line of symmetry through the shape.
AC and BC connect from the ~~center O~~ tangent to the center O
So so their length is equal.
B1
[4]

Examiner commentary

The candidate has two correctly referenced facts that could be used in support of congruence. The justification of the right angle is missing, and the justification for AC and BC being equal is incorrect, but the facts themselves are true. Two pairs of equal sides/angles identified with insufficient or no reasons scored B1. The sides or angles needed to be referenced, using letters as here, or indicated on the diagram. It is not made clear how OC being a "line of symmetry" is relevant and so does not receive any credit.

Question 14(b)

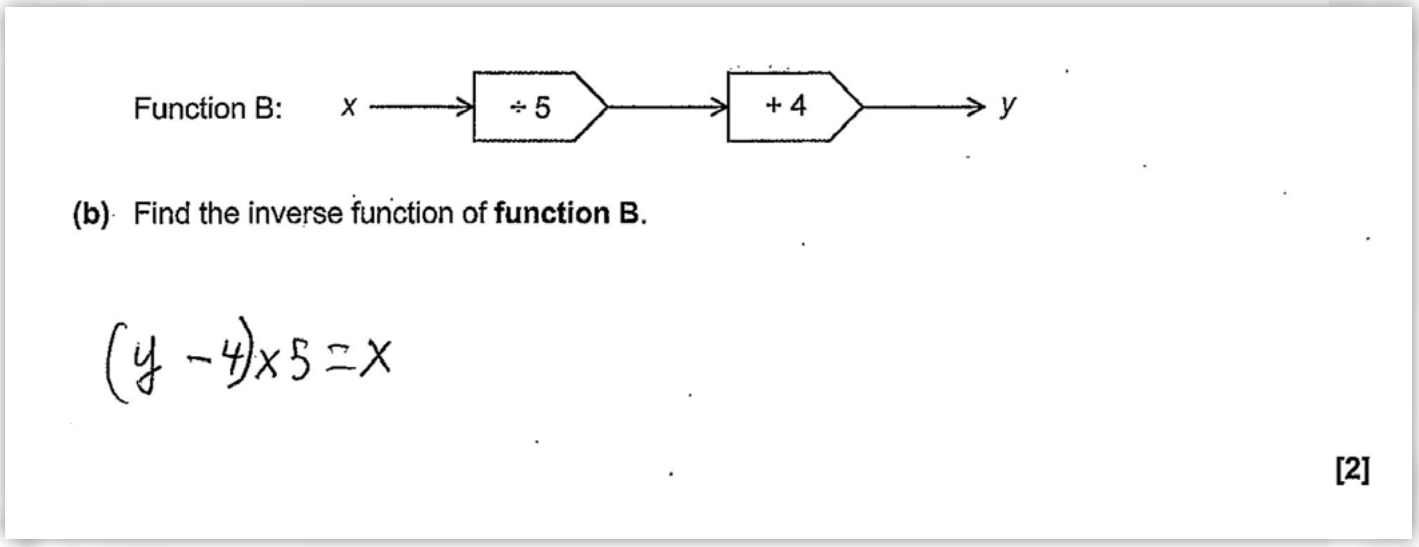
Here is a function.

Function B: $x \rightarrow \div 5 \rightarrow + 4 \rightarrow y$

(b) Find the inverse function of **function B**.

[2]

