



Cambridge Assessment
International Education

Example Candidate Responses – Paper 4

Cambridge IGCSE / IGCSE (9-1)

Mathematics 0580 / 0980

For examination from 2020



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Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE / IGCSE (9-1) Mathematics 0580 / 0980, and to show how different levels of candidates' performance (high, middle and low) relate to the subject's curriculum and assessment objectives.

In this booklet, candidate responses have been chosen from the November 2020 series to exemplify a range of answers.

For each question, the response is annotated with a clear explanation of where and why marks were awarded or omitted. This is followed by examiner comments on how the answer could have been improved. In this way, it is possible for you to understand what candidates have done to gain their marks and what they could do to improve their answers. There is also a list of common mistakes candidates made in their answers for each question.

This document provides illustrative examples of candidate work with examiner commentary. These help teachers to assess the standard required to achieve marks beyond the guidance of the mark scheme. Therefore, in some circumstances, such as where exact answers are required, there will not be much comment

The questions and mark schemes used here are available to download from the School Support Hub. These files are:

0580 November 2020 Question Paper 42

0580 November 2020 Mark Scheme 42

Past exam resources and other teaching and learning resources are available on the School Support Hub:

www.cambridgeinternational.org/support

How to use this booklet

This booklet goes through the paper one question at a time, showing you the high-, middle- and low-level response for each question. The candidate answers are set in a table. In the left-hand column are the candidate answers, and in the right-hand column are the examiner comments.

Example Candidate Response – low	Examiner comments
<p>(a) Use the cumulative frequency diagram to find an estimate of</p> <p>(i) the median, ① 25 cm [1]</p> <p>(ii) the interquartile range, ② $(25-10) \times 2$ 25 30 cm [2]</p> <p>(iii) the 60th percentile, ③ 30 cm [1]</p> <p>(iv) the number of plants with a height greater than 40 cm. ④ 18 [2]</p>	<p>① The candidate gives a correct answer for one mark. Mark for (a)(i) = 1 out of 1</p> <p>② The candidate's answer of 30 is incorrect and there is no evidence of the quartiles being considered. Mark for (a)(ii) = 0 out of 2</p> <p>③ The candidate reads the height that corresponds to a</p>
<p>Answers are by real candidates in exam conditions. These show you the types of answers for each level. Discuss and analyse the answers with your learners in the classroom to improve their skills.</p>	<p>Examiner comments are alongside the answers. These explain where and why marks were awarded. This helps you to interpret the standard of Cambridge exams so you can help your learners to refine their exam technique.</p>

How the candidate could have improved their answer

- **(a)(ii)** Either in the working or annotation on the graph, the candidate needed to find the lower quartile and upper quartile in order to find the interquartile range.
- **(a)(iii)** In order to find the 60th percentile, 60% of 120 must be found first before reading off the height that corresponds to the cumulative frequency of 72.
- **(b)(i)** Having found the mid-interval values, the candidate should have found an estimate of the total.
- **(b)(ii)** The candidate should have considered finding the point.

This section explains how the candidate could have improved each answer. This helps you to interpret the standard of Cambridge exams and helps your learners to refine their exam technique.

Common mistakes candidates made in this question

- **(a)(i)** An occasional incorrect answer of 60 was seen.
- **(a)(ii)** A very small number of candidates gave an answer of 60, presumably coming from 90–30 and a similar number gave one of the two quartiles as the final answer.
- **(a)(iii)** A common error was to give an answer of 25 by using a value of 60 on the cumulative axis. Others did calculate the correct value to use when working out 60% of 120.

Often candidates were not awarded marks because they misread or misinterpreted the questions.

Lists the common mistakes candidates made in answering each question. This will help your learners to avoid these mistakes and give them the best chance of achieving the available marks.

Question 1

Example Candidate Response – high

Examiner comments

1 Karel travelled from London to Johannesburg and then from Johannesburg to Windhoek.

- (a) The flight from London to Johannesburg took 11 hours 10 minutes.
The average speed was 813 km/h.

Calculate the distance travelled from London to Johannesburg.
Give your answer correct to the nearest 10 km.

$$\text{distance} = \text{speed} \times \text{time}$$

$$= 813 \text{ km/h} \times 11 \frac{10}{60} \text{ hours}$$

$$= 9078.5 \text{ km}$$

$$\approx 9080 \text{ km}$$

..... 9080 km [3]

- (b) The total time for Karel's journey from London to Windhoek was 15 hours 42 minutes.
The total distance travelled from London to Windhoek was 10260 km.

(i) Calculate the average speed for this journey.

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

$$\frac{10260 \text{ km}}{15.7 \text{ hours}} = 653.5 \text{ km/h}$$

$$\frac{42 \text{ min}}{60 \text{ min}} = 0.7 \text{ hours}$$

..... 653.5 km/h [2]

- (ii) The cost of Karel's journey from London to Windhoek was \$470.

(a) Calculate the distance travelled per dollar.

$$\frac{10260 \text{ km}}{\$470} \approx 21.83$$

$$\approx 21.8$$

..... 21.8 km per dollar [1]

(b) Calculate the cost per 100 km of this journey.
Give your answer correct to the nearest cent.

$$\begin{array}{l} \text{distance : cost} \\ 21.8 \text{ km : } \$1 \\ 100 \text{ km : } ? \end{array}$$

$$100 \text{ km} \times \$1 \div 21.8 \text{ km} \approx 4.587$$

\$ 4.59 per 100 km [2]

- (c) Karel changed \$300 into 3891 Namibian dollars.

Complete the statement.

$$3891 \div 300 =$$

\$1 = 12.97 Namibian dollars [1]

1 The candidate shows a correct method converting the time in hours and minutes into hours before multiplying by the speed. The more accurate answer of 9078.5 is shown before being rounded correctly to the nearest 10 km as requested in the final line of the question. Mark for (a) = 3 out of 3

2 The candidate correctly converts the time in hours and minutes into hours before the division to calculate the speed. The answer is given to at least 3 significant figures. Mark for (b)(i) = 2 out of 2

3 The candidate gives a correct answer for one mark. Examiners will mark the answer at the most accurate value given which is 21.83 and within the range given on the mark scheme. Mark for (b)(ii)(a) = 1 out of 1

4 The candidate uses a correct method to give a value of 4.587. In this case, they are asked to round to the nearest cent. The mark scheme refers to cao which is 'correct answer only' and the answer 4.59 is awarded both marks. Mark for (b)(ii)(b) = 2 out of 2

5 The candidate gives the correct answer of 12.97 which is awarded the mark. Mark for (c) = 1 out of 1

Total mark awarded = 9 out of 9

How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

1 Karel travelled from London to Johannesburg and then from Johannesburg to Windhoek.

- (a) The flight from London to Johannesburg took 11 hours 10 minutes.
The average speed was 813 km/h.

Calculate the distance travelled from London to Johannesburg.
Give your answer correct to the nearest 10 km.

$$D = S \times T$$

$$11 \text{ h } 10 \text{ mins} = 11.167 \text{ h}$$

$$813 \times 11.167 = 9078.771$$

$$\approx 9080$$

.....9080..... km [3]

1 The candidate gives a correct answer of 9080 supported by a correct method and supplies a more accurate value of 9078.771. Mark for (a) = 3 out of 3

- (b) The total time for Karel's journey from London to Windhoek was 15 hours 42 minutes.
The total distance travelled from London to Windhoek was 10260 km.

(i) Calculate the average speed for this journey.

$$10260 - 9080$$

$$= 1180 \text{ km (Jhn to Windhoek)}$$

$$\text{Time} = 15 \text{ h } 42 \text{ m.}$$

$$\frac{11 \text{ h } 10 \text{ m}}{4 \text{ h } 32 \text{ m.}}$$

.....260.5..... km/h [2]

2 The candidate misunderstands the question and relates it to (a), instead of using the information given in the question. Mark for (b)(i) = 0 out of 2

$$S = \frac{D}{T} \quad \frac{1180}{4.53} = 260.5 \text{ km/h.}$$

- (ii) The cost of Karel's journey from London to Windhoek was \$470.

(a) Calculate the distance travelled per dollar.

$$\frac{10260}{470} = 21.8$$

.....21.8..... km per dollar [1]

3 The candidate gives a correct answer for one mark. Mark for (b)(ii)(a) = 1 out of 1

(b) Calculate the cost per 100 km of this journey.
Give your answer correct to the nearest cent.

$$\frac{100}{21.8} = 4.587$$

$$4.59$$

\$4.60..... per 100 km [2]

4 The candidate shows a correct method and gives an acceptable intermediate value of 4.587. They round to the nearest 10 cents rather than the nearest cent and consequently are awarded one mark. Mark for (b)(ii)(b) = 1 out of 2

- (c) Karel changed \$300 into 3891 Namibian dollars.

Complete the statement.

$$\$1 = \dots\dots\dots 12.97 \dots\dots\dots \text{ Namibian dollars}$$

[1]

5 The candidate gives a correct answer which is awarded one mark. Mark for (c) = 1 out of 1

Total mark awarded = 6 out of 9

How the candidate could have improved their answer

- The candidate needed to read the demand of the question carefully.
- (b)(i) They needed to find the average speed for the entire journey instead of the London to Windhoek leg.
- (b)(ii)(a) They needed to give the answer to the required accuracy.

Example Candidate Response – low

Examiner comments

1 Karel travelled from London to Johannesburg and then from Johannesburg to Windhoek.

- (a) The flight from London to Johannesburg took 11 hours 10 minutes.
The average speed was 813 km/h.

Calculate the distance travelled from London to Johannesburg.
Give your answer correct to the nearest 10 km.

$$\begin{aligned} \text{speed} &= 813 \text{ km/h} \\ \text{time taken} &= 11 \text{ hours } 10 \text{ minutes} \\ \text{distance} &= ? \end{aligned}$$

$$\text{distance} = \text{speed} \times \text{time}$$

$$= 813 \times 11.10$$

$$= 9024.3 \quad 1$$

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

..... 9000 km [3]

1 The candidate uses 11.10 as the time in hours which results in an inaccurate answer. The working is awarded one mark for $813 \times$ their 11 hours 10 mins.
Mark for (a) = 1 out of 3

- (b) The total time for Karel's journey from London to Windhoek was 15 hours 42 minutes.
The total distance travelled from London to Windhoek was 10260 km.

(i) Calculate the average speed for this journey.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$= \frac{10260}{15.42}$$

$$= 665.3 \quad 2$$

..... 665.3 km/h [2]

2 There is an incorrect time conversion of 15 hours 42 minutes to 15.42 hours. The answer is incorrect as a result, but a mark is awarded for the intention to divide by 15 hrs 42 mins.
Mark for (b)(i) = 1 out of 2

- (ii) The cost of Karel's journey from London to Windhoek was \$470.

(a) Calculate the distance travelled per dollar.

$$= \frac{665.3}{470}$$

$$= 1.41 \quad 3$$

..... 1.41 km per dollar [1]

3 The candidate has used their average speed from London to Windhoek instead of the total distance.
Mark for (b)(ii)(a) = 0 out of 1

(b) Calculate the cost per 100 km of this journey.
Give your answer correct to the nearest cent.

$$1 : 1.41 \quad \frac{100}{1.41} = x \quad 4$$

$$x : 100$$

$$\$ 70.9 \quad \text{per 100 km [2]}$$

4 The answer is incorrect, but the method follows through from their previous answer and a mark is awarded for 100 divided by their previous answer. The mark scheme does not allow a second mark for this part.
Mark for (b)(ii)(b) = 1 out of 2

- (c) Karel changed \$300 into 3891 Namibian dollars.

Complete the statement.

$$\begin{aligned} \$ 300 &= 3891 \text{ N\$} \\ 1 &= x \quad \frac{3891}{300} = x \quad 5 \end{aligned}$$

\$1 = 12.97 Namibian dollars [1]

5 This is a correct answer and is awarded one mark.
Mark for (c) = 1 out of 1

Total mark awarded = 4 out of 9

How the candidate could have improved their answer

The issue preventing more marks being awarded was in converting the time in hours and minutes to hours. The candidate needed to convert time correctly or to use the calculator function key for hours and minutes when entering the time.

Common mistakes candidates made in this question

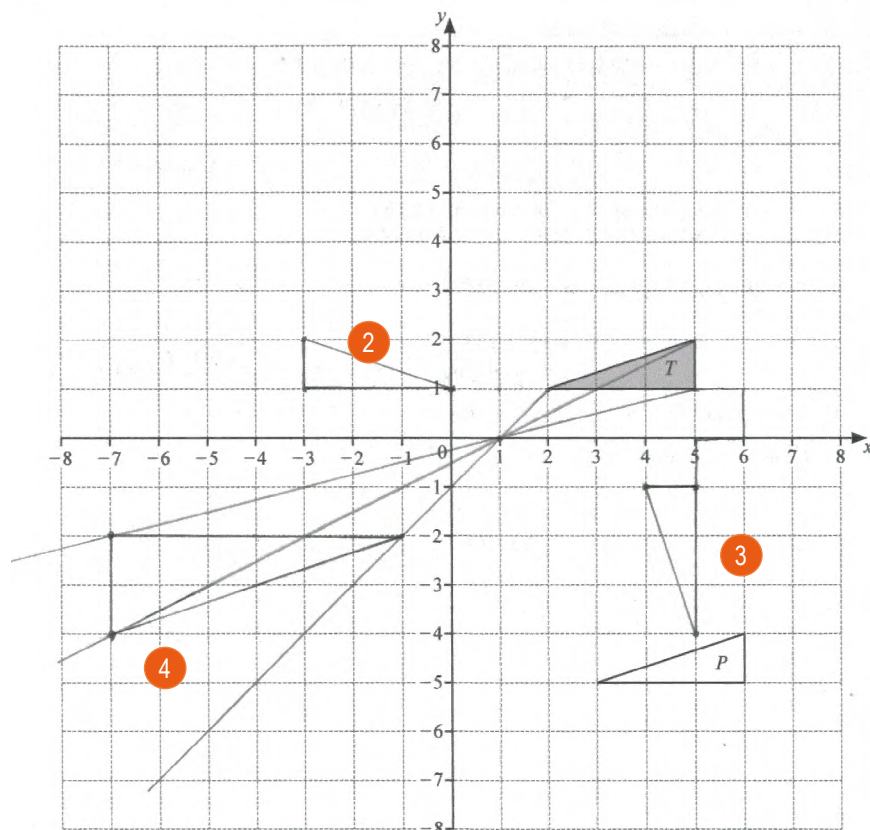
- **(a)** Some candidates did not convert the 10 minutes into hours correctly and multiplied by 11.1, for example. A few candidates multiplied by 670 minutes but did not always divide by 60. Those who obtained a correct value for the distance did not always round it to the nearest 10km, giving a final answer such as 9078.5, 9079 or 9080.0.
- **(b)(i)** Common errors seen included incorrect conversion of the 42 minutes into hours e.g. 15.42 or using 942 minutes and obtaining a flight speed of 10.9km/h. A minority of candidates used $time \times distance$ or $\frac{time}{distance}$.
- **(b)(ii)(a)** Common errors seen included calculating $470 \div 10260$ which gave only 46 metres travelled per dollar. A number of candidates did not read the question carefully and used the wrong distance, either from **(a)** or adding the distance from **(a)** to 10260.
- **(b)(ii)(b)** Common errors included incorrectly multiplying the previous part by 100 and answers not given to the nearest cent with 4.6 often seen, sometimes with no complete method step leading to this value.
- **(c)** The most common error was to give the answer 13 without a more accurate value shown.

