

**GCSE (9–1)**

*Exemplar Candidate Work*

# **MATHEMATICS**

**J560**

For first teaching in 2015

**J560/05 Summer 2019  
examination series**

Version 1

# Contents

Introduction	3	Question 10 (a)	24
Question 1	4	Question 10 (b)	25
Question 2 (a)	5	Question 11 (a)	26
Question 2 (b)	6	Question 12 (a)	27
Question 3 (a)	7	Question 12 (b)	28
Question 3 (b)	8	Question 13	30
Question 4 (a)	9	Question 14	32
Question 5 (b)	10	Question 15	34
Question 5 (d)	12	Question 16 (a)	36
Question 6 (a)	14	Question 16 (b)	39
Question 6 (b)	15	Question 17 (a)	41
Question 7	16	Question 17 (b)	42
Question 8	18	Question 18	44
Question 9 (a)	20	Question 19 (b) (i) and (ii)	47
Question 9 (b)	22		

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# Introduction

These exemplar answers have been chosen from the summer 2019 examination series.

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

Please always refer to the specification <https://www.ocr.org.uk/Images/168982-specification-gcse-mathematics-j560.pdf> for full details of the assessment for this qualification. These exemplar answers should also be read in conjunction with the sample assessment materials and the June 2019 Examiners' report or Report to Centres available from Interchange <https://interchange.ocr.org.uk/>.

The question paper, mark scheme and any resource booklet(s) will be available on the OCR website from summer 2020. Until then, they are available on OCR Interchange (school exams officers will have a login for this and are able to set up teachers with specific logins – see the following link for further information <http://www.ocr.org.uk/administration/support-and-tools/interchange/managing-user-accounts/>).

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

# Question 1

1 Work out  $(2 \times 10^3) \times (4 \times 10^4)$ , giving your answer in standard form.

..... [2]

## Exemplar 1

2 marks

$$2 \times 10^3 \times 40 \times 10^3$$

$$80 \times 10^6 = 8 \times 10^7$$
~~$$2000 \times 40000 = 80000000$$~~

$$8 \times 10^7$$

..... [2]

### Examiner commentary

This exemplar shows the correct answer supported by correct working. The candidate has used two methods to work out and check the answer.

## Exemplar 2

1 mark

$$2 \times 10^3 \times 40 \times 10^3$$
~~$$80 \times 10^3$$~~

$$80 \times 10^3$$

$$8 \times 10^4$$

..... [2]

### Examiner commentary

This candidate makes an error with the indices when multiplying but gives an answer with figs 8 and is awarded 1 mark. The candidate could have improved the answer by applying the rules of indices correctly when multiplying  $10^3$  by  $10^3$  before making the adjustment to standard form.

# Question 2 (a)

2 (a) Simplify fully.

$$\frac{3a^8 \times 2a^5}{a^2}$$

(a) ..... [3]

## Exemplar 1

2 marks

$$\frac{ba^{13}}{a^2} = b^{11}$$

(a) .....  $ba^2$  ..... [3]

## Examiner commentary

The candidate simplifies the numerator of the expression correctly before making an error with the answer and is awarded B2 for showing  $\frac{6a^{13}}{a^2}$ .

## Exemplar 2

1 mark

$$\frac{a(3a^7 \times 2a^4)}{a^2} = \frac{a(3a^7 \times 2a^2)}{a^2} = \frac{a(3a^9 \times 2)}{a^2} = \frac{6a^{10}}{a^2} = 6a^8$$

(a) .....  $6a^8$  ..... [3]

## Examiner commentary

This candidate makes errors with the indices in their working but gets to an answer of the form  $6a^k$  having dealt with the coefficients correctly and is awarded B1.

The candidate did not need to factorise the numerator as the first step and may have avoided subsequent issues by evaluating the numerator as  $6a^{13}$  as the first step before cancelling with the denominator.

# Question 2 (b)

(b) Solve.

$$\frac{6x - 10}{5} = 1$$

(b)  $x = \dots\dots\dots$  [3]

## Exemplar 1

2 marks

Handwritten working for Exemplar 1:

$$6x = 15$$

$$\sqrt[15]{15}$$

$$6 \overline{) 15.10.40}$$

2.16

$$\frac{(6 \times 2.16) - 10}{5} = 1$$

(b)  $x = \dots\dots\dots 2.16$  [3]

## Examiner commentary

$6x = 15$  shown in the working implies that the first step and second step in solving the equation have both been completed correctly. There is then an error in evaluating the solution, so the candidate is awarded M1 M1.

The candidate could have written the answer as a simplified fraction  $\frac{15}{6} = \frac{5}{2}$  and avoided formal division to score all 3 marks.

## Exemplar 2

1 mark

Handwritten working for Exemplar 2:

$$\frac{6x - 10}{5} = 1$$

30, 60, 90, 120, 150, 180, 210, 240  
1 2 3 4 5 6 7 8

$$(6x - 10) \times 5 = 1 \times 5$$

$$30x - 50 = 5$$

$$+ 50$$

$$30x = 55$$

$$x = 1.83$$

$$55 \overline{) 30}$$

$$30 \overline{) 55.25.0}$$

$$30 \overline{) 55.25.10.0}$$

(b)  $x = \dots\dots\dots$  [3]

## Examiner commentary

The candidate makes an error in the first line of working when multiplying by 5 as they have overlooked the fact that this step removes the fraction from the left-hand side of the equation.

The second step is correct following through their first line of working and can be awarded M1 when they reach  $30x = 55$ .

# Question 3 (a)

3 Ed has a card shop.

(a) He buys a particular card for £1.20 and sells it for £1.68.

Calculate his percentage profit on this card.

(a) ..... % [3]

## Exemplar 1

3 marks

(a) He buys a particular card for £1.20 and sells it for £1.68.

Calculate his percentage profit on this card.

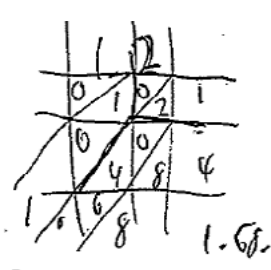
Handwritten working for Exemplar 1:

$$1.20 \times \frac{1.4}{100} = 1.68$$

$$1.68 - 1.20 = 48$$

$$\frac{48}{120} = \frac{24}{60} = \frac{2}{5}$$

(a) ..... 40 ..... % [3]



## Examiner commentary

A correct response that shows a concise method of obtaining and then simplifying the fraction  $\frac{48}{120}$  to reach  $\frac{2}{5}$  which is then easier to recognise as 40%.

## Exemplar 2

1 mark

Calculate his percentage profit on this card.

Handwritten working for Exemplar 2:

$$1.68 - 1.20 = 48$$

$$\frac{1.68}{1.20}$$

(a) ..... 48 ..... % [3]

## Examiner commentary

This exemplar shows an incorrect answer but the candidate earns M1 for  $1.68 - 1.20$  shown in their working.

The candidate needed to use the difference in the costs as a proportion of the original cost to then go on to find the percentage.

# Question 3 (b)

- (b) Ed's profit on "Good Luck" cards in 2018 was £360. This was a decrease of 20% on his profit in 2017.

Work out Ed's profit on "Good Luck" cards in 2017.

(b) £ ..... [3]

## Exemplar 1

3 marks

- (b) Ed's profit on "Good Luck" cards in 2018 was £360. This was a decrease of 20% on his profit in 2017.

Work out Ed's profit on "Good Luck" cards in 2017.

2018 profit is 80% of last year's profit <sup>2017</sup>

$$360 \div 4 \times 5 = 90 \times 5 = 450$$

(b) £ ..... 450 [3]

## Examiner commentary

A concise method where the profit in 2018 is recognised as 80% of the profit in 2017. The candidate shows insight and makes the calculation easier by dividing by  $\frac{4}{5}$  rather than 0.8.

## Exemplar 2

0 marks

$$10\% \text{ OF } 360 = 36$$

$$20\% \text{ OF } 360 = 72$$

$$\begin{array}{r} 360 \\ - 72 \\ \hline \end{array}$$

$$\begin{array}{r} 72 \\ 1 \quad \backslash \\ 12 \quad 60 \end{array}$$

$$\begin{array}{r} 360 - 72 \\ \hline 360 - 80 = 280 \\ \quad \swarrow \\ 280 - 12 = 268 \end{array}$$

(b) £ ..... £288 [3]

## Examiner commentary

This type of response highlights a common error where 80% of £360 is calculated rather than regarding £360 as 80% of the required profit.