Exemplar 1 – Mark(s): 2



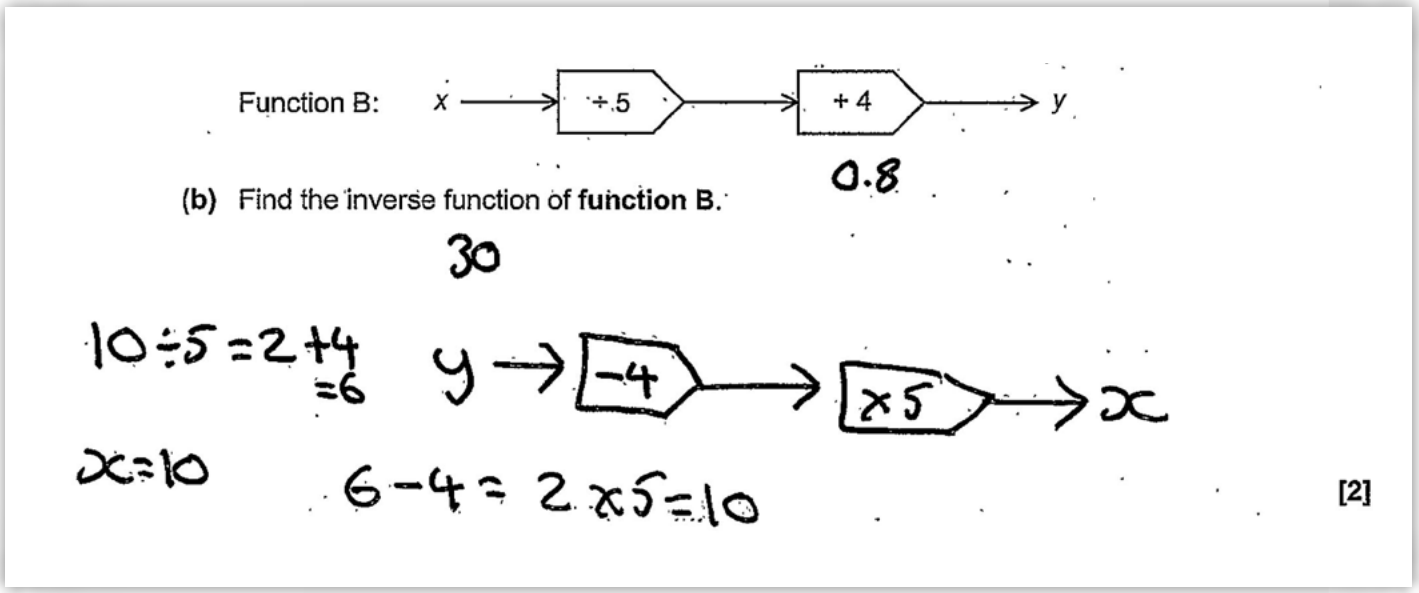
Examiner commentary

Correct inverse function, presented algebraically.

There was a lot of confusion regarding the use of x and y, and so both $y = (x - 4) \times 5$ and $x = (y - 4) \times 5$, and their algebraic equivalents, were accepted.

Expressions with notation errors, such as missing brackets or omitting the "=" symbol, scored 1 mark.

Exemplar 2 – Mark(s): 2



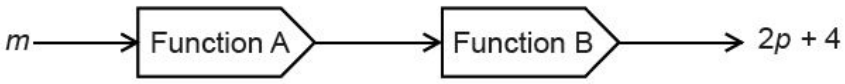
Examiner commentary

Correct inverse function, presented as a number machine. As in the algebraic presentation, *x* and *y* were allowed to be switched and diagrams that went from right-to-left were also accepted.

Diagrams showing the correct functions in the correct order but with *x* and *y* omitted scored 1 mark.

Question 14(c)

Here is a composite function.



Find an expression for m in terms of p.
Give your answer in its simplest form.

(c) $m =$ ..... [4]

Exemplar 1 – Mark(s): 4

$\frac{2(m+3)}{5} + 4 = 2p + 4$

$\frac{2m+6}{5} + 4 = 2p + 4$

$\frac{2m+6}{5} = 2p$

$\frac{2m+6}{5} = 2p$

$2m + 6 = 10p$

$2m = 10p - 6$

$m = 5p - 3$

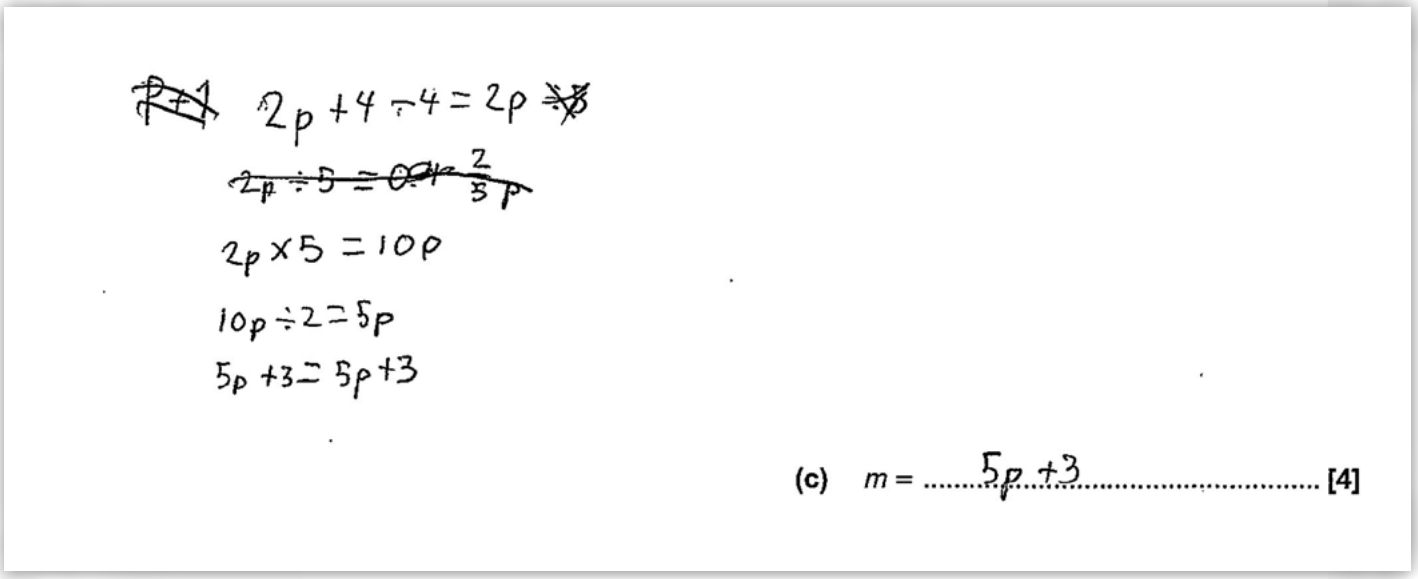
(c) $m =$ 5p - 3 [4]