Question 2

Example Candidate Response – high

Examiner comments

2



(a) Describe fully the **single** transformation that maps triangle T onto triangle P .

..... Translation by $\begin{pmatrix} 5 \\ -6 \end{pmatrix}$

1

[2]

(b) (i) Reflect triangle T in the line $x = 1$.

[2]

(ii) Rotate triangle T through 90° anticlockwise about $(6, 0)$.

[2]

(iii) Enlarge triangle T by a scale factor of -2 , centre $(1, 0)$.

[2]

1 The candidate gives the correct answer using the correct terminology and vector notation. Mark for (a) = 2 out of 2

2 The candidate correctly reflects triangle T in the line $x = 1$. Mark for (b)(i) = 2 out of 2

3 The candidate correctly rotates triangle T by 90° anticlockwise around the point $(6, 0)$. Mark for (b)(ii) = 2 out of 2

4 The candidate correctly enlarges triangle T by scale factor -2 and centre of enlargement $(1, 0)$. Here, they use the 'ray' method. Other candidates correctly used other methods such as counting squares from the centre. Mark for (b)(iii) = 2 out of 2

Total mark awarded = 8 out of 8

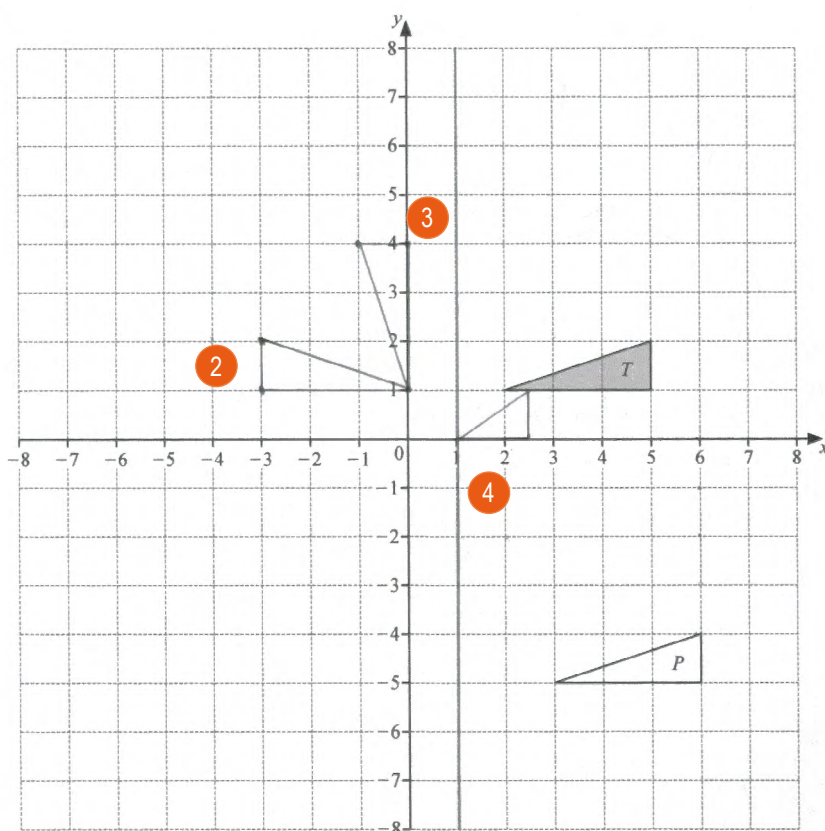
How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

2



(a) Describe fully the **single** transformation that maps triangle *T* onto triangle *P*.

~~Translate 1, 6~~ H's translate 1, 6 1

..... [2]

(b) (i) Reflect triangle *T* in the line $x = 1$. [2]

(ii) Rotate triangle *T* through 90° anticlockwise about $(6, 0)$. [2]

(iii) Enlarge triangle *T* by a scale factor of -2 , centre $(1, 0)$. [2]

1 The candidate is awarded one mark for the term translate. The description of the translation is not acceptable and is incorrect. Mark for (a) = 1 out of 2

2 The candidate draws a correct reflection in $x = 1$. Mark for (b)(i) = 2 out of 2

3 The candidate rotates triangle *T* 90° anticlockwise around the centre $(1, 0)$ instead of $(6, 0)$ as asked for in the question. One mark is awarded, but to score both marks, the correct centre must be used. Mark for (b)(ii) = 1 out of 2

4 The candidate draws a smaller triangle with a vertex on $(1, 0)$ which is incorrect. The candidate should use $(1, 0)$ as the centre of enlargement and realise that a scale factor of -2 involves making the shape twice as big through the given centre. Mark for (b)(iii) = 0 out of 2

Total mark awarded = 4 out of 8

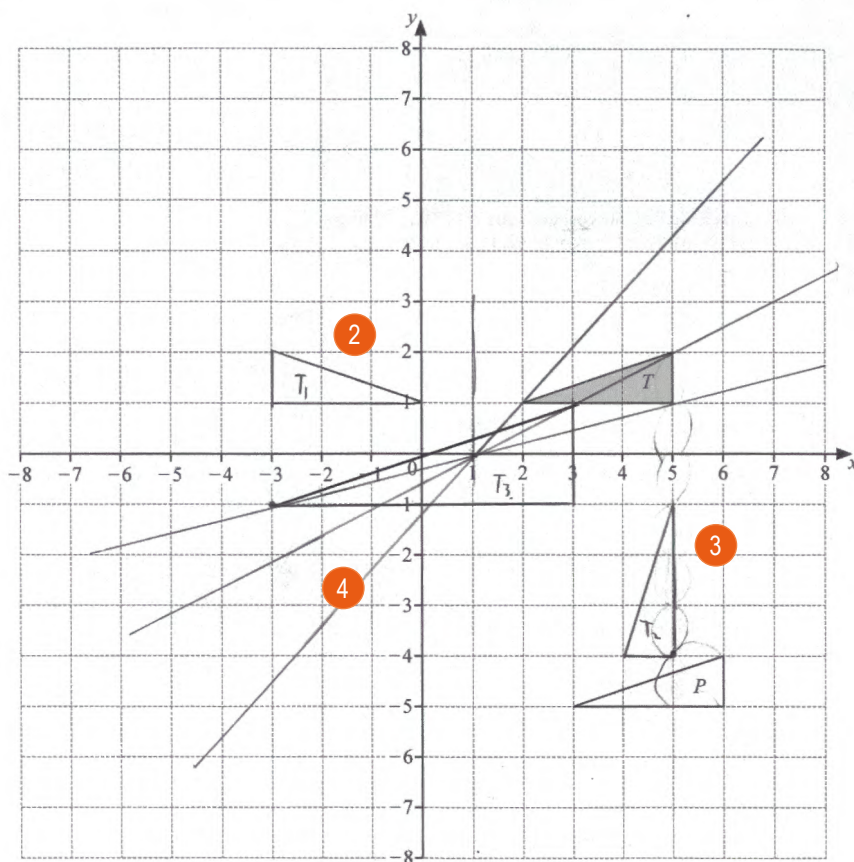
How the candidate could have improved their answer

- (a) The candidate should have used a vector or a clear worded description such as 1 square to the right and 6 squares down.
- (b) They should have used the given centre for drawing a rotation and they needed to understand the effects of enlargement by a negative scale factor from a given centre.

Example Candidate Response – low

Examiner comments

2



(a) Describe fully the **single** transformation that maps triangle T onto triangle P .

translation $\begin{pmatrix} -1 \\ 7 \end{pmatrix}$

1

(b) (i) Reflect triangle T in the line $x = 1$.

[2]

(ii) Rotate triangle T through 90° anticlockwise about $(6, 0)$.

[2]

(iii) Enlarge triangle T by a scale factor of -2 , centre $(1, 0)$.

[2]

1 The candidate correctly identifies the transformation as a translation, but the vector is incorrect so only one mark is awarded.

Mark for (a) = 1 out of 2

2 A correct reflection in $x = 1$ for two marks.

Mark for (b)(i) = 2 out of 2

3 The rotation is incorrect in orientation and position and is awarded no marks. Many candidates would use tracing paper to check the position of the rotation to avoid errors.

Mark for (b)(ii) = 0 out of 2

4 The enlargement is incorrect in orientation and position and no marks are awarded.

Mark for (b)(iii) = 0 out of 2

Total mark awarded = 3 out of 7

How the candidate could have improved their answer

- (a) To find the correct vector, the candidate could have focused on one vertex and counted the horizontal movement and vertical movement of the vertex to its image.
- (b) The candidate needed to demonstrate a better understanding of rotation around a given centre and needed to understand the effect of enlargement by a negative scale factor from a given centre.

Common mistakes candidates made in this question

- (a) Describing the translation as either a translocation or move, or giving the vector as a coordinate which is not acceptable.
- (b)(i) Reflecting the triangle in $x = 0$ or occasionally $y = 1$.
- (b)(ii) The most frequent errors were a rotation through 90° clockwise around $(6, 1)$ or to rotate 90° anticlockwise around an incorrect point.
- (b)(iii) The most common error was to use a scale factor of $\frac{1}{2}$ or $-\frac{1}{2}$.

Question 3

Example Candidate Response – high

Examiner comments

3 (a) Beth invests \$2000 at a rate of 2% per year compound interest.

(i) Calculate the value of this investment at the end of 5 years.

$$= 2000 \left(1 + \frac{2}{100}\right)^5$$

$$= 2208.161606 \quad \text{①}$$

$$\approx 2210 \quad \text{\$ } \dots\dots\dots 2210 \quad [2]$$

(ii) Calculate the overall percentage increase in the value of Beth's investment at the end of 5 years.

$$= \frac{2208.1616 - 2000}{2000} \times 100$$

$$= \frac{208.1616}{2000} \times 100 \quad \text{②}$$

$$= 10.4\% \quad \dots\dots\dots 10.4 \quad \% [2]$$

(iii) Calculate the minimum number of complete years it takes for the value of Beth's investment to increase from \$2000 to more than \$2500.

$$2500 < 2000 \left(1 + \frac{2}{100}\right)^n \quad \text{minimum years} = 12$$

$$\frac{2500}{2000} < \left(\frac{51}{50}\right)^n$$

$$1.25 < (1.02)^n \quad \text{③}$$

$$1.02^{11} < 1.02^n$$

$$11 < n$$

$$\dots\dots\dots 12 \quad [3]$$

(b) The population of a village decreases exponentially at a rate of 4% each year. The population is now 255.

Calculate the population 16 years ago.

$$255 = u \left(1 - \frac{4}{100}\right)^{16}$$

$$\frac{255}{\left(1 - \frac{4}{100}\right)^{16}} = u$$

$$\frac{255}{0.5204} = u \quad \text{④}$$

$$\dots\dots\dots 490 \quad [3]$$

① The candidate shows a correct method leading to the value 2208.16... which is in the acceptable range on the mark scheme. Examiners will mark the most accurate answer given. Mark for (a)(i) = 2 out of 2

② The candidate shows a correct method to calculate the overall percentage increase and gives an acceptable value of 10.4%. Mark for (a)(ii) = 2 out of 2

③ The candidate gives a correct answer of 12 and is awarded full marks. Mark for (a)(iii) = 3 out of 3

④ The candidate gives a correct answer which is fully supported by a correct method. The answer is given to an appropriate level of accuracy in this context. Mark for (b) = 3 out of 3

Total marks awarded = 10 out of 10

How the candidate could have improved their answer

(a)(iii) The candidate could have shown the full method leading to the answer 12, e.g. correct trials for 11 years and 12 years.

Example Candidate Response – middle

Examiner comments

3 (a) Beth invests \$2000 at a rate of 2% per year compound interest.

(i) Calculate the value of this investment at the end of 5 years.

$$2000 \left(1 + \frac{2}{100}\right)^5$$

$$= \cancel{2000} = 2208.16 \quad \text{\$ } 2208.16 \quad [2]$$

1 The candidate gives a correct answer, supported by correct working.
Mark for (a)(i) = 2 out of 2

(ii) Calculate the overall percentage increase in the value of Beth's investment at the end of 5 years.

$$\frac{2208.16 - 2000}{2000} \times 100\%$$

$$= 10.41 \quad 10.41 \quad \% [2]$$

2 Another correct answer is given, again supported by correct working.
Mark for (a)(ii) = 2 out of 2

(iii) Calculate the minimum number of complete years it takes for the value of Beth's investment to increase from \$2000 to more than \$2500.

Simple interest

$$2000 \times \frac{2}{100} \times 5 = 200 \text{ per year}$$

$$2208.16 - 2000 = 208.16 - 5 \text{ years}$$

$$+ 208.16 - 5 \text{ years} = 13 \text{ years}$$

$$416.32$$

$$83.264$$

$$416.32$$

$$541.216 > 500$$

$$1 \text{ year} = \frac{208.16}{5} = 41.632$$

10 years
2 years
1 year
13 years

13 [3]

3 The candidate is unable to set up a correct statement connecting \$2000 and \$2500 which is required in this question. The candidate incorrectly appears to scale up the interest from (a)(i) to make the extra \$500. No marks can be awarded.
Mark for (a)(iii) = 0 out of 3

(b) The population of a village decreases exponentially at a rate of 4% each year. The population is now 255.

Calculate the population 16 years ago.

$$255 \left(1 - \frac{4}{100}\right)^{16} = 255$$

$$432 \quad [3]$$

4 The candidate makes a correct statement in the first line of working and is awarded two marks. However the answer is incorrect.
Mark for (b) = 2 out of 3

Total mark awarded = 6 out of 10

How the candidate could have improved their answer

- (a)(iii) The candidate needed to make a correct mathematical statement using the compound growth of 2% from \$2000 to \$2500 as a starting point.
- (b) The candidate needed to show the full steps in the working from the initial statement to the final answer.

Example Candidate Response – low

Examiner comments

3 (a) Beth invests \$2000 at a rate of 2% per year compound interest.