To improve this response, the candidate needed to recognise as a first step that in 2018, £360 is 80% of the profit in 2017.



## Question 4 (a)

- 4 (a) A sunflower grows at a rate of 4 cm each day.

How many days does it take to grow from a height of 80 cm to more than 1.06 m?

(a) ..... [3]

### Exemplar 1

2 marks

$$106 - 80 = 26$$

$$\frac{26}{4} = 6.5 \text{ days}$$

(a) ..... 6.5 days ..... [3]

### Examiner commentary

This candidate shows a correct calculation to reach 6.5 days but does then not give an answer of a whole number of days. This scores B2.

### Exemplar 2

1 mark

4cm every day

$$1.06 \text{ m} = 106 \text{ cm}$$

$$106 - 80 = 26$$

$$26 \div 4 = 7.5 = 8 \text{ days}$$

(a) ..... 8 days ..... [3]

### Examiner commentary

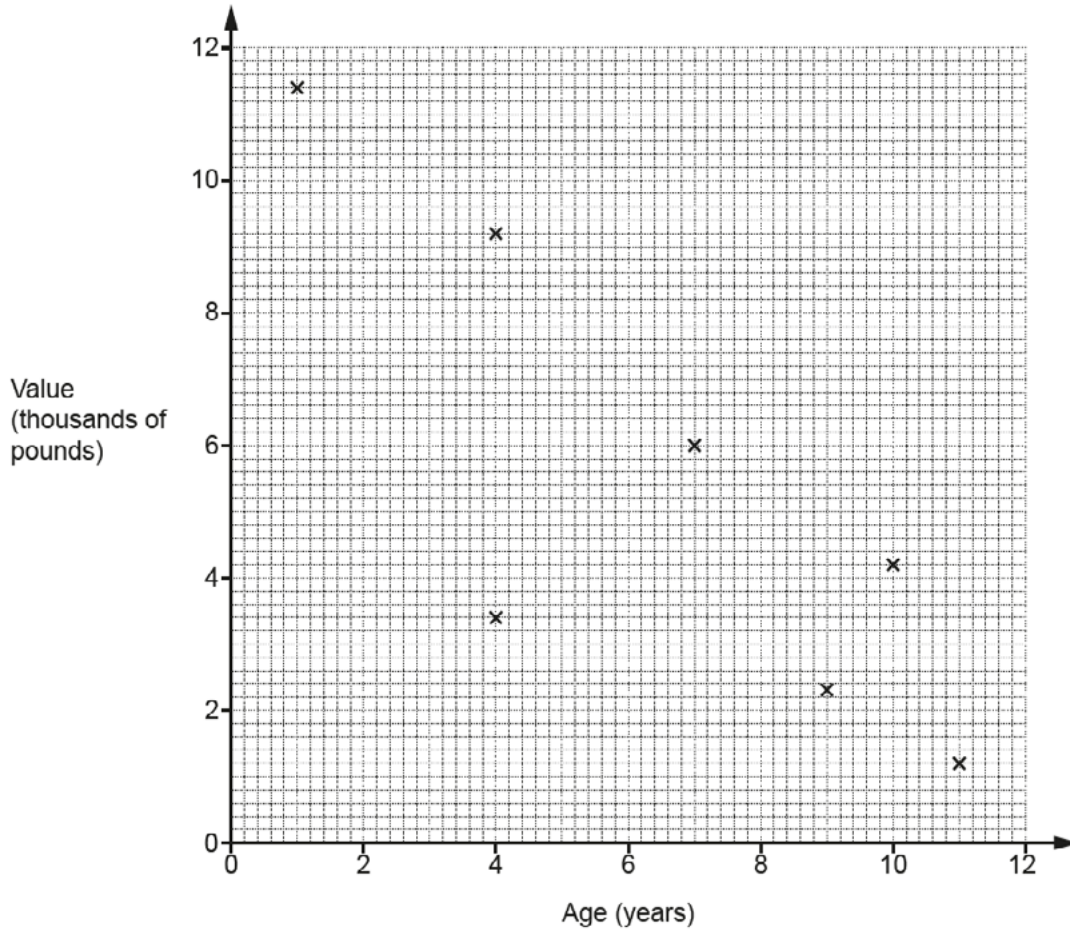
The candidate shows  $(106 - 80) \div 4$  in working before making a processing error. M1 is awarded.

# Question 5 (b)

5 The table shows the ages and values of 11 cars of the same model.

Age (years)	4	7	11	1	9	10	4	3	7	8	12
Value (thousands of pounds)	9.2	6.0	1.2	11.4	2.3	4.2	3.4	8.0	5.6	5.0	0.4

The points for the first 7 cars are plotted on the scatter diagram.



(b) Describe the type and strength of the correlation shown in the completed scatter diagram.

..... [2]

## Exemplar 1

2 marks

(b) Describe the type and strength of the correlation shown in the completed scatter diagram.

..... It is a strong negative correlation. .... [2]

## Examiner commentary

Both marks are awarded for correct type and strength of correlation.

## Exemplar 2

**1 mark**

(b) Describe the type and strength of the correlation shown in the completed scatter diagram.

..... weak negative ..... [2]

### Examiner commentary

This candidate has the correct type of correlation but the strength is incorrect. This scores 1 mark.

# Question 5 (d)

(d) By drawing a line of best fit, estimate the value of a car that is 6 years old.

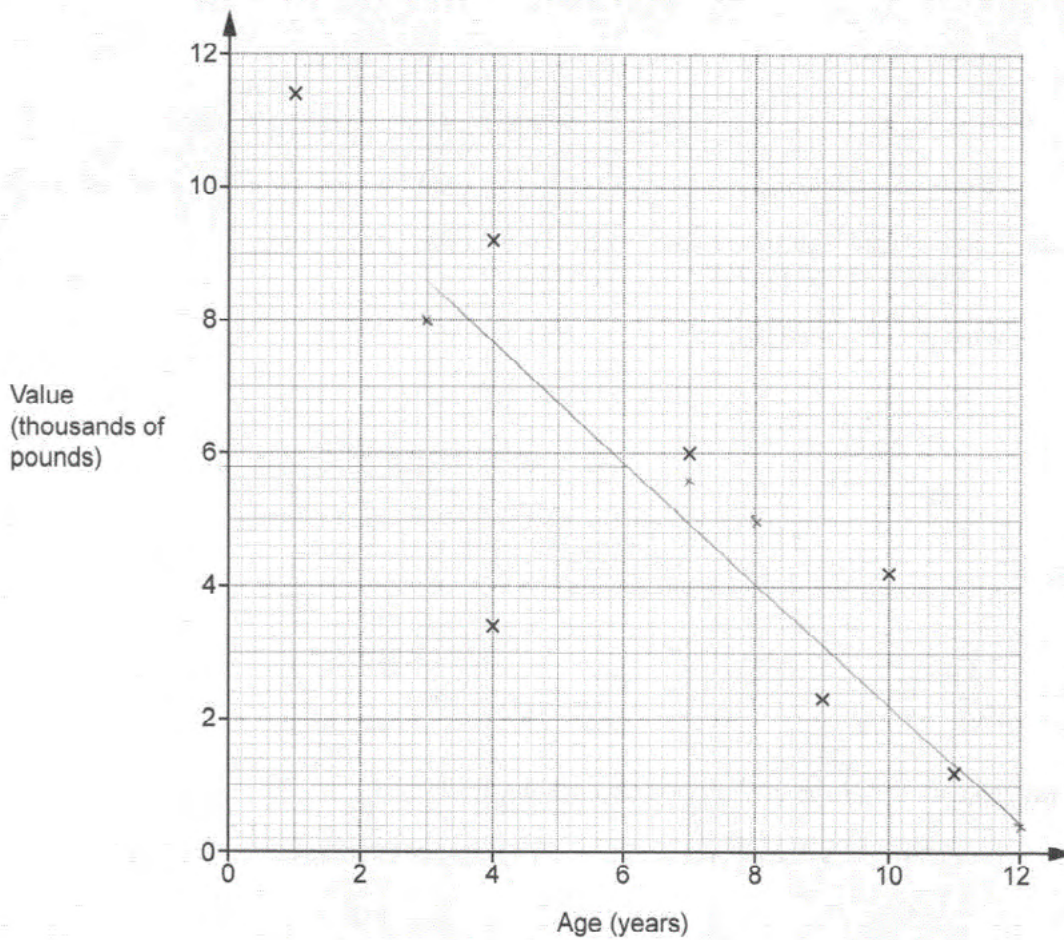
(d) £ ..... [2]

## Exemplar 1

1 mark

Age (years)	4	7	11	1	9	10	4	3	7	8	12
Value (thousands of pounds)	9.2	6.0	1.2	11.4	2.3	4.2	3.4	8.0	5.6	5.0	0.4

The points for the first 7 cars are plotted on the scatter diagram.