Examiner commentary

This candidate has started from the input side. $2(m + 3)$ scores M1 and $\frac{2(m+3)}{5} + 4$ scores another M1. Equating to the output $2p + 4$ scores a third M1, and this is then correctly rearranged for the final mark.

Many basic algebraic errors were seen, such as $2m + 3$ rather than $2(m + 3)$.

Exemplar 2 – Mark(s): 3



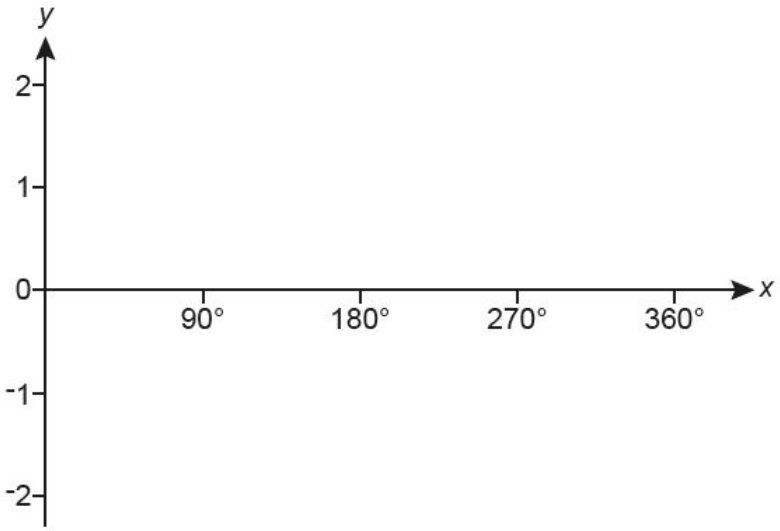
Examiner commentary

This candidate has started from the output side. They correctly perform the inverse of + 4 (for M1), the inverse of ÷ 5 (for M1), the inverse of × 2 (for M1) but make an error with the inverse of + 3, so 3 marks.

Many candidates were unable to use the correct inverse at each stage or had them in the wrong order.

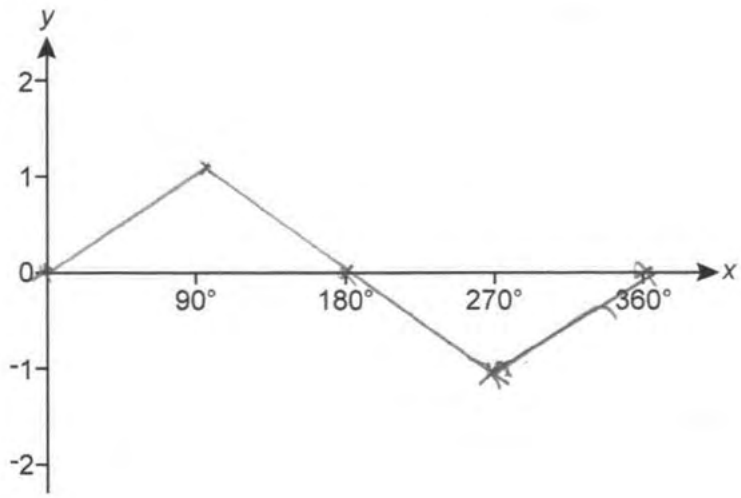
Question 15(a)

Sketch the graph of $y = \sin x$ for $0° \leqslant x \leqslant 360°$.