(i) Calculate the value of this investment at the end of 5 years.

$$A = P\left(1 + \frac{r}{100}\right)^n$$

$$= 2000 \times \left(1 + \frac{2}{100}\right)^5$$

\$ 2208.16 [2] 1

(ii) Calculate the overall percentage increase in the value of Beth's investment at the end of 5 years.

$$= \frac{2208.16 - 2000}{2000} \times 100$$

9.42 % [2] 2

(iii) Calculate the minimum number of complete years it takes for the value of Beth's investment to increase from \$2000 to more than \$2500.

$$25 = 2000 \times \left(1 + \frac{2}{100}\right)^n$$

$$n = 2500$$

$$= \frac{2500 \times 5}{2208.16}$$

5.66 [3] 3

(b) The population of a village decreases exponentially at a rate of 4% each year. The population is now 255.

Calculate the population 16 years ago.

$$= 255 \times \frac{100}{96}$$

$$= 265.6$$

266 [3] 4

1 A correct answer in range with supporting working is awarded two marks.

Mark for (a)(i) = 2 out of 2

2 The answer is incorrect and here, the candidate has made a common error in not using the original value of 2000 in the denominator of the fraction in the working. The method is incorrect and no mark is awarded.

Mark for (a)(ii) = 0 out of 2

3 No mark is awarded as the method is incorrect.

Mark for (a)(iii) is 0 out of 3

4 The candidate has shown an incorrect method, calculating the population 1 year ago instead of 16 years ago. No marks are awarded.

Mark for (b) = 0 out of 3

Total mark awarded = 2 out of 10

How the candidate could have improved their answer

- **(a)(ii)** The original value of \$2000 should have been used in the denominator of the fraction.
- **(a)(iii)** The candidate needed to make a correct mathematical statement using the compound growth of 2% from \$2000 to \$2500 as a starting point.
- **(b)** The candidate needed to make a mathematical statement involving 255, 16 years and a decrease of 4% as a starting point, for example $P(1 - 0.04)^{16} = 255$ where P is the population 16 years ago. This enables the reverse process to be done to solve the problem.

Common mistakes candidates made in this question

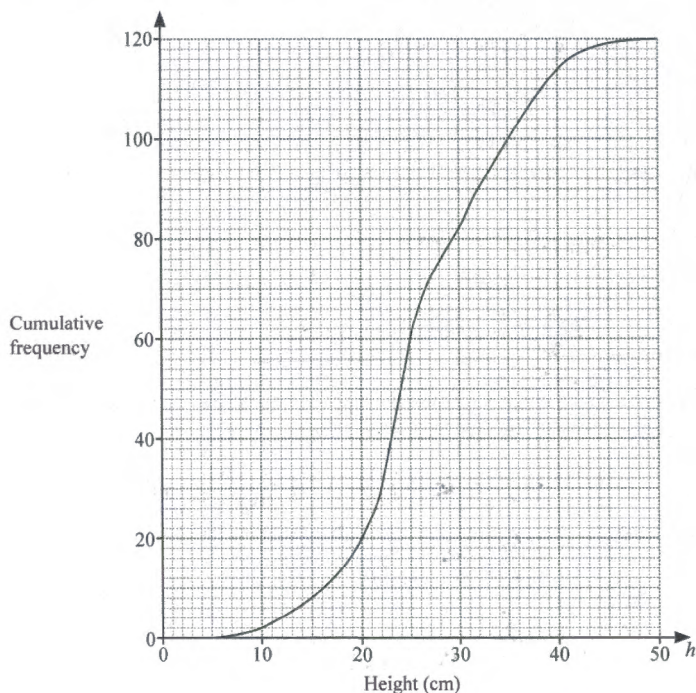
- **(a)(i)** Giving the interest as the final answer rather than the amount of the investment or using simple interest rather than compound interest.
- **(a)(ii)** A common error was to divide the increase by the answer to **(a)(i)**, rather than 2000.
- **(a)(iii)** A common error after a correct method had been shown was to give an answer of 11.3 rather than 12.
- **(b)** A common error was to use percentage increase $\left(1 + \frac{4}{100}\right)^{16}$. Another error was to use $255 \times \left(1 + \frac{4}{100}\right)^{16}$ rather than $P \times \left(1 + \frac{4}{100}\right)^{16} = 255$.

Question 4

Example Candidate Response – high

Examiner comments

- 4 The height, h cm, of each of 120 plants is measured.
The cumulative frequency diagram shows this information.



- (a) Use the cumulative frequency diagram to find an estimate of

- (i) the median,

$$\frac{120}{2} = 60$$

median = 25

..... 25 cm [1]

- (ii) the interquartile range,

$$\frac{1}{4} \times 120 = 30$$

$$\frac{3}{4} \times 120 = 90$$

$$\begin{array}{l} Q_1 = 22 \\ Q_3 = 32 \end{array} \quad \begin{array}{l} = 32 - 22 \\ = 10 \end{array}$$

1

..... 10 cm [2]

- (iii) the 60th percentile,

$$\frac{60}{100} \times 120 = 72$$

Ans = 27

..... 27 cm [1]

- (iv) the number of plants with a height greater than 40 cm.

$$= 120 - 114$$

$$= 6$$

..... 6 [2]

1 The candidate answers all 4 parts of (a) correctly and shows a correct supporting method in each case.

Mark for (a) = 6 out of 6

Example Candidate Response – high, continued

Examiner comments

(b) The information in the cumulative frequency diagram is shown in this frequency table.

Height, h cm	$0 < h \leq 10$	$10 < h \leq 20$	$20 < h \leq 30$	$30 < h \leq 50$
Frequency	2	18	62	38

(i) Calculate an estimate of the mean height.

Mid values = 5, 15, 25, 40

~~Mean = $5(2) + 15(18) + 62(25) + 40$~~

Mean = $\frac{5(2) + 15(18) + 25(62) + 40(38)}{120}$

= $\frac{3350}{120}$

= 27.916667

≈ 27.9 (3 s.f.)

~~27.9~~ cm [4]

(ii) A histogram is drawn to show the information in the frequency table. The height of the bar representing the interval $10 < h \leq 20$ is 7.2 cm.

Calculate the height of the bar representing the interval $30 < h \leq 50$.

$7.2 = \frac{18}{10} \times k$

$7.2 = 1.8 \times k$

$\frac{7.2}{1.8} = k$

$4 = k$

$h = \frac{38}{20} \times 4$

= 1.9×4

~~= 7.6~~

= 7.6 cm

..... cm [2]

2 The candidate shows a well-structured solution with all steps of working. They use mid-interval values leading to an accurate answer. Examiners will mark the answer at the value 27.916667 which is the most accurate value given.

Mark for (b)(i) = 4 out of 4

3 The candidate gives a correct answer using the correct frequency density and 'scaling factor' of 4 for the height of the bar.

Mark for (b)(ii) = 2 out of 2

Total mark awarded = 12 out of 12

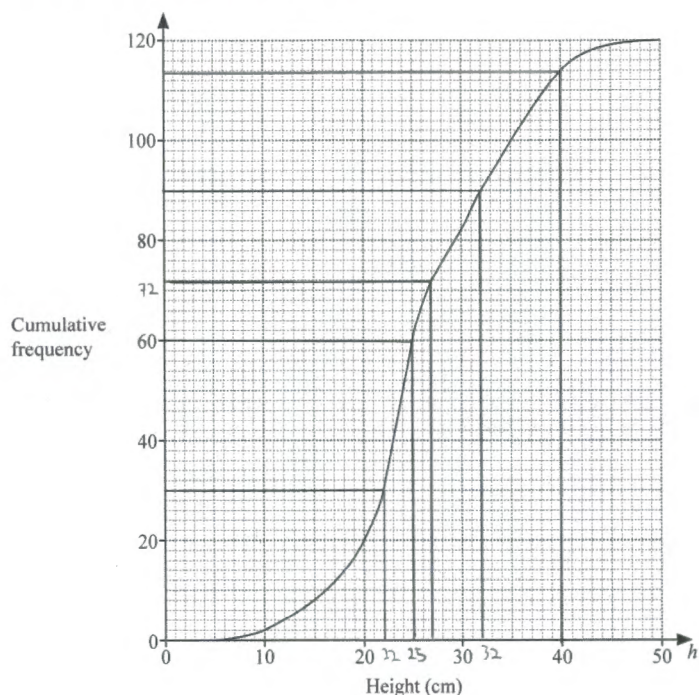
How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

- 4 The height, h cm, of each of 120 plants is measured.
The cumulative frequency diagram shows this information.



(a) Use the cumulative frequency diagram to find an estimate of

- (i) the median,

..... 25 cm [1]

- (ii) the interquartile range,

..... 10 cm [2]

- (iii) the 60th percentile,

..... 27 cm [1]

- (iv) the number of plants with a height greater than 40 cm.

..... 6 [2]

1 The candidate gives all 4 solutions in (a) correctly. Some annotation is given on the graph to support the interquartile range in (ii) and importantly the written quartiles are correct.
Mark for (a) = 6 out of 6

Example Candidate Response – middle, continued

Examiner comments

(b) The information in the cumulative frequency diagram is shown in this frequency table.

	5	15	25	40
Height, h cm	$0 < h \leq 10$	$10 < h \leq 20$	$20 < h \leq 30$	$30 < h \leq 50$
Frequency	2	18	62	38

(i) Calculate an estimate of the mean height.

$$\begin{aligned}
 & 2 \times 5 + 18 \times 15 + 62 \times 25 + 38 \times 40 \\
 & = 10 + 270 + 1550 + 1520 \\
 & = \frac{3350}{150}
 \end{aligned}$$

2

..... 22.3 cm [4]

(ii) A histogram is drawn to show the information in the frequency table. The height of the bar representing the interval $10 < h \leq 20$ is 7.2 cm.

Calculate the height of the bar representing the interval $30 < h \leq 50$.

$$\begin{aligned}
 \frac{7.2}{18} &= \frac{x}{38} \\
 18x &= \\
 x &= 15.2
 \end{aligned}$$

3

..... 15.2 cm [2]

2 In the first line of the working, the candidate shows the sum of the products of the mid-interval values with the frequencies. These are all correct and two marks are awarded. In the third line of working, the sum is divided by 150 which is the incorrect total frequency, and this is not awarded the mark. Mark for (b)(i) = 2 out of 4

3 The candidate does not consider the different widths of the classes and the frequency densities. An incorrect answer and no marks are awarded. Mark for (b)(ii) = 0 out of 2

Total mark awarded = 8 out of 12

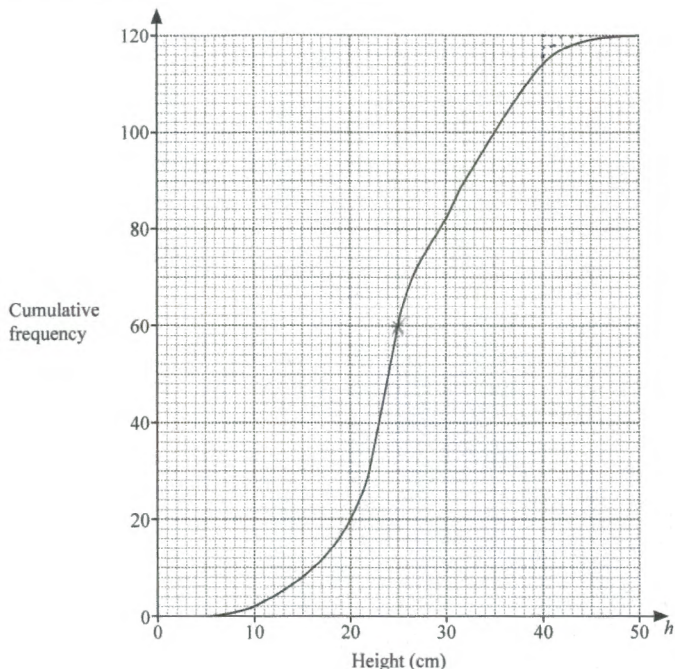
How the candidate could have improved their answer

- (b)(i) The candidate needed to take greater care when reading the question. The total frequency of 120 is given in the question but the candidate divided by 150 when finding the mean.
- (b)(ii) The candidate should have considered finding the frequency density for the class $30 < h \leq 50$ as a starting point.

Example Candidate Response – low

Examiner comments

- 4 The height, h cm, of each of 120 plants is measured.
The cumulative frequency diagram shows this information.



(a) Use the cumulative frequency diagram to find an estimate of

- (i) the median,

..... 25 cm [1]

- (ii) the interquartile range,

$$(25-10) \times 2$$

..... ~~75~~ 30 cm [2]

- (iii) the 60th percentile,

..... 30 cm [1]

- (iv) the number of plants with a height greater than 40 cm.

..... ~~4~~ 18 [2]

1 The candidate gives a correct answer for one mark.
Mark for (a)(i) = 1 out of 1

2 The candidate's answer of 30 is incorrect and there is no evidence of the quartiles being considered.
Mark for (a)(ii) = 0 out of 2

3 The candidate reads the height that corresponds to a cumulative frequency of 60 leading to an incorrect answer.
Mark for (a)(iii) = 0 out of 1

4 The candidate supplies an incorrect answer and, in the working, there is no reference to 114 so no marks are awarded. In order to find the answer, the starting point is to read the cumulative frequency that corresponds to a height of 40 cm on the graph.
Mark for (a)(iv) = 0 out of 2

Example Candidate Response – low, continued

Examiner comments

(b) The information in the cumulative frequency diagram is shown in this frequency table.

Height, h cm	$0 < h \leq 10$	$10 < h \leq 20$	$20 < h \leq 30$	$30 < h \leq 50$
Frequency	2	18	62	38

(i) Calculate an estimate of the mean height.

$$2 + 18 + 62 + 38 = 120$$

5

$$\frac{120}{4} = 30$$

$$5 + 15 + 25 + 40 = 85$$

$$\frac{85}{4} = 21.25$$

..... 21.25 cm [4]

(ii) A histogram is drawn to show the information in the frequency table. The height of the bar representing the interval $10 < h \leq 20$ is 7.2 cm.

Calculate the height of the bar representing the interval $30 < h \leq 50$.

$$\frac{40 - 15}{7.2} = 25$$

6

$$7.2$$

..... cm [2]

5 The candidate has identified the mid-interval values and is awarded one mark but the method that follows is incorrect. No further marks are awarded. Mark for (b)(i) = 1 out of 4

6 The candidate gives an incorrect answer which is not awarded a mark. Mark for (b)(ii) = 0 out of 2

Total marks awarded = 2 out of 12

How the candidate could have improved their answer

- **(a)(ii)** Either in the working or annotation on the graph, the candidate needed to find the lower quartile and upper quartile in order to find the interquartile range.
- **(a)(iii)** In order to find the 60th percentile, 60% of 120 must be found first before reading off the height that corresponds to the cumulative frequency of 72.
- **(b)(i)** Having found the mid-interval values, the candidate needed to multiply these by the frequencies in order to find an estimate of the total.
- **(b)(ii)** The candidate should have considered finding the frequency density for the class $30 < h \leq 50$ as a starting point.