(d) By drawing a line of best fit, estimate the value of a car that is 6 years old.

(d) £ 5800 ..... [2]

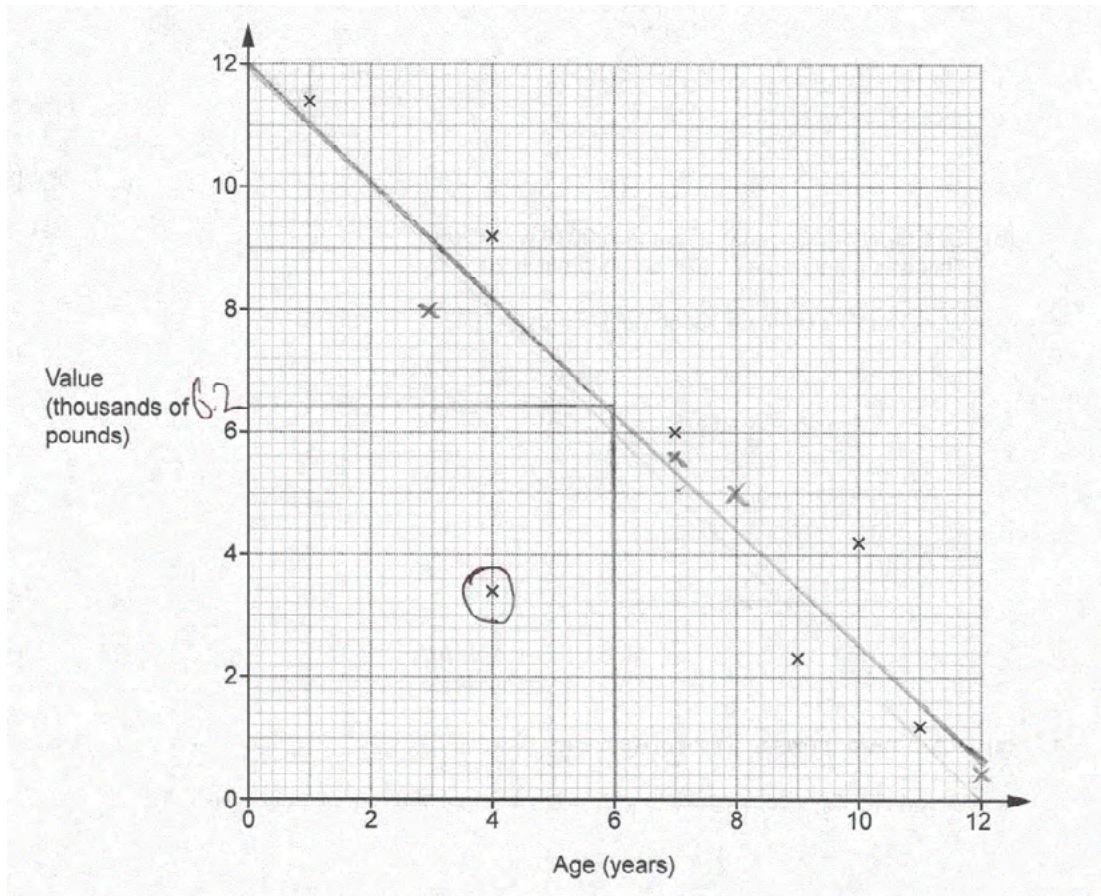
## Examiner commentary

In this exemplar, the candidate is awarded 1 mark. The line of best fit is too short on the left-hand side of the graph but the value has been correctly read as £5800 from the drawn ruled line.

The line of best fit needs to extend fully through the data provided on the graph.

## Exemplar 2

1 mark



(d) By drawing a line of best fit, estimate the value of a car that is 6 years old.

(d) £ 6.2 thousand [2]

### Examiner commentary

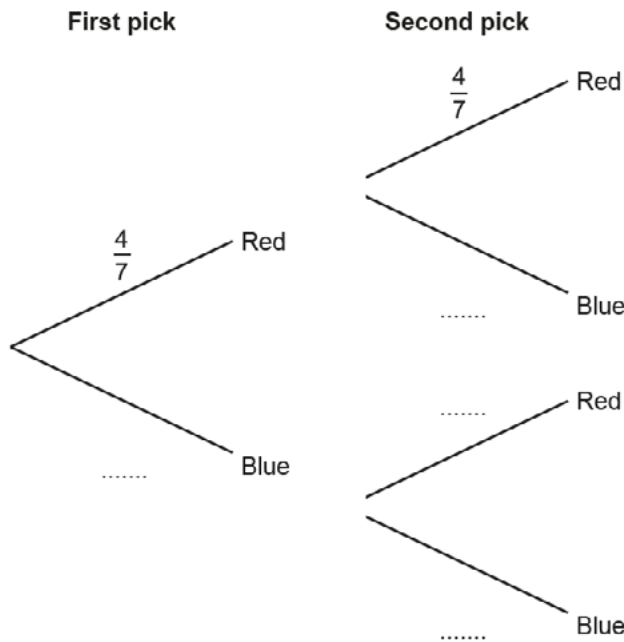
The line of best fit is acceptable but the scale has been misinterpreted when reading the graph at 6 years so B1 is awarded.

Care is needed when reading scales to ensure that the scale is correctly interpreted.

# Question 6 (a)

- 6 A bag contains 4 red counters and 3 blue counters only. Jack picks a counter at random and then replaces it. Jack then picks a second counter at random.

(a) Complete the tree diagram.

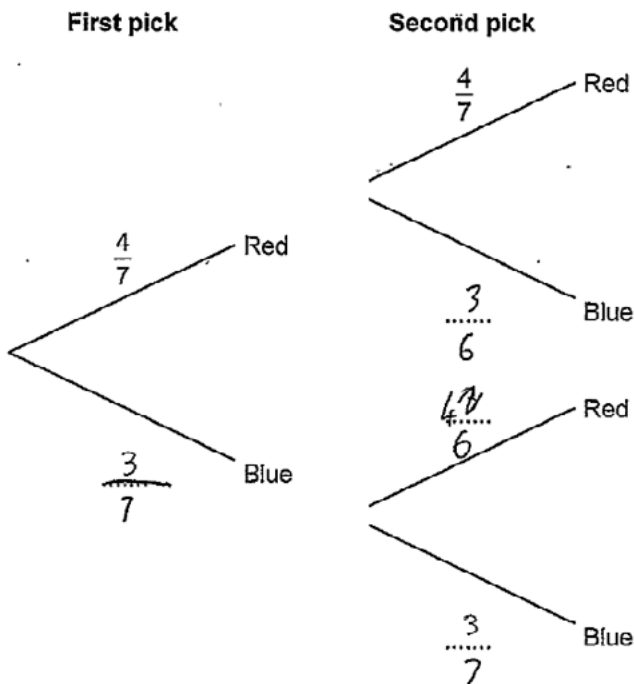


[2]

## Exemplar 1

1 mark

(a) Complete the tree diagram.



[2]

## Examiner commentary

The probabilities for blue counters have been correctly placed on the tree diagram in two places but for red after picking blue and for blue after picking red, the candidate appears to be using non-replacement. M1 is awarded for 2 correctly placed probabilities.