[2]

Mark(s): 1



[2]

Examiner commentary

Many candidates demonstrated some knowledge of the shape of the graph.

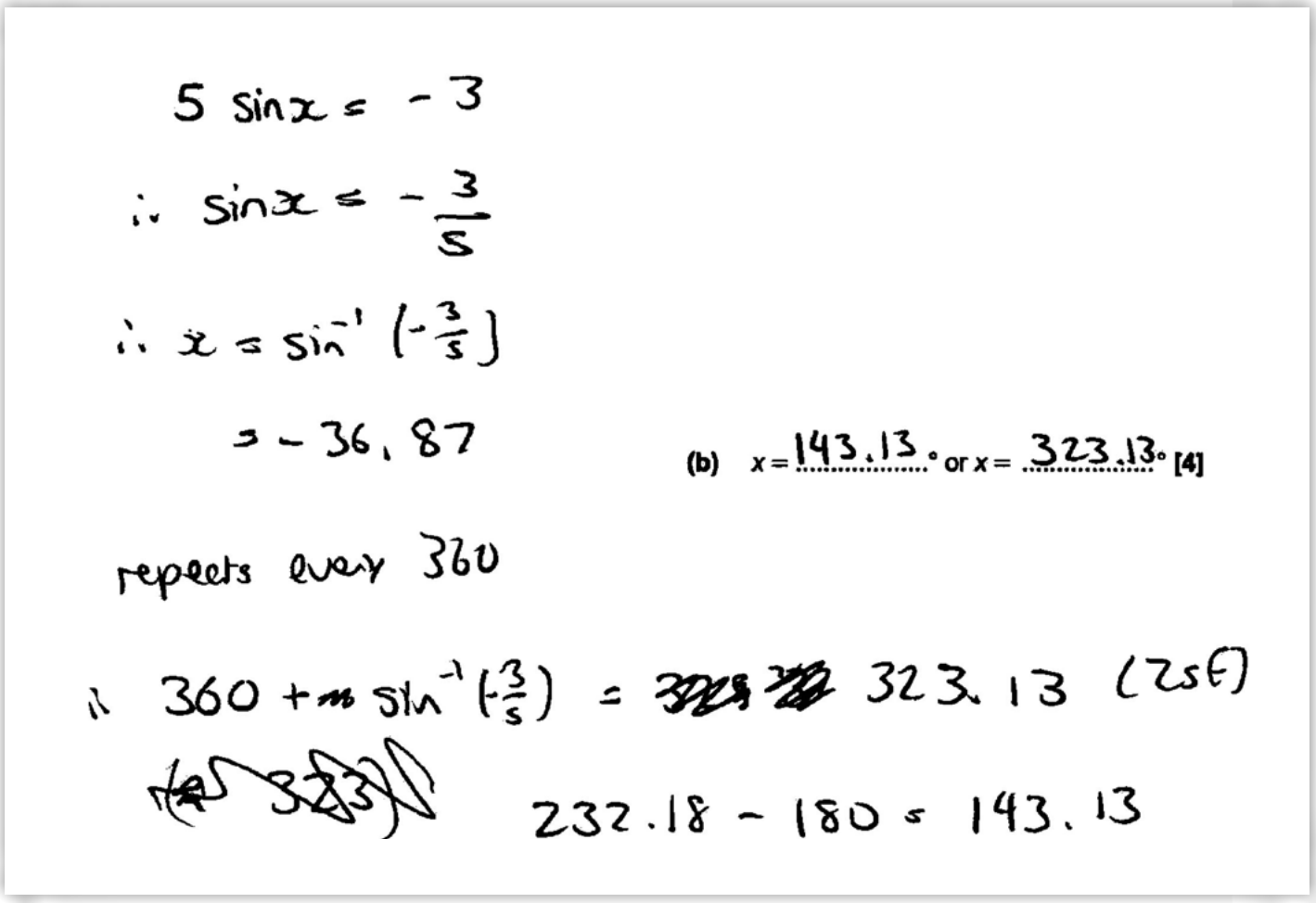
For full marks, the graph needed to have its maximum and minimum within the overlay provided to examiners. There were a few instance of ruled graphs, such as here, and these were awarded 1 mark. Sine curves starting at (0, 0) but of the wrong period were also awarded 1 mark. Curves starting at (0, 1) did not score.