Common mistakes candidates made in this question

- **(a)(i)** An occasional incorrect answer of 60 was seen.
- **(a)(ii)** A very small number of candidates gave an answer of 60, presumably coming from $90 - 30$ and a similar number gave one of the two quartiles as the final answer.
- **(a)(iii)** A common error was to give an answer of 25 by using a value of 60 on the cumulative axis. Others did calculate the correct value to use when working out 60% of 120 but did not use the diagram and gave 72 as the final answer.
- **(a)(iv)** Errors included giving 114 as the answer and misreading the scale leading to a value of 117 for example.
- **(b)(i)** Some candidates included the class widths, or one half of the widths, rather than the mid-values and a few divided by 4 rather than the total frequency.
- **(b)(ii)** A common error was to not take any account of the different class widths of the two intervals and giving an incorrect answer of 15.2.

Question 5

Example Candidate Response – high

Examiner comments

- 5 Ahmed sells different types of cake in his shop.
The cost of each cake depends on its type and its size.

Every small cake costs \$ x and every large cake costs $\$(2x + 1)$.

- (a) The total cost of 3 small lemon cakes and 2 large lemon cakes is \$12.36.

Find the cost of a small lemon cake.

$$3(u) + 2(2u+1) = 12.36$$

$$3u + 4u + 2 = 12.36$$

$$7u = 12.36 - 2$$

$$7u = 10.36$$

$$u = \frac{10.36}{7}$$

$$u = \$1.48$$

1

$$\$ \dots\dots\dots 1.48 \dots\dots\dots [3]$$

- (b) The cost of 18 small chocolate cakes is the same as the cost of 7 large chocolate cakes.

Find the cost of a small chocolate cake.

$$18(u) = 7(2u+1)$$

$$18u = 14u + 7$$

$$18u - 14u = 7$$

$$4u = 7$$

$$u = \frac{7}{4}$$

$$u = \$1.75$$

2

$$\$ \dots\dots\dots 1.75 \dots\dots\dots [3]$$

- (c) The number of small cherry cakes that can be bought for \$4 is the same as the number of large cherry cakes that can be bought for \$13.

Find the cost of a small cherry cake.

~~$$n(4) = n(13)$$~~

~~$$n(u) + n(2u+1) = 4 + 13$$~~

$$\frac{4}{u} = \frac{13}{2u+1}$$

$$4(2u+1) = 13(u)$$

$$8u + 4 = 13u$$

$$4 = 13u - 8u$$

$$4 = 5u$$

$$\frac{4}{5} = u$$

3

$$\$ \dots\dots\dots 0.8 \dots\dots\dots [3]$$

1 The candidate gives a fully correct solution supported by staged correct working. x 's are poorly written throughout, but this is condoned.

Mark for (a) = 3 out of 3

2 The candidate gives a fully correct solution supported by staged correct working.

Mark for (b) = 3 out of 3

3 The candidate gives a fully correct solution supported by staged correct working. The answer is given correctly in this context as the candidate has worked out that $x = \frac{4}{5}$ and then converted this to 0.8 dollars.

Mark for (c) = 3 out of 3

Example Candidate Response – high, continued

Examiner comments

- (d) Petra spends \$20 on small coffee cakes and \$10 on large coffee cakes. The total number of cakes is 45.

Write an equation in terms of x .
Solve this equation to find the cost of a small coffee cake.
Show all your working.

~~20x~~ ~~10(45-x)~~

$$\frac{20}{u} + \frac{10}{(2u+1)} = 45 \quad 4$$

$$\frac{20(2u+1) + 10(u)}{u(2u+1)} = 45$$

$$\frac{40u + 20 + 10u}{2u^2 + u} = 45$$

$$50u + 20 = 45(2u^2 + u)$$

$$50u + 20 = 90u^2 + 45u$$

$$0 = 90u^2 + 45u - 50u - 20$$

$$0 = 90u^2 - 5u - 20 \quad 5$$

$a = 90$ $b = -5$ $c = -20$

$$= \frac{-(-5) \pm \sqrt{(-5)^2 - 4(90)(-20)}}{2(90)} \quad 6$$

$$= \frac{5 \pm \sqrt{7225}}{180} \quad 7$$

\$ 0.5 [7]

$$= \frac{5 + \sqrt{7225}}{180} \quad \text{or} \quad \frac{5 - \sqrt{7225}}{180}$$

$u = 0.5$ or $u = \frac{4}{9}$

- 4 This question requires full working to be shown. The candidate sets up a correct equation in x in the first line of working and is awarded two method marks.
- 5 The candidate is awarded two marks for simplifying the original equation correctly to a 3-term quadratic equation.
- 6 The candidate is awarded two method marks for correctly substituting into the quadratic formula which they correctly use to solve their equation.
- 7 The final mark is awarded for the answer 0.5.
Mark for (d) = 7 out of 7
- Total mark awarded = 16 out of 16**

How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

5 Ahmed sells different types of cake in his shop.
The cost of each cake depends on its type and its size.

Every small cake costs \$ x and every large cake costs \$ $(2x + 1)$.

(a) The total cost of 3 small lemon cakes and 2 large lemon cakes is \$12.36.

Find the cost of a small lemon cake.

$$\begin{aligned} 3x + 2(2x + 1) &= 12.36 \\ 3x + 4x + 2 &= 12.36 \\ 7x &= 10.36 \\ x &= 1.48 \end{aligned}$$

1

\$ 1.48 [3]

(b) The cost of 18 small chocolate cakes is the same as the cost of 7 large chocolate cakes.

Find the cost of a small chocolate cake.

$$18x = 7(2x + 1)$$

$$18x = 14x + 7$$

$$4x = 7$$

$$x = \frac{7}{4}$$

$$x = 0.25$$

2

\$ 0.25 [3]

(c) The number of small cherry cakes that can be bought for \$4 is the same as the number of large cherry cakes that can be bought for \$13.

Find the cost of a small cherry cake.

$$nx = 4$$

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

$$n(2x + 1) = 13$$

$$\frac{4}{x}(2x + 1) = 13$$

$$\frac{8x}{x} + \frac{4}{x} = 13$$

$$\frac{8x}{x} + \frac{4}{x} = \frac{13x}{x}$$

$$8x + 4 = 13x$$

$$4 = 5x$$

$$x = \frac{4}{5}$$

3

\$ 0.8 [3]

1 The candidate produces a correct solution, supported by full working and is awarded all three marks.

Mark for (a) = 3 out of 3

2 The candidate is awarded one mark for setting up a correct equation in the first line of working. The second line of working contains an error when expanding the brackets and this leads to an incorrect final answer.

Mark for (b) = 1 out of 3

3 The candidate gives a correct final answer, and this is supported by correct working.

Mark for (c) = 3 out of 3

Example Candidate Response – middle, continued

Examiner comments

- (d) Petra spends \$20 on small coffee cakes and \$10 on large coffee cakes. The total number of cakes is 45.

Write an equation in terms of x .
Solve this equation to find the cost of a small coffee cake.
Show all your working.

Let number of small coffee cakes be n
and number of large coffee cakes be N .

$$n + N = 45$$

$$20(x) + 10(2x+1) = 45$$

$$20x + 20x + 10 = 45$$

$$40x = 35$$

$$x = 0.875$$

4

\$ 0.88 [7]

4 The setting up of the initial equation is essential to this question. The candidate gives an incorrect initial equation in x and, as a consequence, is unable to set up the correct quadratic equation to solve.

Mark for (d) = 0 out of 7

Total mark awarded = 7 out of 16

How the candidate could have improved their answer

- (b) Care was needed when expanding the brackets having set up a correct initial equation.
- (c) A slight improvement would have been to give 0.80 dollars as the answer which is conventional but 0.8 was an acceptable answer.
- (d) The candidate needed to translate the information given into a correct initial equation to begin with and to find the number of each type of cake by dividing the total cost by the cost of each cake.

Example Candidate Response – low

Examiner comments

5 Ahmed sells different types of cake in his shop.
The cost of each cake depends on its type and its size.

Every small cake costs \$ x and every large cake costs $\$(2x + 1)$.

(a) The total cost of 3 small lemon cakes and 2 large lemon cakes is \$12.36.

Find the cost of a small lemon cake.

$$\begin{aligned} 3x + (2x+1) + (2x+1) &= 12.36 & 3(1.48) = \\ 7x + 2 &= 12.36 & \text{①} \\ 7x &= 10.36 \\ x &= 1.48, \$ \text{ ~~4.44~~ 4.44 } & [3] \end{aligned}$$

(b) The cost of 18 small chocolate cakes is the same as the cost of 7 large chocolate cakes.

Find the cost of a small chocolate cake.

$$\begin{aligned} 18x &= 7(2x+1) & x &= 1.75 \\ 18x &= 14x+7 & 18(1.75) &= \\ 18x - 14x &= 7 & \text{②} \\ \frac{4x}{4} &= \frac{7}{4} & \$ \text{ ~~4.75~~ 31.5 } & [3] \end{aligned}$$

(c) The number of small cherry cakes that can be bought for \$4 is the same as the number of large cherry cakes that can be bought for \$13.

Find the cost of a small cherry cake.

$$\begin{aligned} x &= 4 & \text{③} \\ 2x + 1 &= 13 \\ 2x + 1 - x &= 13 - 4 \\ x + 1 &= 9 \\ x &= 8 \end{aligned}$$

\$ ~~8~~ [3]

(d) Petra spends \$20 on small coffee cakes and \$10 on large coffee cakes.
The total number of cakes is 45.

Write an equation in terms of x .

Solve this equation to find the cost of a small coffee cake.

Show all your working.

$$\begin{aligned} \$x &= \$20 & \text{④} \\ \$ (2x+1) &= \$10 \end{aligned}$$

① The candidate sets up a correct equation and then solves this correctly to get 1.48. In the answer space, they have given 4.44. the cost of 3 small lemon cakes rather than one.

Mark for (a) = 2 out of 3

② Similarly here, a correct equation, correctly solved to get $x = 1.72$ but then the answer is the cost of 18 small chocolate cakes rather than the one cake that is asked for. The mark scheme awards two marks for this.

Mark for (b) = 2 out of 3

③ The candidate sets up an incorrect equation in x that leads to an incorrect answer.

Mark for (c) = 0 out of 3

④ The candidate is unable to set up the correct starting equation in x and, as a consequence, is unable to derive the correct quadratic equation.

Mark for (d) = 0 out of 7

Total mark awarded = 4 out of 16

How the candidate could have improved their answer

- **(a), (b)** Care was needed in reading the demand of the question. The candidate found the correct answer using algebra but then went on to answer a different question.
- **(c)** The candidate needed to consider that the cost of a cake is price divided by the number of cakes, e.g. $4/x =$ number of small cherry cakes.
- **(d)** The candidate needed to consider that the number of cakes is the price divided by the cost of one cake, e.g. $20/x =$ number of small coffee cakes.

Common mistakes candidates made in this question

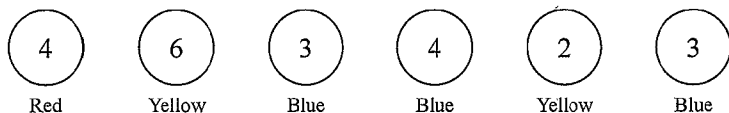
- **(a)** Giving the cost of 3 small cakes as the final answer or setting up the equation correctly $3x + 2(2x + 1) = 12.36$ but then incorrectly expanding the brackets, giving $3x + 4x + 1 = 12.36$.
- **(b)** Some candidates gave the cost of the 18 small chocolate cakes or set up the correct equation but then expanded the brackets incorrectly, giving $14x + 1$.
- **(c)** Setting up an incorrect equation, usually $4x = 13(2x + 1)$.
- **(d)** Setting up a correct quadratic equation and then writing down the answer of 0.5 without showing the required working. Many candidates incorrectly gave $20x + 10(2x + 1) = 45$ as their initial equation.

Question 6

Example Candidate Response – high

Examiner comments

6



The diagram shows six discs.
Each disc has a colour and a number.

(a) One disc is picked at random.

Write down the probability that

(i) the disc has the number 4,

$$\frac{2}{6} = \frac{1}{3}$$

..... $\frac{1}{3}$ [1]

(ii) the disc is red and has the number 3,

$$\frac{0}{6} = 0$$

..... 0 [1]

(iii) the disc is blue and has the number 4.

$$\frac{1}{6}$$

..... $\frac{1}{6}$ [1]

(b) Two of the six discs are picked at random **without** replacement.

Find the probability that

(i) both discs have the number 3,

$$\frac{2}{6} \times \frac{1}{5} = \frac{2}{30} = \frac{1}{15}$$

..... $\frac{1}{15}$ [2]

(ii) both discs have the same colour.

All possibilities:

Red Red
Yellow Yellow
Blue Blue

$$\text{Red Red: } \frac{1}{6} \times \frac{0}{5} = \frac{0}{30} = 0$$

$$\text{Yellow Yellow: } \frac{2}{6} \times \frac{1}{5} = \frac{2}{30} = \frac{1}{15}$$

$$\text{Blue Blue: } \frac{3}{6} \times \frac{2}{5} = \frac{6}{30} = \frac{1}{5}$$

$$\frac{1}{15} + \frac{1}{15} + \frac{3}{15} = \frac{4}{15}$$

..... $\frac{4}{15}$ [3]

1 The candidate correctly answers part (a).
Mark for (a) = 3 out of 3

2 The candidate shows a correct answer supported by a correct method.
Mark for (b)(i) = 2 out of 2

3 The candidate considers all of the correct options for both discs having the same colour and then calculates all of the relevant products before adding the probabilities to give the correct answer.
Mark for (b)(ii) = 3 out of 3

Example Candidate Response – high, continued	Examiner comments
<p>(c) Two of the six discs are picked at random with replacement.</p> <p>Find the probability that both discs have the same colour.</p> <p>All possibilities:</p> <p>Red Red: $\frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$</p> <p>Yellow Yellow: $\frac{2}{6} \times \frac{2}{6} = \frac{4}{36} = \frac{1}{9}$</p> <p>Blue Blue: $\frac{3}{6} \times \frac{3}{6} = \frac{9}{36} = \frac{1}{4}$</p> <p>$\frac{1}{36} + \frac{4}{36} + \frac{9}{36} = \frac{14}{36} = \frac{7}{18}$</p> <p>..... $\frac{7}{18}$ [3]</p>	<p>4 In this part, the discs are replaced after each pick and the candidate recognises that, in each case, the probability for the second pick will be the same as the probability for the first pick. A correct answer is given supported by fully correct working.</p> <p>Mark for (c) = 3 out of 3</p> <p>Total mark awarded = 11 out of 11</p>

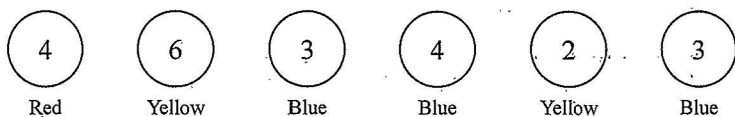
How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

6



The diagram shows six discs.
Each disc has a colour and a number.