As a checking strategy, the sum of each vertical pair of branches should be equal to 1.

## Question 6 (b)

(b) Work out the probability that Jack picks two red counters.

(b) ..... [2]

### Exemplar 1

1 mark

$$\frac{4}{7} \times \frac{4}{7} = \frac{8}{49}$$

(b)  $\frac{8}{49}$  ..... [2]

### Examiner commentary

A correct method is shown but then incorrectly processed so M1 is awarded.

These types of errors are easily made and emphasise the need to do a second check through on all processing on the non-calculator paper.

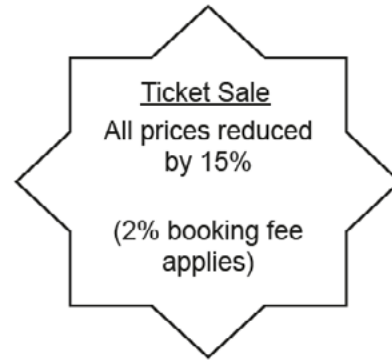
# Question 7

7 Adam buys some theatre tickets in a sale.

The normal prices are:

£80 for each adult  
£40 for each child.

In the sale, the prices are reduced by 15%.  
Adam buys 2 adult tickets and 1 child ticket at the sale price.  
A 2% booking fee is then added to the total cost of the tickets.



Calculate the total amount that Adam must pay.

£..... [6]

## Exemplar 1

4 marks

$80 \div 10 = 8$   
 $8 \div 2 = 4$   
 $8 + 4 = 12$   
 $80 - 12 = £68$  } adult ticket  
  
 $40 \div 10 = 4$   
 $4 \div 2 = 2$   
 $4 + 2 = 6$   
 $40 - 6 = £34$  } child ticket  
  
 $68 + 68 + 34 = £170$   
  
 $170 \div 100 = 1.7$   
 $1.7 \times 2 = 2.4$   
  
 $170 \div 2.4 = 167.60$

£.....167.60..... [6]

### Examiner commentary

The candidate shows a correct method to reduce both the adult and child ticket price and then correctly finds the total ticket cost of £170. These 2 stages earn M2M1.

A correct method is shown to find 2% but there is a processing error  $1.7 \times 2 = 2.4$  and then this value is subtracted rather than added. The mark scheme allows a further M1 for a complete method to find 2% of the ticket cost and because the steps are shown this is awarded despite the processing error.

The candidate earns 4 marks altogether.



**Exemplar 2****3 marks**

$$\begin{array}{r} 8 \quad 12 \\ 160 - 24 = 136 \\ \\ 34 \quad 170 \\ 300 - 30 = \\ \\ 172.4 \end{array}$$

$$\text{£ } 172.40 \dots\dots\dots [6]$$

**Examiner commentary**

Working is minimal but the figures provided allow some method marks to be considered.

In the guidance column in the mark scheme a complete method to reduce any valid ticket price can be implied by the figures 136 (and 34) and this is shown in the second (and third) line of working and earns M2.

The value 170 is also shown which is evidence of intention to find the total ticket cost and earns M1.

No method is shown for the increase of 2% and the value 172.40 is incorrect. If correct steps had been shown in calculating the 2% then method marks would have been available even if the processing had errors, so this indicates the importance of writing down a method.

The candidate is awarded 3 marks overall.

## Question 8

8 Mrs Mills buys 4 packs of treats for her cats, Fluff and Tigger.

She gives Fluff  $\frac{1}{6}$  of a pack each day.

She gives Tigger  $\frac{1}{5}$  of a pack each day.

For how many complete days will the 4 packs of treats last?

..... [5]

### Exemplar 1

5 marks

4 packs

$$\frac{1}{6} = \frac{5}{30} \quad \frac{1}{5} = \frac{6}{30}$$

$$\frac{5}{30} + \frac{6}{30} = \frac{11}{30} \text{ every day}$$

$$4 \times 30 = 120$$

$$120 \div 11 = 10.9$$

4 packs last 10.9 days

= 10 complete days

..... 10 days [5]

### Examiner commentary

The candidate shows a complete correct method and gives the correct answer of 10 complete days. 5 marks are awarded.

## Exemplar 2

4 marks

$$\frac{1}{6} + \frac{1}{5} = \frac{11}{30}$$

$$\frac{4}{1} \div \frac{11}{30} = \frac{4}{1} \times \frac{30}{11} = \frac{120}{11}$$

$$11 \overline{) 120} \quad 10.9$$

$$\underline{110}$$

$$00.9$$

$$11 \overline{) 10.0'0}$$

..... 11 [5]

## Examiner commentary

The candidate shows a fully correct method reaching  $\frac{120}{11}$  before attempting a division.

The only error is to give the answer 11 from 10.9 rather than realising that in the context of the question, the packs of treats will last for 10 complete days.

## Exemplar 3

1 mark

4 packs

$$\text{Fluff} = \frac{1}{6} \text{ per day}$$

$$\text{Tigger} = \frac{1}{5} \text{ per day}$$

1 day, 2 cats =

$$\frac{1}{6} + \frac{1}{5} = \frac{2}{11}$$

1 ~~11th~~ pack

..... [5]

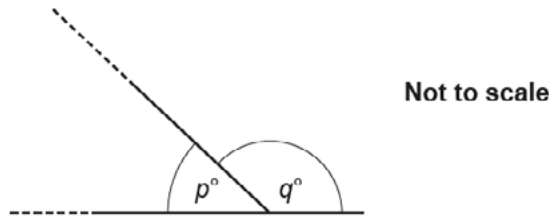
## Examiner commentary

The candidate realises that the first step is to add the fractions and is awarded M1 for the intention to do this. The fractions are incorrectly added however and no further progress is made.

To improve the answer, the fractions needed to have been added correctly and then an attempt made to divide the number of packs by the total of the two fractions.

# Question 9 (a)

9 An interior angle of an isosceles triangle is  $p^\circ$  and an exterior angle is  $q^\circ$ .



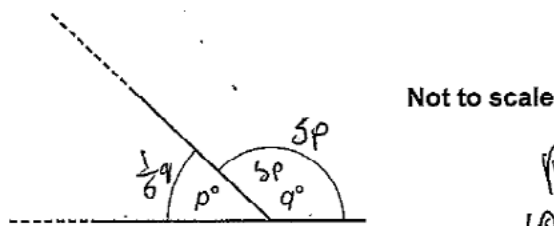
It is given that  $q = 5p$ .

(a) Write the ratio  $p : q$  in its simplest form.

(a) ..... : ..... [2]

## Exemplar 1

1 mark



It is given that  $q = 5p$ .

(a) Write the ratio  $p : q$  in its simplest form.

Handwritten solution:

$$p + q = 180$$

$$1p + 5p = 180$$

$$6p = 180$$

$$p = 30$$

$$5p = 150$$

$$q = 150$$

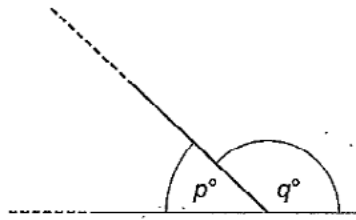
$$q = 15$$

$$p = 3$$

(a) 3 : 15 [2]

## Examiner commentary

In this exemplar, the candidate uses a longer method and works out both angle  $p$  and angle  $q$  correctly before attempting to simplify the ratio. The ratio has not been given in its simplest form however so B1 is awarded.

**Exemplar 2****0 marks**

Not to scale

It is given that  $q = 5p$ .

(a) Write the ratio  $p : q$  in its simplest form.

(a) ..... 5 ..... : ..... 1 ..... [2]

**Examiner commentary**

The ratio has been given incorrectly and no other working is shown. This scores 0 marks.

To improve the answer, the candidate could have checked the order of the ratio 5 : 1 by looking at the relative size of the angles with the statement  $q = 5p$  which means  $q$  is larger than  $p$ .

# Question 9 (b)

(b) Work out the two different possible sets of angles for the isosceles triangle.