Question 15(b)

Solve the equation $5 \sin x = -3$.
Give all of the solutions in the range $0° \leqslant x \leqslant 360°$.

(b) $x =$ .....° or $x =$ .....° [4]

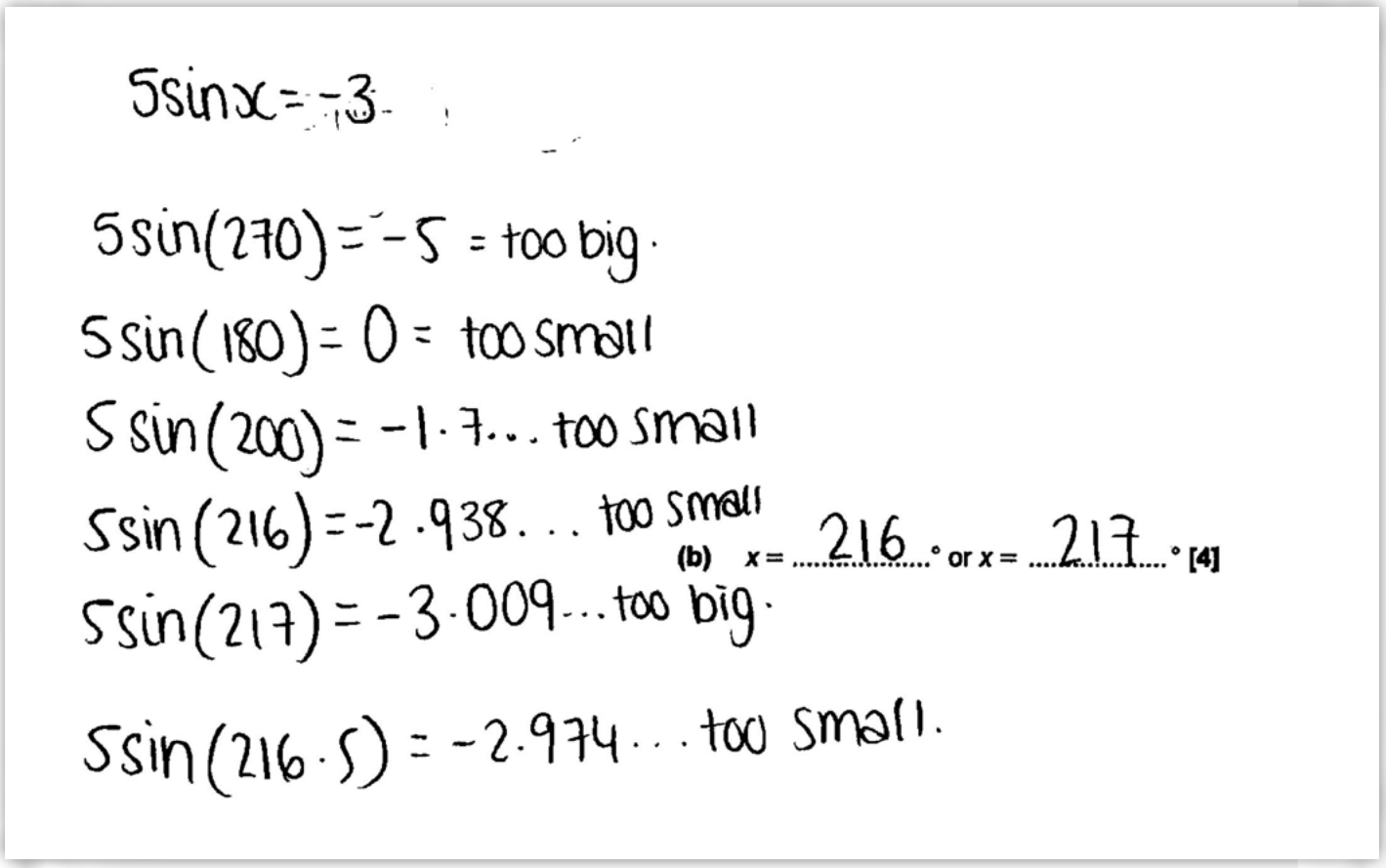
Exemplar 1 – Mark(s): 3



Examiner commentary

The candidate has used formal methods leading to one correct angle which scores B3. If the angle had been incorrect, their working would have scored M2 for -36.87. Failing that, there would have been M1 for $\sin x = -\frac{3}{5}$.