(a) One disc is picked at random.

Write down the probability that

(i) the disc has the number 4,

1

$\frac{1}{2}$ [1]

(ii) the disc is red and has the number 3,

0 [1]

(iii) the disc is blue and has the number 4.

$\frac{1}{6}$ [1]

(b) Two of the six discs are picked at random **without** replacement.

Find the probability that

(i) both discs have the number 3,

$$\frac{2}{6} \times \frac{1}{5} = \frac{1}{15}$$

2

$\frac{1}{15}$ [2]

(ii) both discs have the same colour.

$$\frac{1}{6} \times \frac{5}{5} \times \frac{2}{6} \times \frac{4}{5} \times \frac{3}{6} \times \frac{3}{5} = \frac{1}{75}$$

3

~~$\frac{2}{125}$~~ $\frac{1}{75}$ [3]

1 The candidate answers all three parts of (a) correctly and is awarded one mark for each. Mark for (a) = 3 out of 3

2 The candidate gives a correct answer using a correct method and is awarded two marks. Mark for (b)(i) = 2 out of 2

3 The candidate uses an incorrect method involving the product of 6 probabilities. The answer is incorrect, and no marks are awarded. Mark for (b)(ii) = 0 out of 3

Example Candidate Response – middle, continued	Examiner comments
<p>(c) Two of the six discs are picked at random with replacement. Find the probability that both discs have the same colour.</p> $\frac{1}{6} \times \frac{5}{6} \times \frac{2}{6} \times \frac{4}{6} \times \frac{3}{6} \times \frac{3}{6} = \frac{5}{648}$ <p style="text-align: right;">..... $\frac{5}{648}$ [3]</p>	<p>4 The candidate again uses an incorrect method finding the product of 6 probabilities. The answer is incorrect, and no marks are awarded. Mark for (c) = 0 out of 3</p> <p>Total mark awarded = 5 out of 11</p>

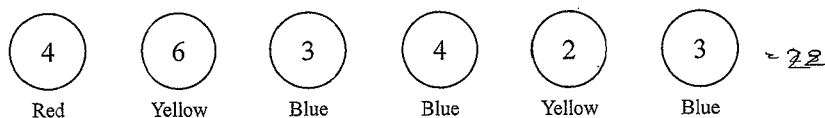
How the candidate could have improved their answer

(b)(ii), (c) The candidate could have identified the pairs of discs that may result in the same colour, e.g. *RR* or *BB* or *YY*. This may have assisted in the pairing up of the correct three separate products rather than the product of six probabilities.

Example Candidate Response – low

Examiner comments

6



The diagram shows six discs.
Each disc has a colour and a number.

(a) One disc is picked at random.

Write down the probability that

(i) the disc has the number 4,

1

$$\frac{2}{6} \quad [1]$$

(ii) the disc is red and has the number 3,

$$\frac{0}{6} \quad [1]$$

(iii) the disc is blue and has the number 4.

$$\frac{1}{6} \quad [1]$$

(b) Two of the six discs are picked at random without replacement.

Find the probability that

(i) both discs have the number 3,

$$6 - 2 = 4$$

$$\frac{2}{4}$$

$$\frac{2}{4} \quad [2]$$

(ii) both discs have the same colour.

yellow blue
= 2 + 3

~~2~~
 $\frac{2}{4} + \frac{3}{4}$

2

$$\frac{5}{4} \quad [3]$$

1 In (a), the candidate gives correct answers which are awarded three marks.

Mark for (a) = 3 out of 3

2 In both parts of (b), the candidate supplies incorrect answers from incorrect methods.

Mark for (b) = 0 out of 2

Example Candidate Response – low, continued	Examiner comments
<p>(c) Two of the six discs are picked at random with replacement. Find the probability that both discs have the same colour.</p> <p>6 disks and 2 of them are yellow and 3 are blue</p> <p>$2 + 3 = 5$ - colours same colours. 3</p> <p>$\frac{2}{6} + \frac{3}{6}$</p> <p>..... $\frac{5}{6}$ [3]</p>	<p>3 As in (b), the candidate does not show how to combine probabilities of events and no marks are awarded. Mark for (c) = 0 out of 3</p> <p>Total mark awarded = 3 out of 11</p>

How the candidate could have improved their answer

- (b), (c) The candidate needed to develop an understanding of the methodology for combining probabilities for successive events.
- (b)(i) The candidate could have started by identifying the individual probabilities for each pick.
- (b)(ii), (c) The candidate could have identified the pairs of discs that may result in the same colour, e.g. RR or BB or YY.

Common mistakes candidates made in this question

- (b)(i) Common errors included an incorrect answer $\frac{2}{6}$, and some incorrect methods included $\frac{1}{6} + \frac{1}{5}$, $2 \times \left(\frac{2}{6} + \frac{1}{5}\right)$ and $\frac{2}{6} + \frac{2}{6}$.
- (b)(ii) Similar types of errors to those in (b)(i), including just giving one component or multiplying a component by a constant, for example, $\frac{2}{6} \times \frac{1}{5} + 2 \left(\frac{3}{6} \times \frac{2}{5}\right)$.
- (c) It was quite common to see an answer coming from $\frac{2}{6} \times \frac{2}{6} + \frac{3}{6} \times \frac{3}{6}$, the probability of picking two yellow discs and two blue discs with two red discs not considered.

Question 7

Example Candidate Response – high

Examiner comments

7 $y = x^2 + \frac{1}{x}, x \neq 0$

(a) Complete the table.

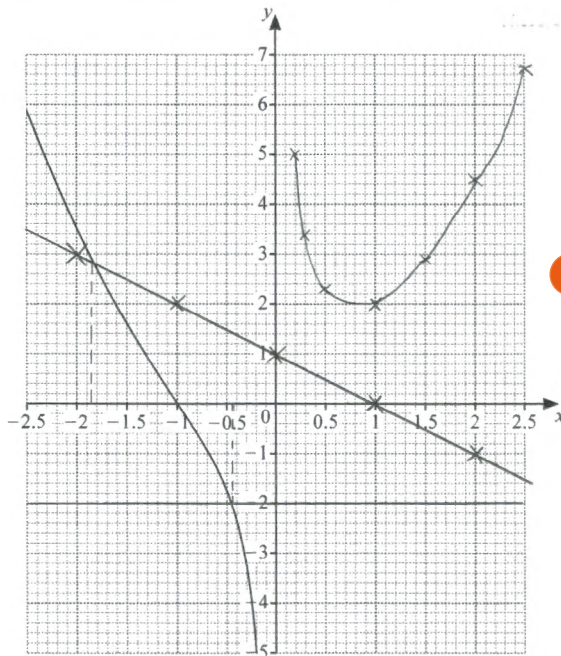
x	0.2	0.3	0.5	1	1.5	2	2.5
y	5.0	3.4	2.3	2	2.9	4.5	6.7

1

[2]

(b) On the grid, draw the graph of $y = x^2 + \frac{1}{x}$ for $0.2 \leq x \leq 2.5$.

The graph of $y = x^2 + \frac{1}{x}$ for $-2.5 \leq x \leq -0.2$ has been drawn for you.



2

[4]

(c) By drawing suitable straight lines on the grid, solve the following equations.

(i) $x^2 + \frac{1}{x} = -2$

$x = -0.45$ [1]

3

(ii) $x^2 + \frac{1}{x} + x - 1 = 0$

$y + x - 1 = 0$

$y = 1 - x$

x	-2	-1	0	1	2
y	3	2	1	0	-1

$x = -1.85$ [2]

4

(d) k is an integer and the equation $x^2 + \frac{1}{x} = k$ has three solutions.

Write down a possible value of k .

$k = 4$ [1]

5

1 The candidate supplies both correct values and two marks are awarded.

Mark for (a) = 2 out of 2

2 The candidate draws a smooth curve within $\frac{1}{2}$ small square of all of the correct points from the table and is awarded 4 marks.

Mark for (b) = 4 out of 4

3 The candidate gives a correct answer in the required range.

Mark for (c)(i) = 1 out of 1

4 The candidate recognises the required line is $y = 1 - x$ and rules this line on the graph. They correctly give the x value -1.85 , read from the intersection of their ruled line with the curve.

Mark for (c)(ii) = 2 out of 2

5 The candidate gives an integer greater than 2 which is awarded the mark.

Mark for (d) = 1 out of 1

Total mark awarded = 10 out of 10

How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

7 $y = x^2 + \frac{1}{x}, x \neq 0$

(a) Complete the table.

x	0.2	0.3	0.5	1	1.5	2	2.5
y	5.0	3.4	2.3	2	2.9	4.5	6.7

1

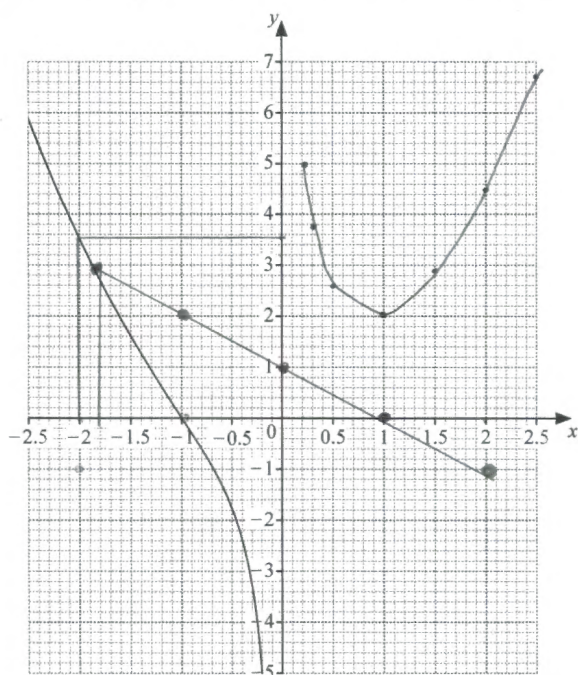
1 The candidate completes the table correctly and is awarded two marks.

[2]

Mark for (a) = 2 out of 2

(b) On the grid, draw the graph of $y = x^2 + \frac{1}{x}$ for $0.2 \leq x \leq 2.5$.

The graph of $y = x^2 + \frac{1}{x}$ for $-2.5 \leq x \leq -0.2$ has been drawn for you.



2

2 The candidate's graph is incorrect. The points at $x = 0.5$ and $x = 0.3$ are incorrectly plotted. Two marks are awarded for 5 correct points.

Mark for (b) = 2 out of 4

[4]

Example Candidate Response – middle, continued	Examiner comments
<p>(c) By drawing suitable straight lines on the grid, solve the following equations.</p> <p>(i) $x^2 + \frac{1}{x} = -2$</p> <p style="text-align: right;">$x = 3.5$ [1] 3</p> <p>(ii) $x^2 + \frac{1}{x} + x - 1 = 0$</p> <p style="text-align: right;">$x = -1.57$ [2] 4</p> <p>(d) k is an integer and the equation $x^2 + \frac{1}{x} = k$ has three solutions.</p> <p>Write down a possible value of k.</p> <p style="text-align: right;">$k = 3$ [1] 5</p> <p><i>(Handwritten notes for (d):)</i> $-x + 1$ -0.01</p>	<p>3 The candidate's answer is incorrect, and no mark is awarded. Mark for (c)(i) = 0 out of 1</p> <p>4 Although no working is shown in the working space here, the candidate has ruled the line $y = 1 - x$ on the graph. The value of x is incorrect. The error appears to be in interpreting the horizontal scale when looking at the intersection of the line and the curve. One mark is earned for the line. Mark for (c)(ii) = 1 out of 2</p> <p>5 The candidate gives a correct answer which is awarded one mark. Mark for (d) = 1 out of 1</p> <p>Total mark awarded = 6 out of 10</p>

How the candidate could have improved their answer

In this question, all the errors arose as a result of misreading the scales on the two axes and confusion between the x - and y -axes. To improve, the candidate needed to carefully work out the value of each of the small squares on each axis using the given scale and take care when plotting and reading values.

Example Candidate Response – low

Examiner comments

7 $y = x^2 + \frac{1}{x}, x \neq 0$

(a) Complete the table.

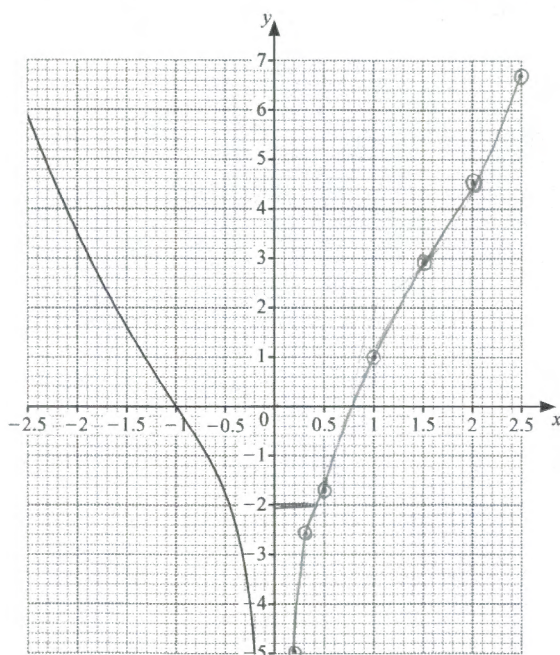
x	0.2	0.3	0.5	1	1.5	2	2.5
y	5.0	3.4	2.3	2.2	2.9	4.5	6.7

1

[2]

(b) On the grid, draw the graph of $y = x^2 + \frac{1}{x}$ for $0.2 \leq x \leq 2.5$.

The graph of $y = x^2 + \frac{1}{x}$ for $-2.5 \leq x \leq -0.2$ has been drawn for you.



2

[4]

(c) By drawing suitable straight lines on the grid, solve the following equations.

(i) $x^2 + \frac{1}{x} = -2$

3

$x = \dots\dots\dots 0.4 \dots\dots\dots$ [1]

(ii) $x^2 + \frac{1}{x} + x - 1 = 0$

4

$x = \dots\dots\dots -6 \dots\dots\dots$ [2]

(d) k is an integer and the equation $x^2 + \frac{1}{x} = k$ has three solutions.

Write down a possible value of k .