(b) Triangle 1: .....°, .....°, .....°

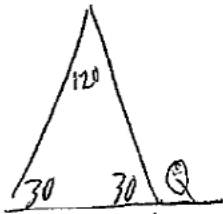
Triangle 2: .....°, .....°, .....°

[4]

## Exemplar 1

3 marks

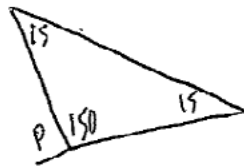
6 parts = 180  
1 part = 30



(b) Triangle 1: 30°, 30°, 120°

Triangle 2: 15°, 15°, 150°

[4]



5 parts = 150

## Examiner commentary

The candidate has given one set of angles correctly but has then incorrectly used angle  $q$  rather than angle  $p$  to find a different set of angles. The candidate is awarded B3 for one correct set of angles.

**Exemplar 2****0 marks**

$$110 + 70 = 180$$

$$70 + 55 + 55 = 180$$

$$90 + 90 = 180$$

$$45 + 45 + 90 = 180$$

(b) Triangle 1: 45°, 45°, 90°

Triangle 2: 55°, 55°, 70°

[4]

**Examiner commentary**

This candidate had part (a) correct but then did not link part (b) with the information given in part (a) and chose two random sets of angles for isosceles triangles. No marks are awarded.

To improve, the candidate needed to recognise the link with part (a) and attempt to find the size of angle  $p$  by dividing 180 by  $(1 + 5)$ .

# Question 10 (a)

10 (a) Write  $\frac{1}{6}$  as a recurring decimal.

(a) ..... [2]

## Exemplar 1

2 marks

$$\begin{array}{r} 0.1\dot{6} \\ 6 \overline{) 1.000} \end{array}$$

(a)  $0.1\dot{6}$  ..... [2]

## Examiner commentary

This exemplar shows a correct answer with correct notation used. Both marks are awarded.

## Exemplar 2

0 marks

10 (a) Write  $\frac{1}{6}$  as a recurring decimal.

$$\begin{array}{r} 0.15 \\ 6 \overline{) 1.000} \end{array}$$
~~$$\begin{array}{r} 110 \\ 6 \overline{) 1.000} \end{array}$$~~

$$\begin{array}{r} 0.122 \\ 6 \overline{) 1.000} \end{array}$$

(a)  $0.1\dot{5}$  ..... [2]

## Examiner commentary

This candidate recognises division as the appropriate method to convert the fraction to a decimal but makes an error in processing and does not reach 0.16.... No marks are awarded.

Accurate division is needed to score any marks here.



# Question 10 (b)

- (b) Elsa divides a two-digit number by another two-digit number. She gets the answer 0.15.

She says that there is only one possible pair of numbers that will give this answer. Is she correct? Show how you decide.

..... [4]

## Exemplar 1

4 marks

$$\begin{aligned}
 x &= 0.1\dot{5} \\
 100x &= 15 \\
 100x &= 15.5 \\
 90x &= 14 \\
 \text{Not 2 digit} & \\
 \frac{14}{90} = x & \quad \frac{28}{180} = x \\
 \text{Not 2 digit} &
 \end{aligned}$$

Yes, so my other reason for the question doesn't use both 2 digit numbers [4]

## Examiner commentary

The candidate converts the recurring decimal correctly to  $\frac{14}{90}$  and then shows two other equivalent fractions to consider Elsa's statement. A correct conclusion is made with the two equivalent fractions annotated along with a comment about them not having two digits. Full marks are awarded. The candidate is awarded 4 marks.

## Exemplar 2

2 marks

$$\begin{aligned}
 x &= 0.1\dot{5} \\
 10x &= 1.5 \\
 100x &= 15.5 \\
 \frac{14}{90}
 \end{aligned}$$

..... [4]

## Examiner commentary

The candidate converts the recurring decimal correctly to  $\frac{14}{90}$  to earn B2 but then needs to show at least one other equivalent fraction to consider Elsa's statement. No further equivalent fraction is seen and no comment on Elsa's statement is made. Two marks are awarded.

# Question 11 (a)

11 (a) Simplify fully.

$$\sqrt{200}$$

(a) ..... [2]

## Exemplar 1

2 marks

$$\sqrt{200} = \sqrt{2 \times 100} = 10\sqrt{2}$$

(a) .....  $10\sqrt{2}$  ..... [2]

## Examiner commentary

Correct answer supported by a correct method. Both marks are awarded.

## Exemplar 2

1 mark

$$\sqrt{200} = \sqrt{25 \times 8}$$

$$\sqrt{25} = 5 \quad \sqrt{8}$$

(a) .....  $5\sqrt{8}$  ..... [2]

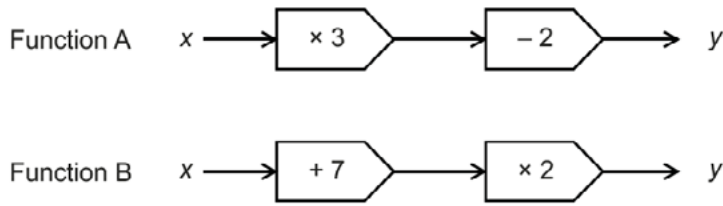
## Examiner commentary

The candidate recognises the need to find a square number as a factor of 200 but does not choose the largest square factor and thus the answer can be further simplified. Credit is given for reaching  $5\sqrt{8}$  and the candidate earns B1.

As a check that this was fully simplified, the candidate could have considered the factors of the square root of 8 and checked that there was no other square number factor.

# Question 12 (a)

12 Here are two functions.



(a) Find an algebraic expression for the output of the **inverse** of function A when the input is  $x$ .

(a) ..... [2]

## Exemplar 1

1 mark

$$3y - 2$$

(a)  ~~$x \div 3 + 2 = y$~~   $\frac{(y+2)}{3}$  ..... [2]

## Examiner commentary

Looking at the answer space, the candidate has shown a correct 'reversal' of operations for function A and has formed the correct inverse expression for  $x$  in terms of  $y$  but then has not rewritten this as an expression for  $y$  in terms of  $x$ . M1 is awarded.

## Exemplar 2

0 marks

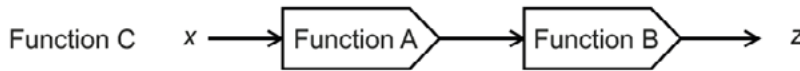
(a)  $x \div 3 + 2 = y$  ..... [2]

## Examiner commentary

The candidate misunderstands the reverse process required and has done the inverse operations but in the wrong order. No marks are awarded.

# Question 12 (b)

(b) Here is a composite function C.



Find the value  $x$  when  $z = 4x$ .

(b)  $x = \dots\dots\dots$  [5]

## Exemplar 1

5 marks

$$\begin{aligned} &(3x - 2 + 7) \times 2 \\ &(3x + 5) \times 2 \\ &(6x + 10 = 4x) - (4x + 10) \\ &\left( \begin{array}{l} 2x = -10 \\ x = -5 \end{array} \right) \div 2 \end{aligned}$$

(b)  $x = \dots\dots\dots -5$  [5]

### Examiner commentary

The candidate has correctly set up an equation in terms of  $x$  and included all essential brackets.

The equation has been solved correctly and the candidates earns the full 5 marks.

## Exemplar 2

2 marks

$$\begin{aligned} &\frac{4x}{2} = 2x \\ &2x - 7 \\ &2x - 5 \\ &\frac{2x - 5}{3} \end{aligned}$$

(b)  $x = \dots\dots\dots \frac{2x - 5}{3}$  [5]

### Examiner commentary

The candidate works backwards from  $z$  using function B and correctly substitutes  $z = 4x$  and sets up an expression equivalent to  $\frac{2x - 7 + 2}{3}$  for which the mark scheme awards M2. No further progress is made.

To improve, the candidate should form an equation in  $x$  using the fact that  $\frac{2x - 7 + 2}{3}$  is equal to  $x$  and then solve the equation.

**Exemplar 3****2 marks**Find the value  $x$  when  $z = 4x$ .

$$z \longrightarrow 3x - 2 \longrightarrow 2(3x + 7) \longrightarrow z$$

$$4x = (3x - 2) + (2x + 14)$$

$$4x = 5x + 12$$

$$-12 = x$$

$$(b) x = \dots\dots\dots -12 \dots\dots\dots [5]$$

**Examiner commentary**

The candidate uses  $x$  and works forward with function A. The expression  $3x - 2$  seen is sufficient to earn M1 but from the second line of working the rest of the equation is incorrect.