Exemplar 2 – Mark(s): 3



Examiner commentary

Formal methods for solving the trigonometric equation were not required. Here the candidate has used a trial and improvement approach leading to one correct angle for 3 marks. Their answers are lower and upper bounds of one of the angles. It was very rare for a candidate using trial and improvement to obtain both correct angles.

Question 16(b)

Write as a single fraction in its simplest form.

$$\frac{3}{x-1}+\frac{4}{x+2}$$

(b) ..... [3]

Mark(s): 2

(b) Write as a single fraction in its simplest form.

$\frac{3}{x-1} \times \frac{4}{x+2}$

$$\frac{3x+6+4x-4}{x^2-1x+2x-2}$$

$$\frac{7x-2}{x^2+x-2}$$

(b) $\frac{7x-2}{x^2+x-2}$ [3]

Examiner commentary

Despite the error in the final answer, there is 1 mark for the numerator working. This would have been awarded even if the brackets had not been expanded. Similarly, 1 mark for the denominator.

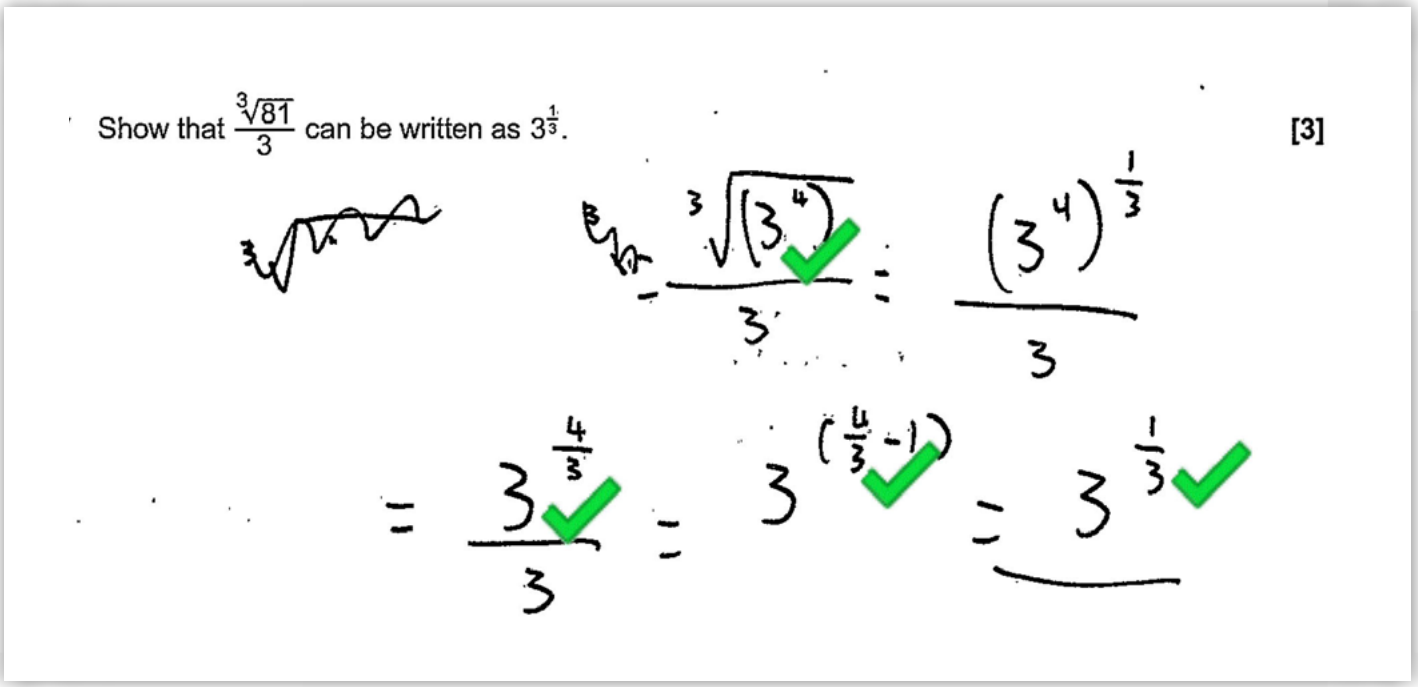
The numerator should be simplified, which is where the error occurs. It was an unnecessary risk to expand the denominator as it would have already been in its simplest form.

The candidate also took a chance in performing their expansions without writing down the initial expressions; had they made a mistake in an expansion they would have lost the mark.