5

$k = \dots\dots\dots 1.5 \dots\dots\dots$ [1]

1 The candidate correctly completes the table for two marks. Mark for (a) = 2 out of 2

2 The candidate's graph is incorrect, but 3 points are correctly plotted for one mark. Mark for (b) = 1 out of 4

3 The candidate's value is incorrect, and no marks are awarded. Mark for (c)(i) = 0 out of 1

4 The candidate gives an incorrect answer, and no working is shown. Mark for (c)(ii) = 0 out of 2

5 The candidate gives an incorrect, non-integer answer which is not awarded a mark. Mark for (d) = 0 out of 1

Total mark awarded = 3 out of 10

How the candidate could have improved their answer

- The candidate needed to correctly plot the points with negative y -values on the graph which could have gained up to 4 extra marks.
- **(c)(ii)** The candidate needed to begin by manipulating the equation to find the line needed to obtain the solution.

Common mistakes candidates made in this question

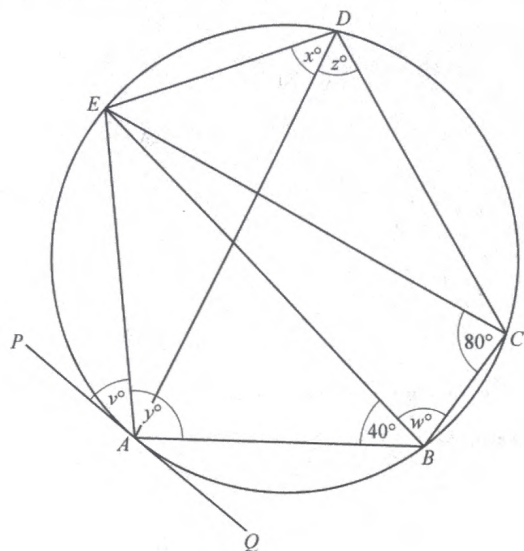
- **(b)** Some common errors apart from mis-plots of points were a few very thick curves drawn, and a smaller number using their rulers to join the points.
- **(c)(i)** A common error was 0.45 without the negative sign.
- **(c)(ii)** A common error was to obtain $y = 1 - x$ in working but then either not to draw a line, or draw $y = x - 1$ or $y = 1 + x$.

Question 8

Example Candidate Response – high

Examiner comments

8 (a)



NOT TO SCALE

The points A, B, C, D and E lie on the circle.
 PAQ is a tangent to the circle at A and $EC = EB$.
 Angle $ECB = 80^\circ$ and angle $ABE = 40^\circ$.

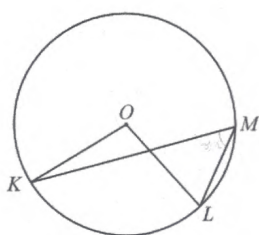
1

Find the values of v, w, x, y and z .

$v = 40$ $w = 80^*$ $x = 40$ $y = 100$ $z = 60^*$ [5]

1 The candidate correctly gives all 5 required angles.
 Mark for (a) = 5 out of 5

(b)



NOT TO SCALE

In the diagram, K, L and M lie on the circle, centre O .
 Angle $KML = 2x^\circ$ and reflex angle $KOL = 11x^\circ$.

Find the value of x .

$$\begin{aligned} \angle KOL &= 2 \times \angle KML \\ &= 4x \\ 11x + 4x &= 360 \\ 15x &= 360 \\ x &= 24 \end{aligned}$$

2

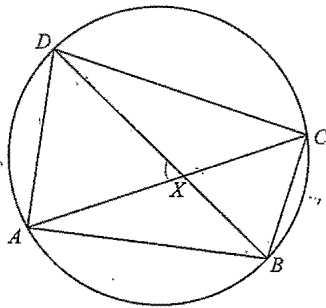
$x = 24$ [3]

2 The candidate supplies a correct answer with full supporting working.
 Mark for (b) = 3 out of 3

Example Candidate Response – high, continued

Examiner comments

(c)



NOT TO SCALE

The diagonals of the cyclic quadrilateral $ABCD$ intersect at X .

- (i) Explain why triangle ADX is similar to triangle BCX .
Give a reason for each statement you make.

$\angle DXA = \angle CXB$ (opposite angles)
 $\angle DAC = \angle DBC$ (angles on same segment) **3**
 $\angle ADB = \angle ACB$ (angles on same segment)
 As all three angles are same by A.A.A (angle-angle-angle) ΔADX is similar to ΔBCX [3]

- (ii) $AD = 10$ cm, $BC = 8$ cm, $BX = 5$ cm and $CX = 7$ cm.

- (a) Calculate DX .

$$\frac{10}{8} = \frac{DX}{7}$$

$$DX = 8.75 \text{ cm}$$

$DX = 8.75$ cm [2] **4**

- (b) Calculate angle BXC .

By cosine rule,
 $8^2 = 5^2 + 7^2 - 2(5)(7) \cos \angle BXC$
 $-10 = -70 \cos \angle BXC$
 $\cos \angle BXC = \frac{1}{7}$
 $\angle BXC = 81.8^\circ$ (1 d.p.)

Angle $BXC = 81.8^\circ$ [4] **5**

3 The candidate gives a model answer. Equal angles are stated with a correct geometric reason using the correct terminology before a conclusion. The candidate makes sensible use of the structured answer lines, to supply each condition, with a reason, on a separate line.

Mark for (c)(i) = 3 out of 3

4 The candidate gives a correct answer supported by a correct initial statement relating the corresponding sides.

Mark for (c)(ii)(a) = 2 out of 2

5 The candidate recognises that the cosine rule is needed to solve this problem and then correctly substitutes values into it, rearranging the formula to give a correct angle.

Mark for (c)(ii)(b) = 4 out of 4

Total mark awarded = 17 out of 17

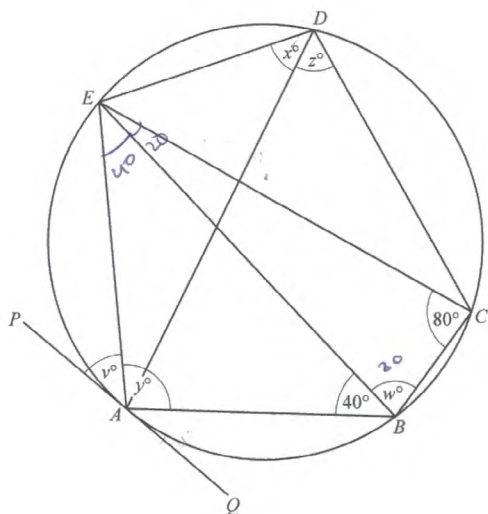
How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

8 (a)



NOT TO SCALE

The points A, B, C, D and E lie on the circle.
 PAQ is a tangent to the circle at A and $EC = EB$.
 Angle $ECB = 80^\circ$ and angle $ABE = 40^\circ$.

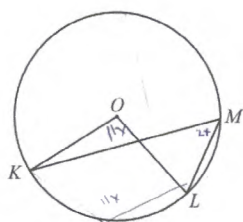
Find the values of v, w, x, y and z .

1

$v = 40$ $w = 80$ $x = 20$ $y = 100$ $z = 40$ [5]

1 The candidate correctly identifies angles v, w and y . Angles x , and z are both incorrect. Mark for (a) = 3 out of 5

(b)



NOT TO SCALE

In the diagram, K, L and M lie on the circle, centre O .
 Angle $KML = 2x^\circ$ and reflex angle $KOL = 11x^\circ$.

Find the value of x .

$$2(2x) + 11x = 180$$

$$x = 12$$

$$\frac{360 - 11x}{2} = 2x$$

2

$$2x + \frac{360 - 11x}{2} = 2x$$

$$360 = 15x$$

$$x = 12$$

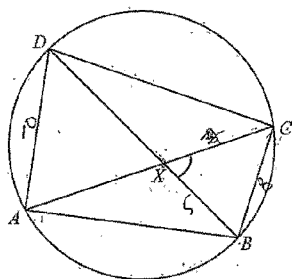
$x = 12$ [3]

2 In pencil, the candidate writes a correct equation. In pen, they reach $360 = 15x$ which is correct and is awarded two marks. The answer 12 is incorrect and it is unclear how it is arrived at. Mark for (b) = 2 out of 3

Example Candidate Response – middle, continued

Examiner comments

(c)



NOT TO SCALE

The diagonals of the cyclic quadrilateral $ABCD$ intersect at X .

- (i) Explain why triangle ADX is similar to triangle BCX . Give a reason for each statement you make.

$\angle XAD = \angle XBC$ because alternate angles / angle at a point = 360
 $\angle XDA = \angle XCB$ because alternate angles
 $\angle AXD = \angle BXC$ because alternate angles
 AAA test proves these triangles are similar [3]

- (ii) $AD = 10$ cm, $BC = 8$ cm, $BX = 5$ cm and $CX = 7$ cm.

(a) Calculate DX .

$$\frac{AD}{BC} = \frac{DX}{CX}$$

$DX = 8.75$ cm [2]

(b) Calculate angle BXC .

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$8^2 = 7^2 + 5^2 - 2(7)(5) \cos A$$

$$\frac{64 - 74}{-70} = \cos A$$

$$\frac{-10}{-70} = \frac{1}{7}$$

Angle $BXC = 81.7$ [4]

3 The candidate approaches the problem correctly, but the statements supplied are inaccurate. Line 1 is a correct pairing of equal angles but with an incorrect reason. Lines 2 and 3 have incorrect pairings of angles and as a result no marks are earned. The misconception appears to be in thinking that AD and BC are parallel lines, rather than in using the angle properties of a circle to determine the equal pairs.

Mark for (c)(i) = 0 out of 3

4 A correct answer which is awarded two marks.

Mark for (c)(ii)(a) = 2 out of 2

5 The candidate gives a fully correct method using the cosine rule which is awarded two marks at the 3rd line and a third mark for $\frac{-10}{-70}$. However, the final answer is inaccurate as the answer has been truncated rather than rounded correct to 3 significant figures.

Mark for (c)(ii)(b) = 3 out of 4

Total mark awarded = 10 out of 17

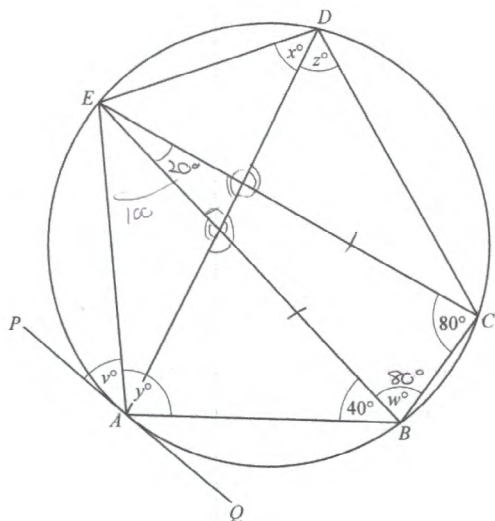
How the candidate could have improved their answer

- (a) The candidate needed to recognise that angle x is in the same segment as the angle of 40 degrees and angle z is in the same segment as the angle AEC which is correctly annotated on the diagram.
- (b) Writing the final method step of $\frac{360}{15}$ may have helped the candidate to spot the error in solving their correct equation.
- (c)(i) They needed to identify pairs of equal angles and give reasons using the correct geometric terminology from the syllabus for each statement.
- (c)(ii), (b) Care was needed when rounding to 3 significant figures and a more accurate decimal value should have been supplied first.

Example Candidate Response – low

Examiner comments

8 (a)



NOT TO SCALE

The points A, B, C, D and E lie on the circle.
 PAQ is a tangent to the circle at A and $EC = EB$.
 Angle $ECB = 80^\circ$ and angle $ABE = 40^\circ$.

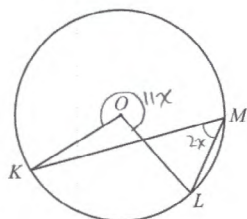
Find the values of v, w, x, y and z .

1

$v = 60$ $w = 80$ $x = 60$ $y = 40$ $z = 20$ [5]

1 Only angle w is correct so the candidate's response is awarded one mark.
 Mark for (a) = 1 out of 5

(b)



NOT TO SCALE

2

In the diagram, K, L and M lie on the circle, centre O .
 Angle $KML = 2x^\circ$ and reflex angle $KOL = 11x^\circ$.

Find the value of x .

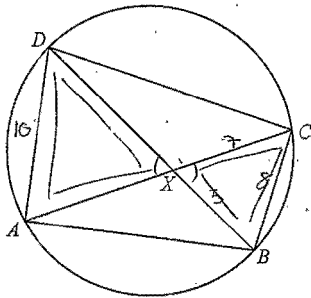
2 The candidate correctly annotates the diagram, but no method is shown, and the answer is incorrect.
 Mark for (b) = 0 out of 3

$x = 40$ [3]

Example Candidate Response – low, continued

Examiner comments

(c)



NOT TO SCALE

The diagonals of the cyclic quadrilateral $ABCD$ intersect at X .

- (i) Explain why triangle ADX is similar to triangle BCX .
Give a reason for each statement you make.

3

$\angle CXB = \angle DXA$ (Vert. opp. \angle s)

.....

.....

..... [3]

- (ii) $AD = 10$ cm, $BC = 8$ cm, $BX = 5$ cm and $CX = 7$ cm.

- (a) Calculate DX .

$$\frac{5}{DX} = \frac{8}{10}$$

$$8DX = 50$$

$$DX = \dots\dots\dots 6.25 \dots\dots\dots \text{cm} [2]$$

4

- (b) Calculate angle BXC .

$$\cos(A) = \frac{b^2 + c^2 - a^2}{2bc}$$

$$\cos(A) = \frac{7^2 + 8^2 - 5^2}{2(7)(8)}$$

$$\cos(A) = \frac{88}{112}$$

$$\text{Angle } BXC = \dots\dots\dots 38.2 \dots\dots\dots [4]$$

5

3 The candidate gives a correct statement with correct reasoning and is awarded one mark, but no further written work is seen. Mark for (c)(i) = 1 out of 3

4 The candidate has incorrectly paired corresponding sides in triangles ADX and BXC . This common error results in the incorrect answer of 6.25 and is awarded no marks. Mark for (c)(ii)(a) = 0 out of 2

5 The candidate recognises that the cosine rule is needed but makes an error in the substitution and thus finds the incorrect angle BCX . Mark for (c)(ii)(b) = 0 out of 4

Total mark awarded = 2 out of 17

How the candidate could have improved their answer

- **(a)** The working demonstrated that the candidate needed a greater knowledge and understanding of applying angle theorems relating to circles.
- **(b)** Although the diagram was correctly annotated, the candidate needed to know that the angle in the centre is twice the angle at the circumference.
- **(c)(i)** It was important to identify pairs of equal angles and give reasons using the correct geometric terminology from the syllabus for each statement.
- **(c)(ii)(a)** More care was needed when pairing corresponding lengths of similar figures as the wrong pair was used.
- **(c)(ii)(b)** The candidate identified the use of the cosine rule but then made an incorrect substitution. This could have been avoided if a labelled diagram had been drawn.