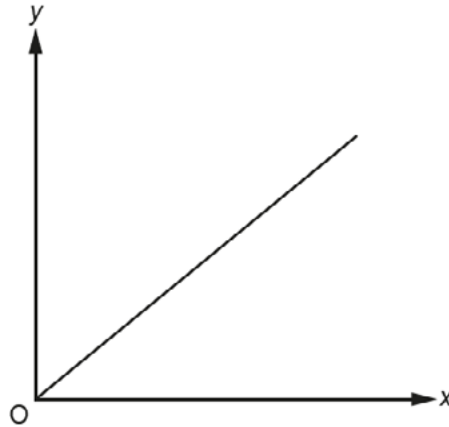
On the mark scheme there is an M1 dep (on at least M1 earned previously) for setting up an equation with at least 2 terms in  $x$  and then correctly rearranging this to  $ax = b$ . As the candidate has already earned M1, this final method mark is available and is earned at the fourth line of working.

The misconception is that, because this is a function of a function, the expression from function A ( $3x - 2$ ) has not been substituted into function B in the first step, hence the equation is incorrect.

Two marks are awarded.

# Question 13

- 13 Shirley is asked to sketch a graph of  $y = 5^x$  for  $x \geq 0$ . She produces the following.



The graph has two errors.

How should they be corrected?

1 .....

.....

2 .....

..... [2]

## Exemplar 1

2 marks

1 *It should be a line curving upwards* .....

.....

2 *It should go through the y intercept of 1* .....

..... [2]

## Examiner commentary

This is a model answer that clearly describes the shape of the graph and the correct y-intercept. Both marks are awarded.

**Exemplar 2****0 marks**

1 ..... shouldn't go through the origin .....

2 ..... should have points marked on each  
axis. .... [2]

**Examiner commentary**

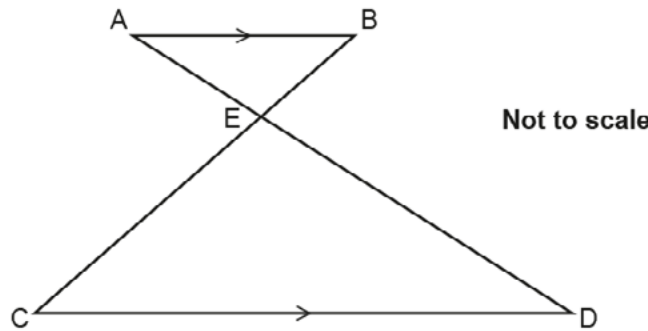
The first reason is insufficient as it needs to describe the correct y - intercept of 1.

The second reason needs to describe the correct shape of the graph and imply it is an increasing curve.

No marks are awarded.

# Question 14

- 14 In the diagram AB is parallel to CD.  
AED and BEC are straight lines.



Prove that triangle ABE is similar to triangle CDE.

.....

.....

.....

..... [3]

## Exemplar 1

3 marks

Angles  $\hat{A}BC$  and  $\hat{B}CD$  are the same because of alternate angles. Angles  $\hat{B}AD$  and  $\hat{A}DC$  are the same because of alternate angles. Angles  $\hat{AEB}$  and  $\hat{CED}$  are the same because of opposite angles. All angles are the same so  $ABE$  is similar to  $CDE$  [3]

## Examiner commentary

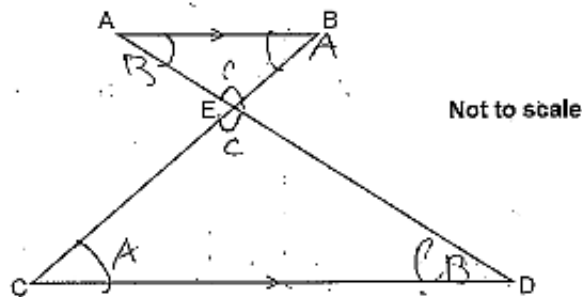
All three pairs of equal angles are given with correct reasons. The reason opposite is acceptable for vertically opposite. A correct reason for similarity is given in the final sentence and all 3 marks are awarded.



## Exemplar 2

1 mark

- 14 In the diagram AB is parallel to CD.  
AED and BEC are straight lines.



Prove that triangle ABE is similar to triangle CDE.

$$\begin{aligned} \angle E &= \angle C \\ \angle A &= \angle D \\ \angle C &= \angle B \end{aligned}$$

As angle  $\hat{EAB}$  is the same as  $\hat{EDC}$  and  
angle  $\hat{EBA}$  is the same as  $\hat{ECD}$  and  
 $\hat{AEB}$  is the same as  $\hat{CED}$ . As the triangles  
both share common lines <sup>between</sup> on parallel lines. [3]

## Examiner commentary

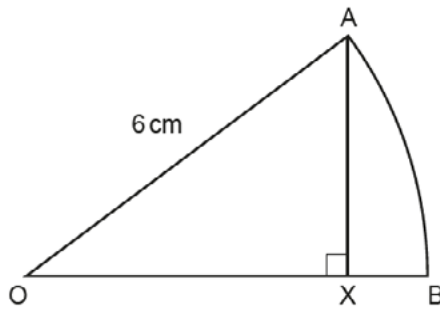
The correct pairs of equal angles in both triangles are identified but no reasons are given so no marks are awarded at this stage. After 0 scored, the mark scheme allows SC1 for at least two correct pairs of angles identified with no/incorrect reasons. The candidate earns this SC1 mark.

To improve, the candidate needs to give a correct geometric reason for each pair of angles that are equal before giving the reason for similarity.

The most successful answers used the 4 lines of working space provided and used one line for each separate statement.

# Question 15

- 15 OAB is a sector of a circle, centre O.  
OA = 6 cm and AX is perpendicular to OB.



Not to scale

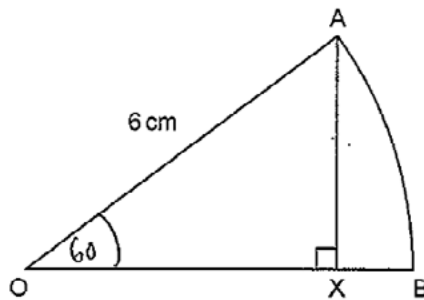
The area of sector OAB is  $6\pi \text{ cm}^2$ .

Show that  $AX = 3\sqrt{3} \text{ cm}$ .

[6]

## Exemplar 1

6 marks



Not to scale

The area of sector OAB is  $6\pi \text{ cm}^2$ .

Show that  $AX = 3\sqrt{3} \text{ cm}$ .

[6]

$$\text{area of a sector} = \frac{\theta}{360} \times \pi r^2$$

OA and OB are both radii

$$\text{so } \left( \frac{\theta}{360} \times 36\pi = \frac{6\pi}{1} \right) \div 36\pi$$

$$\frac{\theta}{360} = \frac{6\pi}{36\pi} \rightarrow \frac{1}{6}$$

$$\frac{\theta}{360} = \frac{1}{6}$$

$$\theta = \frac{360}{6} = 60^\circ$$

$$\frac{6}{\sin 90} = \frac{AX}{\sin 60}$$

$$\frac{6}{1} \times \frac{\sqrt{3}}{2} = AX$$

$$\frac{6\sqrt{3}}{2} = 3\sqrt{3} = AX$$

## Examiner commentary

The candidate shows a full correct method with no omissions and no incorrect working.

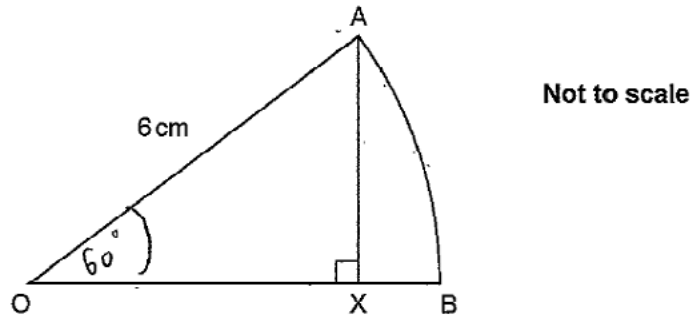
The sector angle  $60^\circ$  is clearly established with each step explicitly shown and the first 3 marks, M1M1A1, are earned.