Question 17

Show that $\frac{\sqrt[3]{81}}{3}$ can be written as $3^{\frac{1}{3}}$. [3]

Exemplar 1 – Mark(s): 3



Examiner commentary

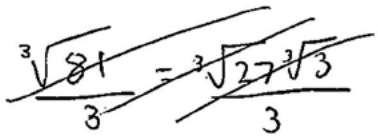
Not many candidates made progress with this question. Any candidate who switched to decimals almost certainly scored zero.

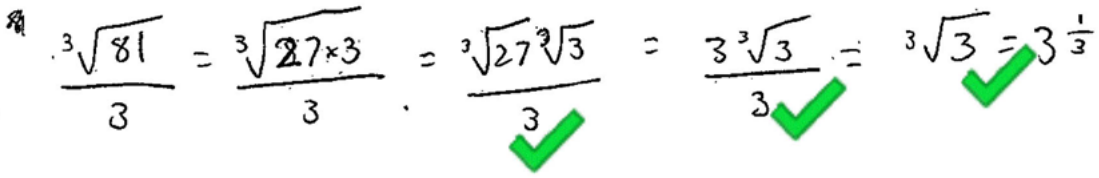
This example shows one of a number of possible methods, and scored full marks.

The mark scheme needed to cater for all methods. A correct and productive first step was required for the award of the first M1, a correct second productive step was required for the second M1, and then convincing working, rather than a big jump, to finish off for the final mark. There was no follow through allowed.

Exemplar 2 – Mark(s): 3

Show that $\frac{\sqrt[3]{81}}{3}$ can be written as $3^{\frac{1}{3}}$. [3]



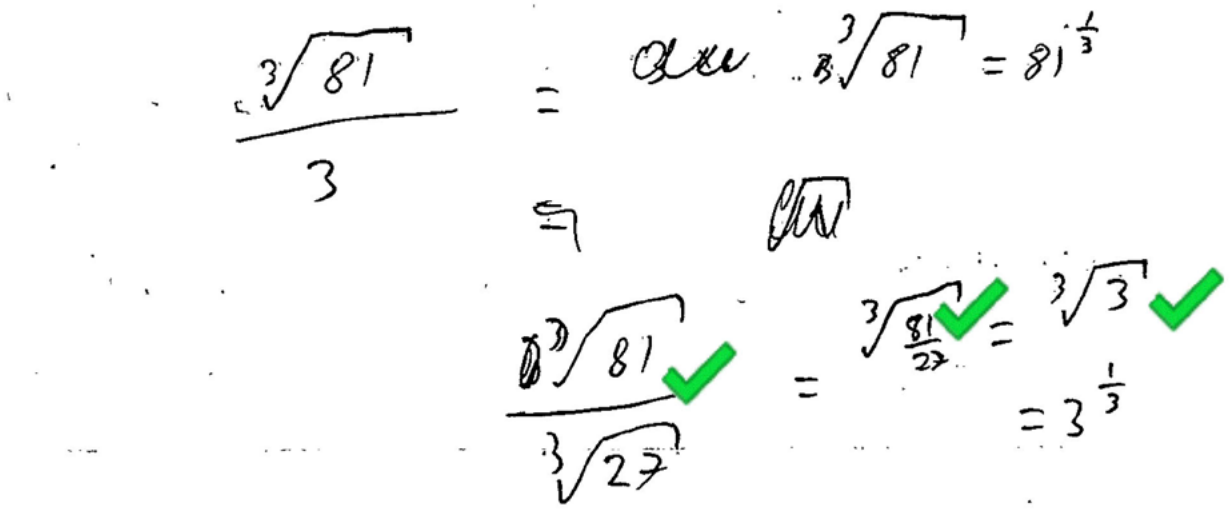


Examiner commentary

This example shows another possible method. There is a correct and productive first step for the award of the first M1, a correct second productive step for the second M1, and then convincing working to finish off.

Exemplar 3 – Mark(s): 3

Show that $\frac{\sqrt[3]{81}}{3}$ can be written as $3^{\frac{1}{3}}$. [3]



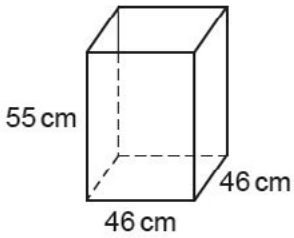
Examiner commentary

This example shows another possible method. There is a correct and productive first step for the award of the first M1 (the left-hand tick), a correct second productive step for the second M1, and then convincing working to finish off.

The working at the top is merely a re-write in different notation and was deemed to be insufficient for a "productive first step"; they needed to do something with the 81 or, as in this example, with the 3.