Common mistakes candidates made in this question

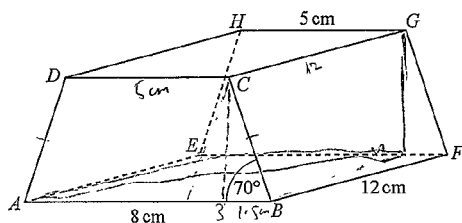
- **(a)** Errors frequently arose from incorrect assumptions, such as that there was a right angle at the intersection of AD with either EB or EC (or sometimes both).
- **(b)** Some candidates did appreciate that $11x$ was the reflex angle, then indicated that the obtuse angle KOL was $180 - 11x$ rather than $360 - 11x$.
- **(c)(i)** Many candidates appeared unfamiliar with what was required to show similarity. A way of preparing candidates for such questions would be to ensure that the correct geometric reasons (stated on the syllabus) for relationships between angles must be given and using the answer lines provided for each separate statement with a reason is a good approach. Finally, a statement in conclusion to say that all three angles are the same and therefore the triangles are similar would secure the final mark.
- **(c)(ii)(a)** Some candidates mixed up the corresponding sides and calculated $\frac{10}{8} \times 5$ rather than $\frac{10}{8} \times 7$.
- **(c)(ii)(b)** The most common error was with candidates that stated the cosine rule in the form $8^2 = 7^2 + 5^2 - 2 \times 7 \times 5 \times \cos(BXC)$ but then made errors when rearranging this to find the angle.

Question 9

Example Candidate Response – high

Examiner comments

9



NOT TO SCALE

The diagram shows a prism with a rectangular base, $ABFE$. The cross-section, $ABCD$, is a trapezium with $AD = BC$. $AB = 8$ cm, $GH = 5$ cm, $BF = 12$ cm and angle $ABC = 70^\circ$.

(a) Calculate the total surface area of the prism.

$$\begin{aligned}
 &= 8 - 5 = 3 \text{ cm} \\
 &= \frac{3}{2} = 1.5 \text{ cm} \\
 \hline
 &\tan 70^\circ = \frac{p}{1.5} \\
 &1.5 \tan 70^\circ = p \\
 &4.121216 = p \\
 &\text{3 s.f. } 4.12 \text{ cm} \approx p \\
 \hline
 &\cos 70^\circ = \frac{1.5}{h} \\
 &h = \frac{1.5}{\cos 70^\circ} \\
 &h = 4.3857066 \\
 &h \approx 4.39 \text{ cm (3 s.f.)}
 \end{aligned}$$

$$\begin{aligned}
 &\text{Area of 2 trapeziums} = 2 \times \left(\frac{1}{2} \times 4 \times 12 \right) \\
 &\text{Area of 2 trapeziums} = 2 \times \frac{1}{2} \times 4 \times 12 \times (5+8) \\
 &= 53.5758 \text{ cm}^2 \\
 &\therefore \text{Area of 2 sides} = 2 \times 12 \times 4.39 \quad \text{①} \\
 &= 105.25696 \text{ cm}^2 \\
 &\text{Area of base} = 12 \times 8 \\
 &= 96 \text{ cm}^2 \\
 &\text{Area of } CGHD = 12 \times 5 \\
 &= 60 \text{ cm}^2 \\
 &\dots\dots\dots 315 \dots\dots\dots \text{ cm}^2 \text{ [6]} \\
 &\text{T.S.A} = 60 + 96 + 105.25696 + 53.5758 \\
 &= 314.83276 \text{ cm}^2 \\
 &\approx 315 \text{ cm}^2 \text{ (3 s.f.)}
 \end{aligned}$$

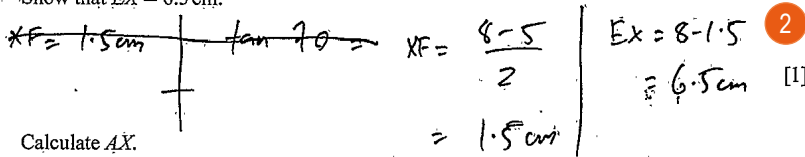
① The candidate presents a really well-structured solution. A particularly good feature is the explanation of which area is being calculated on the right-hand side. The answer is correct and within the required range. Mark for (a) = 6 out of 6

Example Candidate Response – high, continued

Examiner comments

(b) The perpendicular from G onto EF meets EF at X .

(i) Show that $EX = 6.5$ cm.



2 The candidate correctly shows the method leading to $EX = 6.5$ cm. Mark for (b)(i) = 1 out of 1

(ii) Calculate AX .

$(AX)^2 = (AE)^2 + (EX)^2$
 $\sqrt{(AX)^2} = \sqrt{12^2 + 6.5^2}$
 $AX = 13.64734$ [3]
 $\approx 13.6 \text{ cm (3 s.f.)}$ $AX = 13.6 \text{ cm [2]}$

3 The candidate gives a correct method leading to a correct answer. Examiners will mark the more accurate answer given 13.64734. Mark for (b)(ii) = 2 out of 2

(iii) Calculate the angle between the diagonal AG and the base $ABFE$.

~~$\cos A = \frac{13.6}{12}$~~
 $\tan A = \frac{p}{b}$
 $A = \tan^{-1}\left(\frac{4.1212}{13.64734}\right)$ [4]
 $A = 16.8^\circ$ (1 decimal place) 16.8° [2]

4 The candidate gives a correct answer using accurate values to at least 4 significant figures in the method which retains the accuracy of the final answer. Mark for (b)(iii) = 2 out of 2

Total mark awarded = 11 out of 11

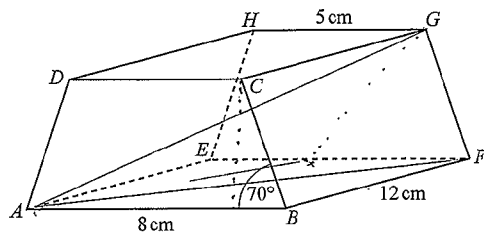
How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

9



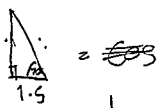
NOT TO SCALE

The diagram shows a prism with a rectangular base, $ABFE$. The cross-section, $ABCD$, is a trapezium with $AD = BC$. $AB = 8$ cm, $GH = 5$ cm, $BF = 12$ cm and angle $ABC = 70^\circ$.

(a) Calculate the total surface area of the prism.

$$\begin{aligned}
 \square &= W \times L & \square &= 5 \times 12 & \square &= \left(\frac{a+b}{2} \times h\right) \times 2 \\
 &= 8 \times 12 & &= 60 * & &= \left(\frac{5+8}{2} \times 4.12\right) 2 \\
 &= 96 * & & & &= 53.6 \text{ (b) } \textcircled{1} \\
 \square &= 2(12 \times 4.12) & & & & \\
 &= 98.9 \text{ (c)} & & & &
 \end{aligned}$$

$$\begin{aligned}
 \text{Total} &= 96 + 60 + 98.9 + 53.6 \\
 &= 308.5
 \end{aligned}$$



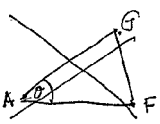
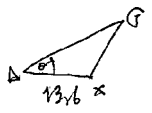
$$\tan 70 = \frac{x}{1.5}$$

$$1.5 \times \tan 70 = x$$

$$x = 4.12 \text{ (a)}$$

$$\dots\dots\dots 308.5 \dots\dots\dots \text{ cm}^2 \text{ [6]}$$

1 The candidate uses a staged approach to calculate the area of each surface. The base and top are given as 96 and 60 and are awarded one mark. The perpendicular height is correctly found as 4.12 and then used correctly to find the area of the trapezium-shaped ends to earn two further marks. There is an error in using 4.12 for the length of BC when calculating the areas of the slant faces of the prism. Mark for (a) = 3 out of 6

Example Candidate Response – middle, continued	Examiner comments
<p>(b) The perpendicular from G onto EF meets EF at X.</p> <p>(i) Show that $EX = 6.5$ cm.</p> <p style="text-align: right;">2 [1]</p>	<p>2 The candidate has not attempted a response. Mark for (b)(i) = 0 out of 1</p>
<p>(ii) Calculate AX.</p> <p>$c^2 = a^2 + b^2$</p> <p>$C = \sqrt{6.5^2 + 12^2}$</p> <p>$C =$</p> <p>$AX = 13.6$ cm [2]</p> <p style="text-align: right;">3</p>	<p>3 The candidate gives a correct answer which is awarded two marks. Mark for (b)(ii) = 2 out of 2</p>
<p>(iii) Calculate the angle between the diagonal AG and the base $ABFE$.</p>   <p style="text-align: right;">4 [2]</p>	<p>4 Although the answer space is blank, the candidate shows a diagram indicating that GAX is the required angle, and this is sufficient to be awarded one mark. Mark for (b)(iii) = 1 out of 2</p> <p>Total mark awarded = 6 out of 11</p>

How the candidate could have improved their answer

- (a) Part marks were awarded for some of the areas of the faces. To improve, the length BC needed to be calculated and used to find the area of the faces $BCGF$ and $ADHE$.
- In the final part, a diagram was drawn. To find the angle, a trigonometric method using AX and GX was required. The length GX has already been calculated in (a).

Example Candidate Response – low

Examiner comments

9

NOT TO SCALE

The diagram shows a prism with a rectangular base, $ABFE$. The cross-section, $ABCD$, is a trapezium with $AD = BC$. $AB = 8$ cm, $GH = 5$ cm, $BF = 12$ cm and angle $ABC = 70^\circ$.

(a) Calculate the total surface area of the prism.

2 + 2 + top + bottom

$$2\left(\frac{1}{2}(8+5) \times 2.8\right) + (12 \times 2.8) + (8 \times 12) + [5 \times 12]$$

$$= 32.4 + 33.6 + 96 + 60$$

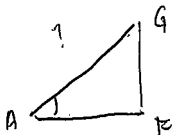
$\frac{3}{\sin 80} \neq \frac{8}{\sin 70}$

$\frac{3}{\sin 80} \times \sin 70 = 2.8$

$AC = \sqrt{2.8^2 - 3^2}$

..... 224 cm^2 [6]

1 The candidate calculates areas using an organised approach but has made errors with the trigonometry when finding the perpendicular height of the trapezium. One mark is awarded for correctly obtaining areas of the base and top. Another mark is awarded for the method for the area of the trapezium which allows 2.8 for the height as this value has come from an attempt at trigonometry. The incorrect value (2.8) has also been used to calculate the area of the rectangle $BCGF$. Mark for (a) = 2 out of 6

Example Candidate Response – low, continued	Examiner comments
<p>(b) The perpendicular from G onto EF meets EF at X.</p> <p>(i) Show that $EX = 6.5$ cm.</p> $\frac{1}{2} \times 13 = 6.5$ <p>(ii) Calculate AX.</p> $\sqrt{2.8^2 + 12^2}$ $AX = 4.10 \dots \text{cm} [2]$ <p>(iii) Calculate the angle between the diagonal AG and the base $ABFE$.</p>  $\frac{70}{2} = 35^\circ$ $35^\circ \dots [2]$	<p>2 No mark is awarded as the candidate does not show where the 13 comes from. Mark for (b)(i) = 0 out of 1</p> <p>3 An incorrect answer and incorrect application of Pythagoras' so no marks awarded. Mark for (b)(ii) = 0 out of 2</p> <p>4 An incorrect method and an incorrect answer so no marks awarded. Mark for (b)(iii) = 0 out of 2</p> <p>Total mark awarded = 2 out of 11</p>

How the candidate could have improved their answer

- **(a)** Part marks have been earned for some of the areas of the faces. The errors occur in finding the perpendicular height of the trapezium and in not finding the length BC . A separate diagram of the relevant right-angled triangle would have helped with the calculation of these lengths.
- **(b)(i)** Insufficient steps are shown in finding the value 13. To improve, the calculation $5 + 8$ leading to 13 should have been written.
- **(b)(ii)** The candidate could have produced a diagram identifying the relevant triangle containing AX . This would have helped to use the correct values in the method.
- **(b)(iii)** Drawing a 2D right-angled triangle containing angle GAX may have helped.

Common mistakes candidates made in this question

- **(a)** Common errors included premature rounding of intermediate values to 2 significant figures, which sometimes led to an accuracy error with the final answer, using an incorrect height due to incorrect trigonometry with the trapezium area and using an incorrect length when finding the area of the slant side faces.
- **(b)(i)** Common errors included using long circular methods to find 6.5.
- **(b)(ii)** The most common error was to use $AF = \sqrt{8^2 + 12^2}$.
- **(b)(iii)** Many candidates had difficulty visualising the required angle and often angle GAF was found or the question was not attempted.