The sine rule is correctly stated using angles  $60^\circ$  and  $90^\circ$ , and  $\sin 60 = \frac{\sqrt{3}}{2}$  is shown at the substitution stage of the sine rule.

The given value for AX is then established and the candidate is awarded 6 marks.

## Exemplar 2

4 marks



The area of sector OAB is  $6\pi \text{ cm}^2$ .

Show that  $AX = 3\sqrt{3} \text{ cm}$ .

[6]

$$A = \pi r^2 \frac{x}{360}$$

$$A = 6^2 \pi \times \frac{x}{360}$$

$$A = 6^2 \pi \times \frac{1}{6}$$

$$A = 6\pi \text{ when } x = 60$$

$$\sin 60^\circ = \frac{\sqrt{3}}{2}$$

$$6 \times \sin 60^\circ = 6 \times \frac{\sqrt{3}}{2} = \frac{6\sqrt{3}}{2}$$

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

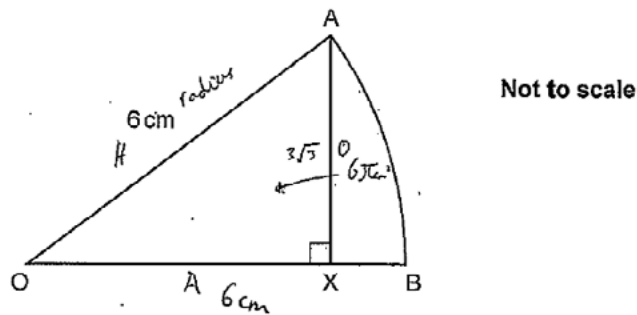
## Examiner commentary

The candidate shows a correct method for finding the area of the sector with the angle AOB shown as  $x$  in the second line of working. The next stage of working to establish the sector angle as  $60^\circ$  is never explicitly shown. To score here, either dividing 360 by 6 or forming an equation and equating the second line of working to  $6\pi$ , the area of the sector is needed. In this case only M1 is earned for this initial work.

The candidate then correctly states that  $\sin 60 = \frac{\sqrt{3}}{2}$  and then shows a correct explicit trigonometry method to establish the given length of AX and earns a further M1M2.

## Exemplar 3

1 mark



The area of sector OAB is  $6\pi \text{ cm}^2$ .

Show that  $AX = 3\sqrt{3} \text{ cm}$ .

[6]

$$6 \text{ cm} = \text{radius}$$

$$\text{area of square} = \pi r^2 = \pi 6^2 = 36\pi$$

$$36 \div 6 = 6 \quad \text{OAB} = \frac{1}{6} \text{ circle}$$

$$\text{CAH} \quad \cos 90^\circ = 0$$

$$\text{circumference} = \pi d \quad \text{diameter} \rightarrow 12 \text{ cm}$$

$$12\pi = \text{sector circumference}$$

$$OB = 6 \text{ cm}$$

$$3\sqrt{3} \times 6 = OX$$

## Examiner commentary

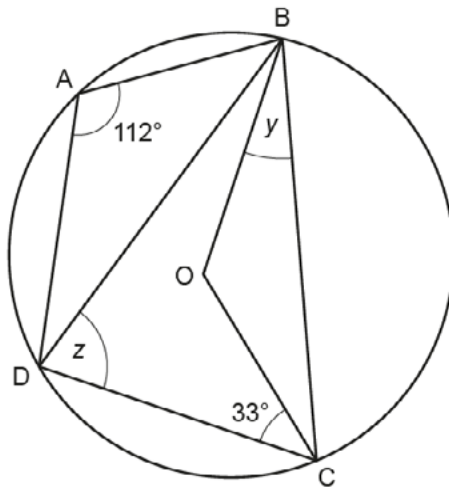
The candidate has correctly calculated the area of the circle, centre O and radius 6 cm, in terms of  $\pi$ , in the second line of working. In the third line of working they have indicated that the area of sector OAB is  $\frac{1}{6}$  of the area of the circle. This is sufficient to earn the first M1.

The sector angle  $\text{AOB} = 60$  is never established and the calculation  $360 \div 6$  must be shown to establish this.

There is no correct further working to establish the given value for AX and so 1 mark is awarded overall.

# Question 16 (a)

16 A, B, C and D are points on the circumference of a circle, centre O.  
 Angle BAD =  $112^\circ$  and angle DCO =  $33^\circ$ .



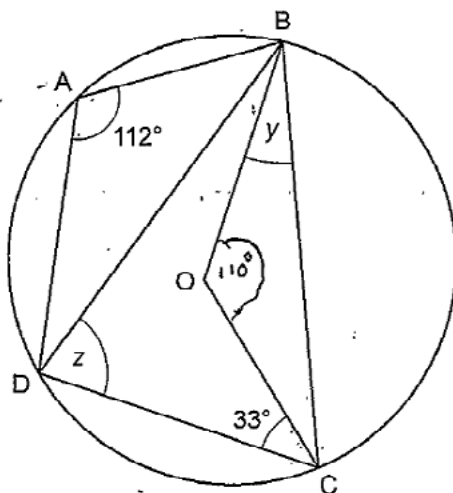
Not to scale

(a) Show that angle  $y = 35^\circ$ .  
 Give reasons for each stage of your working.

[4]

## Exemplar 1

4 marks



Not to scale

(a) Show that angle  $y = 35^\circ$ .  
 Give reasons for each stage of your working.  $\angle OCB = 35^\circ$  [4]

$180 - 112 = 68$   ~~$112$~~   $= 68$   ~~$33$~~   $= 35$   ~~$\angle DOB = 35$~~  cyclic opposite angles in a cyclic quadrilateral add up to  $180^\circ$

Triangle COB is an isosceles because line OC = line OB as they are radii

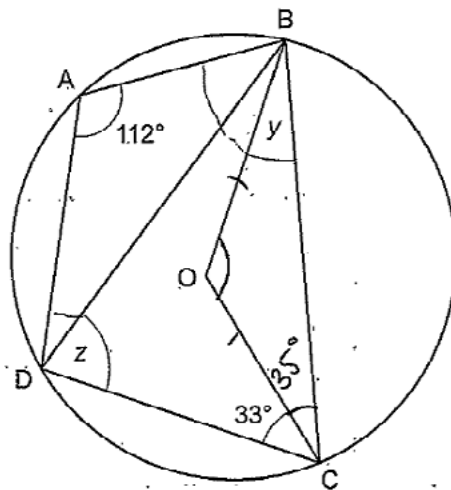
Therefore  $y = 35^\circ$  because of angles in an isosceles triangle

## Examiner commentary

This exemplar shows a fully correct answer with each calculation shown and supported by clear written reasons that use the correct mathematical terminology.

## Exemplar 2

3 marks



Not to scale

$$\begin{array}{r} 112 \\ + 33 \\ \hline = 145 \\ 180 - 145 = 35 \end{array}$$

- (a) Show that angle  $y = 35^\circ$ .  
Give reasons for each stage of your working.

[4]

Angles opposite in quadrilaterals add up to 180 so  $112 + 33 = 145$  meaning  $180 - 145 = 35$  the angle next to it is  $35^\circ$  it's an isosceles triangle meaning two angles equal the same so  $y = 35^\circ$

## Examiner commentary

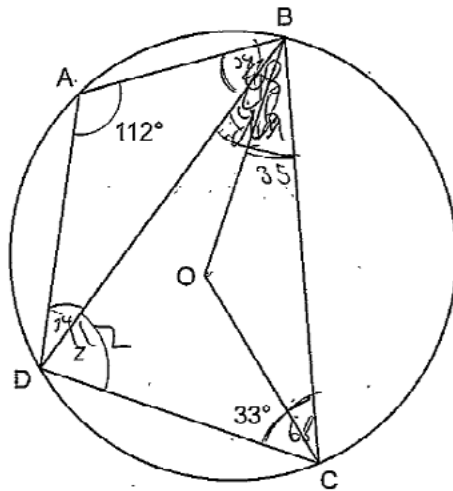
This candidate earns M1M1 for the subtraction  $180 - 145 = 35$  after  $112 + 33$  has been shown and M1 for the written reason involving isosceles triangle. For the first written reason the candidate has omitted the word cyclic before quadrilaterals so does not earn the method mark as a consequence. Three marks are earned in total.