Question 18(a)

Alvin has a crate in the shape of a cuboid.
The crate is open at the top.
The internal dimensions of the crate are 46 cm long by 46 cm wide by 55 cm high.



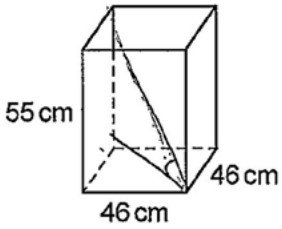
Alvin has a stick of length 95 cm.
Alvin places the stick in the crate so that the shortest possible length extends out above the top of the crate.

(a) Calculate the length of the stick that extends out of the crate.

(a) ..... cm **[4]**

Exemplar 1 – Mark(s): 4

18 Alvin has a crate in the shape of a cuboid.
The crate is open at the top.
The internal dimensions of the crate are 46 cm long by 46 cm wide by 55 cm high.



Alvin has a stick of length 95 cm.
Alvin places the stick in the crate so that the shortest possible length extends out above the top of the crate.

(a) Calculate the length of the stick that extends out of the crate.

$\sqrt{46^2+46^2} = 46\sqrt{2}$

$\sqrt{55^2+46\sqrt{2}^2} = 85.2\text{cm}.$

$95-85.2 = 9.81\text{cm}.$

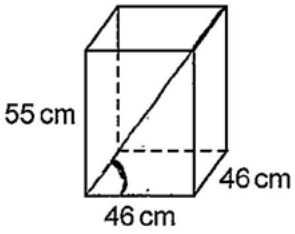
(a) 9.81 cm **[4]**

Examiner commentary

The candidate has performed 3D Pythagoras in two steps to get a correct answer and score 4 marks. They have used their calculator appropriately to maintain accuracy, whereas some candidates using a similar method rounded their interim answer and thus were inaccurate at the end.

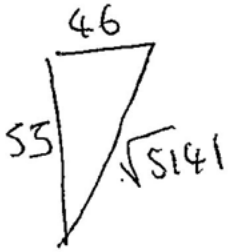
Exemplar 2 – Mark(s): 2

18 Alvin has a crate in the shape of a cuboid.
The crate is open at the top.
The internal dimensions of the crate are 46 cm long by 46 cm wide by 55 cm high.



Alvin has a stick of length 95 cm.
Alvin places the stick in the crate so that the shortest possible length extends out above the top of the crate.

(a) Calculate the length of the stick that extends out of the crate.



$55^2 + 46^2 = \sqrt{5141}$

$95 - \sqrt{5141} = 23.3$

(a) 23.3 cm **[4]**

Examiner commentary

Candidates who merely performed 2D Pythagoras could score a maximum of 2 marks. They were also very unlikely to score in part (b) because they were working with a wrong triangle and hence finding an incorrect angle, as shown here in both the diagram and their sketched triangle.

Question 18(b)

Calculate the angle the stick makes with the base of the crate.

(b) ..... ° [3]

Exemplar 1 – Mark(s): 3

(b) Calculate the angle the stick makes with the base of the crate.

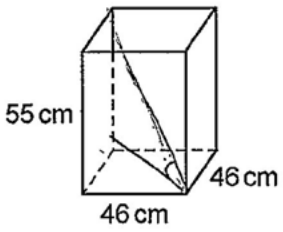
$\tan\theta = \frac{opp}{adj}$

$= \frac{55}{46\sqrt{2}}$

$= 0.85$

$\tan^{-1}(0.85) = 40.2°$

(b) 40.2 ° [3]



Examiner commentary

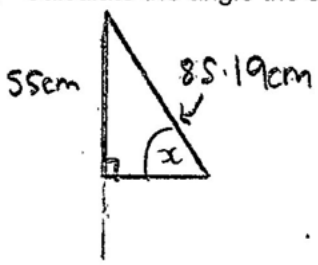
Candidates who answered (a) correctly were usually correct in (b).

This candidate has used $\tan^{-1}$ and calculated a correct answer for full marks. The use of $\sin^{-1}$ and $\cos^{-1}$, along with a hypotenuse of 85.1… from their part (a) working, were also common in other candidates' responses.

If the trigonometry here had been incorrect, this candidate would have scored M1 for indicating the correct angle on the diagram.

Exemplar 2 – Mark(s): 1

(b) Calculate the angle the stick makes with the base of the crate.



(b) ..... ° **[3]**

Examiner commentary

There is no trigonometry but the candidate's sketch shows the correct dimensions, triangle and angle, thus scoring M1.

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