Question 10

Example Candidate Response – high	Examiner comments
<p>10 $f(x) = x^2 + 1$ $g(x) = 1 - 2x$ $h(x) = \frac{1}{x}, x \neq 0$ $j(x) = 5^x$</p> <p>(a) Find the value of</p> <p>(i) $f(3)$, $f(3) = 3^2 + 1 = 9 + 1 = 10$ 10 [1]</p> <p>(ii) $gf(3)$. $f(3) = 10$ $g(10) = 1 - 2(10)$ $= 1 - 20 = -19$ -19 [1]</p> <p>(b) Find $g^{-1}(x)$. $g(x) = -2x + 1$ $g^{-1}(x) = \frac{x-1}{-2}$ $y = -2x + 1$ $g^{-1}(x) = \frac{x+1}{2}$ $x = -\frac{2y+1}{2}$ $\frac{x-1}{2} = y$ $\frac{-x+1}{2}$ [2]</p> <p>(c) Find x when $h(x) = 2$. $\frac{1}{x} = 2$ $x = \frac{1}{2}$ $\frac{1}{2}$ [1]</p> <p>(d) Find $g(x)g(x) - gg(x)$, giving your answer in the form $ax^2 + bx + c$. $g(x) \times g(x) = (1-2x)^2$ $(1-2x)^2 = (1-2x)(1-2x)$ $= 1 - 2x - 2x + 4x^2$ $= 4x^2 - 4x + 1$ $gg(x) = 1 - 2(1-2x)$ $= 1 - 2 + 4x$ $= 4x - 1$ $4x^2 - 4x + 1 - (4x - 1)$ $4x^2 - 4x - 4x + 1 + 1$ $= 4x^2 - 8x + 2$ $4x^2 - 8x + 2$ [4]</p>	<p>1 The candidate gives correct values in (a) and both are awarded one mark each. Mark for (a) = 2 out of 2</p> <p>2 The candidate supplies a correct answer for the inverse of function g supported by correct working. Mark for (b) = 2 out of 2</p> <p>3 The candidate gives a correct answer which is awarded one mark. Mark for (c) = 1 out of 1</p> <p>4 Here, the candidate works in stages looking at $g(x)g(x)$ before $gg(x)$ and then bringing both parts together. The important stage is the use of brackets with $(4x - 1)$ when subtracting $gg(x)$ and this ensures there are no sign errors, leading to a correct final answer. Mark for (d) = 4 out of 4</p>

Example Candidate Response – high, continued	Examiner comments
<p>(e) Find $hh(x)$, giving your answer in its simplest form.</p> $\frac{1}{x} \circ \frac{1}{x} = \frac{1 \times x}{1} = x$ <p>..... [1]</p>	<p>5 The candidate gives a correct, simplified answer which is awarded one mark. Mark for (e) = 1 out of 1</p>
<p>(f) Find $j(5)$.</p> $j(x) = 5^x \quad j(5) = 5^5 = 3125$ <p>..... [1]</p>	<p>6 A correct answer which is awarded one mark. Mark for (f) = 1 out of 1</p>
<p>(g) Find x when $j^{-1}(x) = 2$.</p> $y = 5^x \quad x = 5^y$ $2 = 5^x \quad x = 25$ <p>..... [1]</p>	<p>7 A correct answer which is awarded one mark. Mark for (g) = 1 out of 1</p>
<p>(h) $j(x) = hg(-12)$</p> <p>Find the value of x.</p> $g(-12) = 1 - (2 \times -12)$ $g(-12) = 1 - (-24)$ $g(-12) = 1 + 24$ $g(-12) = 25$ $h(x) = \frac{1}{25}$ $h(x) = 0.04$ $5^x = \frac{1}{25}$ $x = -2$ <p>..... [2]</p>	<p>8 The candidate gives a correct answer which is supported by correct working. Mark for (h) = 2 out of 2</p> <p>Total mark awarded 14 out of 14</p>

How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

10 $f(x) = x^2 + 1$ $g(x) = 1 - 2x$ $h(x) = \frac{1}{x}, x \neq 0$ $j(x) = 5^x$

(a) Find the value of

(i) $f(3)$, $3^2 + 1$ 10 [1]

(ii) $gf(3)$, $g(3^2 + 1) = 1 - 2(10)$ -19 [1]

(b) Find $g^{-1}(x)$.

$g(x) = 1 - 2x$ $g^{-1}(x) = \frac{x-1}{2}$
 $y = 1 - 2x$
 $-2x = y - 1$
 $x = \frac{y-1}{-2}$
 $g^{-1}(x) = \frac{x-1}{2}$ [2]

(c) Find x when $h(x) = 2$.

$\frac{1}{x} = 2$
 $2x = 1$
 $x = \frac{1}{2}$
 $x = \frac{1}{2}$ [1]

(d) Find $g(x)g(x) - gg(x)$, giving your answer in the form $ax^2 + bx + c$.

$g(x)g(x) - gg(x)$
 $= (1-2x)(1-2x) - g(1-2x)$
 $= (1-2x)(1-2x) - 1-2(1-2x)$
 $= 1-2x-2x+4x^2-1-2-4x$
 $= -8x-2+4x^2$
 $= 4x^2-8x-2$ [4]

1 The candidate correctly answers both parts of (a). Mark for (a) = 2 out of 2

2 The inverse of function g is incorrect. The candidate gives a correct first step in line 3 of the working and is awarded a mark. However, greater care was needed when dividing by negative 2 and then transcribing to the answer space. Mark for (b) = 1 out of 2

3 The candidate gives a correct answer which is awarded one mark. Mark for (c) = 1 out of 1

4 The final answer is incorrect as the candidate makes an error with the substitution into $-gg(x)$ resulting in sign errors. The working is awarded a single mark for the correct expansion of $(1 - 2x)(1 - 2x)$ in line 4. Mark for (d) = 1 out of 4

Example Candidate Response – middle, continued	Examiner comments
<p>(e) Find $hh(x)$, giving your answer in its simplest form.</p> $= \frac{h(h(x))}{\frac{1}{x}} = \frac{1}{x^{-1}} = \dots\dots\dots x \quad [1]$	<p>5 The candidate gives a correct answer and is awarded one mark. Mark for (e) = 1 out of 1</p>
<p>(f) Find $j(5)$.</p> $j(x) = 5^x$ $j(5) = 5^5$ $\dots\dots\dots 3125 \quad [1]$	<p>6 The candidate gives a correct answer and is awarded one mark. Mark for (f) = 1 out of 1</p>
<p>(g) Find x when $j^{-1}(x) = 2$.</p> $j(x) = 5^x$ $j^{-1}(x) = \sqrt{x}$ $\sqrt{x} = 2$ $x = 4$ <p>Find the value of x.</p>	<p>7 The candidate needs to show that the inverse function maps back to the original value, leading to 5^2. No mark is awarded. Mark for (g) = 0 out of 1</p>
<p>(h) $j(x) = hg(-12)$</p> $j(x) = hg(-12)$ $5^x = h(1 - 2(-12))$ $5^x = h(25)$ $5^x = \frac{1}{25}$ $5^x = \frac{1}{5^2}$ $5^x = 5^{-2}$ $x = -2$ $x = \dots\dots\dots -2 \quad [2]$	<p>8 The candidate supplies a correct answer which is awarded two marks. Mark for (h) = 2 out of 2</p>
<p>Total mark awarded = 9 out of 14</p>	

How the candidate could have improved their answer

(b), (d) The issues involved dealing correctly with directed numbers. For example, in (d), brackets are needed when subtracting $gg(x)$ to ensure that the negative terms are subtracted.

Example Candidate Response – low

Examiner comments

10 $f(x) = x^2 + 1$ $g(x) = 1 - 2x$ $h(x) = \frac{1}{x}, x \neq 0$ $j(x) = 5^x$

(a) Find the value of

(i) $f(3)$,
 10 [1]

(ii) $gf(3)$.
 5 [1]

(b) Find $g^{-1}(x)$.

 $g^{-1}(x) = \dots 2x + 1 \dots$ [2]

(c) Find x when $h(x) = 2$.

 $x = \dots \frac{1}{2} \dots$ [1]

(d) Find $g(x)g(x) - gg(x)$, giving your answer in the form $ax^2 + bx + c$.

 $1 - 2x^2 - 2x + 1$

 $1 - 2x^2 - 2x + 1$ [4]

1 In (a), 10 is correct and is awarded one mark, but 5 is wrong and no method is shown. Mark for (a) = 1 out of 2

2 No marks are awarded for this incorrect answer. Mark for (b) = 0 out of 2

3 A correct answer is awarded one mark. Mark for (c) = 1 out of 1

4 No marks are awarded as the substitution is incorrect and this leads to an incorrect answer. Mark for (d) = 0 out of 4

Example Candidate Response – low, continued

Examiner comments

(e) Find $hh(x)$, giving your answer in its simplest form.

$\frac{1}{x^2}$ [1]

(f) Find $j(5)$.

3.125 [1]

(g) Find x when $j^{-1}(x) = 2$.

$x = \frac{1}{3.125}$ [1]

(h) $j(x) = hg(-12)$

Find the value of x .

$\frac{1}{x} + 1 - 2x = -2$

$\frac{1}{x} - 2x = -3$

$x - \frac{2x}{1} = -3$

$x - 2x = -\frac{1}{3}$

$-3x = -\frac{1}{3} \quad x =$

$x = \frac{1}{9}$ [2]

5 The candidate gives an incorrect answer with no working shown.

Mark for (e) = 0 out of 1

6 The candidate gives a correct answer which is awarded one mark.

Mark for (f) = 1 out of 1

7 The candidate supplies an incorrect answer with no working shown.

Mark for (g) = 0 out of 1

8 The candidate's working and answer are both incorrect.

Mark for (h) = 0 out of 2

Total mark awarded = 3 out of 14

How the candidate could have improved their answer

- The issue throughout is in correctly interpreting the function notation for both composite functions and inverses and to improve, the candidate needed to understand the used notation as a starting point.
- **(a)(ii)** The candidate needed to substitute 10 into function g and then evaluate.
- **(b)** The candidate needed to show steps in the working. A correct first step shown would have been awarded one mark.
- **(d)** The candidate should first consider $g(x)g(x)$ is $(1 - 2x)^2$ and that $-gg(x)$ is $-(1 - 2(1 - 2x))$.
- **(e)** The candidate could show the full substitution of x into hh as a first step.
- **(g)** The candidate needed to recognise that the inverse function 'undoes' the function.
- **(h)** The candidate needed to substitute -12 into hg and then equate the answer to 5^x .

Common mistakes candidates made in this question

- **(a)(i)** This was nearly always answered correctly.
- **(a)(ii)** Almost all candidates answered this part correctly.
- **(b)** Following a correct first step, making a sign error in the next step when dividing by -2 for example was a common error.
- **(c)** This was nearly always answered correctly.
- **(d)** The most common error was omitting any brackets when writing $-gg(x)$ in terms of the function and then making errors when subtracting $gg(x)$ from $g(x)g(x)$.
- **(e)** Although many candidates were able to write down an expression in x , the common error was not to write it in the simplest form, e.g. an answer of $\frac{x}{1}$.
- **(f)** This was nearly always correct.
- **(g)** A common incorrect answer was $\frac{1}{25}$ or 32.
- **(h)** Candidates who did not gain full marks were often awarded 1 mark for reaching the value $\frac{1}{25}$ and a common error was then to give an answer 2.

Question 11

Example Candidate Response – high

Examiner comments

11

$n^3 = 1, 9, 27, 64$

Sequence	1st term	2nd term	3rd term	4th term	5th term	n th term
A	13	9	5	1	-3	$17 - 4n$ 1
B	0	7	26	63	124	$n^3 - 1$
C	$\frac{7}{8}$	$\frac{8}{16}$	$\frac{9}{32}$	$\frac{10}{64}$	$\frac{11}{128}$	$\frac{n+b}{8 \times 2^{n-1}}$

(a) Complete the table for the three sequences.

~~$a + (n-1)d = 13 + (n-1)4$~~ $a - (n-1)d = 13 - (n-1)4$
 ~~$= 17 - 4n$~~ $= 17 - 4n$

~~$0, 7, 26, 63$~~ $n^3 = 1, 9, 27, 64$
 ~~$1, 8, 27, 64$~~ $t = 0, 8, 26, 63$
 $(n^3 - 1)$

$n + b$
 $a \times r^{n-1} = 8 \times 2^{n-1}$ [10]

(b) One term in Sequence C is $\frac{p}{q}$.

Write down the next term in Sequence C in terms of p and q .

~~$\frac{p+b}{8 \times 2^{n-1}}$~~ ~~$\frac{p+b}{2q}$~~ $\frac{p+1}{2q}$

~~$\frac{p+b}{2q}$~~ $\frac{p+1}{2q}$ 2 [2]

1 The candidate supplies the correct 5th term for each sequence. In each case, the n th term is also correctly expressed and full marks are awarded. Mark for (a) = 10 out of 10

2 The candidate provides a correct expression which is awarded both marks. Mark for (b) = 2 out of 2

Total mark awarded = 12 out of 12

How the candidate could have improved their answer

The candidate produced a good answer that was awarded full marks.

Example Candidate Response – middle

Examiner comments

11

Sequence	1st term	2nd term	3rd term	4th term	5th term	n th term
A	13	9	5	1	-3	$-4n+17$
B	0	7	26	63		
C	$\frac{7}{8}$	$\frac{8}{16}$	$\frac{9}{32}$	$\frac{10}{64}$	$\frac{11}{128}$	$\frac{7+n}{4n^2+4n+3}$

(a) Complete the table for the three sequences.

$$\begin{array}{l}
 a+(n-1)d \\
 13+(n-1)(-4) \\
 13-4n+4 \\
 -4n+17
 \end{array}
 \quad
 \left|
 \begin{array}{l}
 7+n \\
 8(n)+8
 \end{array}
 \right.$$

$$\begin{array}{r}
 8 \quad 16 \quad 32 \\
 \underline{2} \quad \quad \quad \underline{16}
 \end{array}$$

1

1 The candidate completes Sequence A correctly. Sequence C has the 5th term correct but not the n th term so four marks are awarded. Mark for (a) = 4 out of 10

[10]

(b) One term in Sequence C is $\frac{p}{q}$.

Write down the next term in Sequence C in terms of p and q .

$$\frac{p+1}{q \times 2}$$

$$\frac{p+1}{q \times 2} \quad 2 \quad [2]$$

2 The working shown here is marked for (a) as the denominator of the fraction for the n th term. It is incorrect however and is awarded no marks.

$$\begin{aligned}
 & a+(n-1)d + \frac{d}{2}(n-1)(n-2) \\
 & 8 + (n-1)8 + \frac{8}{2}(n^2-3n+2) \\
 & 8 + 8n - 8 \\
 & 8n + 4n^2 - 12n + 8 \\
 & 4n^2 - 4n + 8
 \end{aligned}$$

3

3 The candidate provides a correct expression which is awarded two marks. $q \times 2$, without simplification to $2q$, is acceptable. Mark for (b) = 2 out of 2

Total mark awarded = 6 out of 12

How the candidate could have improved their answer

(a) Some marks are earned for Sequence A and Sequence C. To improve, the working space could be used to explore Sequence B to establish a pattern which leads to a cubic sequence.

Example Candidate Response – low

Examiner comments

11

Sequence	1st term	2nd term	3rd term	4th term	5th term	n th term
A	13	9	5	1	-3	$13 + (n - 4 + 8)$
B	0	7	26	63	119	
C	$\frac{7}{8}$	$\frac{8}{16}$	$\frac{9}{32}$	$\frac{10}{64}$	$\frac{11}{128}$	$\frac{7}{8} + (n - 1) \times \frac{1}{2}$

(a) Complete the table for the three sequences.

[10]

(b) One term in Sequence C is $\frac{p}{q}$.

Write down the next term in Sequence C in terms of p and q .

..... $\frac{12p}{256q}$ [2]

1 The candidate gives the 5th terms of Sequence A and C correctly and is awarded two marks. The n th term of Sequence A contains the term $-4n$ which is awarded another one mark. Mark for (a) = 3 out of 10

2 The candidate gives an incorrect answer which is not awarded any marks. Mark for (b) = 0 out of 2

Total mark awarded = 3 out of 12

How the candidate could have improved their answer

- (a) The candidate could have used the working space to explore Sequence B in order to establish a pattern which lead to a cubic sequence.
- (b) The terms of Sequence C could have been written out and patterns from term to term explored to find an expression.

Common mistakes candidates made in this question

- (a) Sequence B was the least well done, with candidates often attempting difference methods leading to an incorrect answer in many instances.
- (b) A number of candidates tried to use their answers to (a). Simple examination of the term-to-term difference of the first five numerical values given was the method to use here.

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