To improve, the correct mathematical terminology using the angle properties of circles must be used and these terms are written in the specification.

# Exemplar 3

2 marks

Angle BAD = 112° and angle DCO = 33°.



Not to scale

- (a) Show that angle  $y = 35^\circ$ .  
Give reasons for each stage of your working.

[4]

$180 - 112 = 68$   
 $\frac{68}{2} = 34$   
 $180 - 34 = 146$

$180 - 112 = 68$   
 $68 - 33 = 35$   
 $180 - 136 =$   
 ~~$68 + 68 = 136$~~

(35)

## Examiner commentary

The candidate shows two subtractions in their working,  $180 - 112 = 68$  and  $68 - 33 = 35$ . The angles DCB and BCO are bracketed on the mark scheme which means that they do not have to be stated provided the values are not associated with incorrect angles. There is some annotation on the diagram which confirms the values have not been associated with the wrong angles so this can earn M1M1.

There are no written geometric reasons given to support the calculations and so only 2 marks, one for each calculation, are awarded.

## Question 16 (b)

- (b) Work out angle  $z$ .  
Give reasons for your answer.

Angle  $z = \dots\dots\dots^\circ$  because  $\dots\dots\dots$   
 $\dots\dots\dots$   
 $\dots\dots\dots$  [3]

### Exemplar 1

2 marks

- (b) Work out angle  $z$ .  
Give reasons for your answer.

$$\begin{aligned} 35 + 35 &= 70 \\ 180 - 70 &= 110 \\ \frac{110}{2} &= 55 \\ z &= 55 \end{aligned}$$

Angle  $z = 55^\circ$  because the isosceles triangle in front  
 is  $35^\circ$  two angles add them up subtract by  $180^\circ$   
 $= 110^\circ$  and that's double  $z$  [3]

### Examiner commentary

The correct angle is given earning B1 and the first reason involving isosceles triangle is acceptable for M1 even though triangle BOC has not been mentioned. On the mark scheme [triangle BOC = ] is in square brackets which means it does not have to be stated provided the reason has not been associated with the wrong triangle.

The second reason is not acceptable as incorrect mathematical language has been used. The reason should mention key terms centre and circumference and indicate that the angle at the centre is twice the angle at the circumference.

2 mark are awarded in total.



**Exemplar 2****1 mark**

Angle  $z = 55^\circ$  because it is half of angle  
 O which is 110

[3]

**Examiner commentary**

The angle  $z$  is correctly given as  $55^\circ$  which earns B1 but the reason is not acceptable as it does not use the correct terminology 'angle at the circumference is half the angle at the centre'. The other required reason is not included. 1 mark is awarded.

The number of marks for the question is an indication that two reasons are required along with the language 'Give reasons' that is used in the demand.

# Question 17 (a)

17 (a) Write  $x^2 + 8x + 3$  in the form  $(x + a)^2 - b$ .

(a) ..... [3]

## Exemplar 1

3 marks

$$(x+4)^2 + 3 - 16 = (x+4)^2 - 13$$

(a)  $(x+4)^2 - 13$  ..... [3]

### Examiner commentary

This is a fully correct answer with supporting working. This earns 3 marks.

## Exemplar 2

1 mark

$$(x+4)^2 + 3$$

$$\begin{array}{r} 8 \\ 16 \\ 24 \end{array}$$

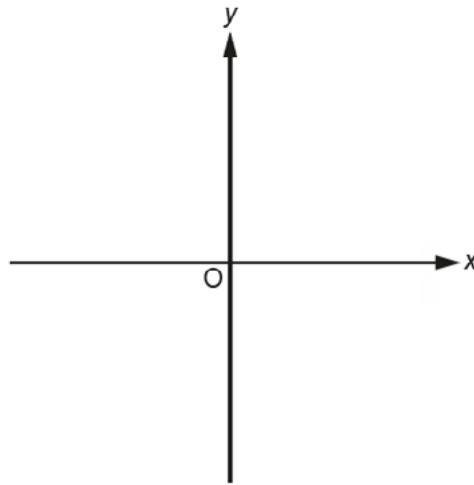
(a) ..... [3]

### Examiner commentary

The candidate has recognised the form needed for  $(x + a)^2$  but has not then gone on to complete the square by subtracting  $4^2$  from 3. One mark is awarded for the first stage given as  $(x + 4)^2$ .

## Question 17 (b)

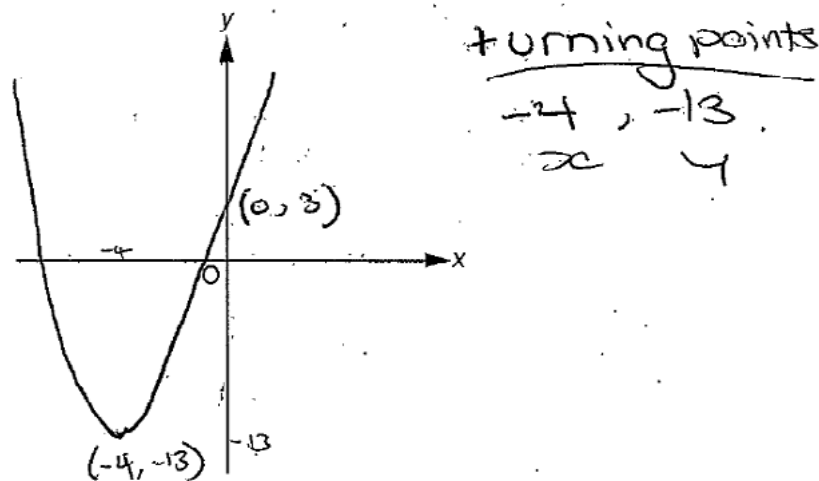
- (b) Sketch the graph of  $y = x^2 + 8x + 3$ .  
Show clearly the coordinates of any turning points and the  $y$ -intercept.



[4]

### Exemplar 1

4 marks



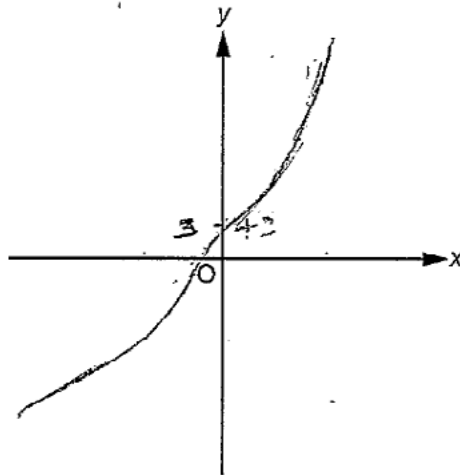
[4]

### Examiner commentary

A correct sketch showing all of the key features in the correct quadrants.

The minimum value is correctly indicated with coordinates and the  $y$ -intercept is also clearly indicated.

4 marks are awarded.

**Exemplar 2****1 mark**

[4]

**Examiner commentary**

The sketch is incorrect for 4 marks as it is not a U shape and the minimum value is not indicated.

The graph earns 1 mark however as the mark scheme allows B1 for a line or curve with a  $y$  - intercept of 3 and this is clearly indicated.

# Question 18

18 21 people travelled to a meeting.

- 12 used a train.
- 6 used a car.
- 7 did not use a train or a car.
- Some used a train and a car.

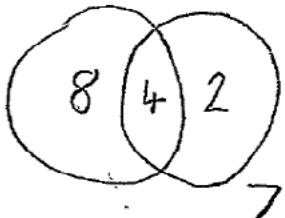
Two people are chosen at random from those who used a train.

Find the probability that both these people also used a car.

..... [6]

## Exemplar 1

6 marks



$$2 + 6 = 18$$

$$18 - 14 = 4$$

$$\frac{4}{12} \times \frac{3}{11} = \frac{12}{132} = \frac{6}{66} = \frac{1}{11}$$

$$\frac{1}{11}$$

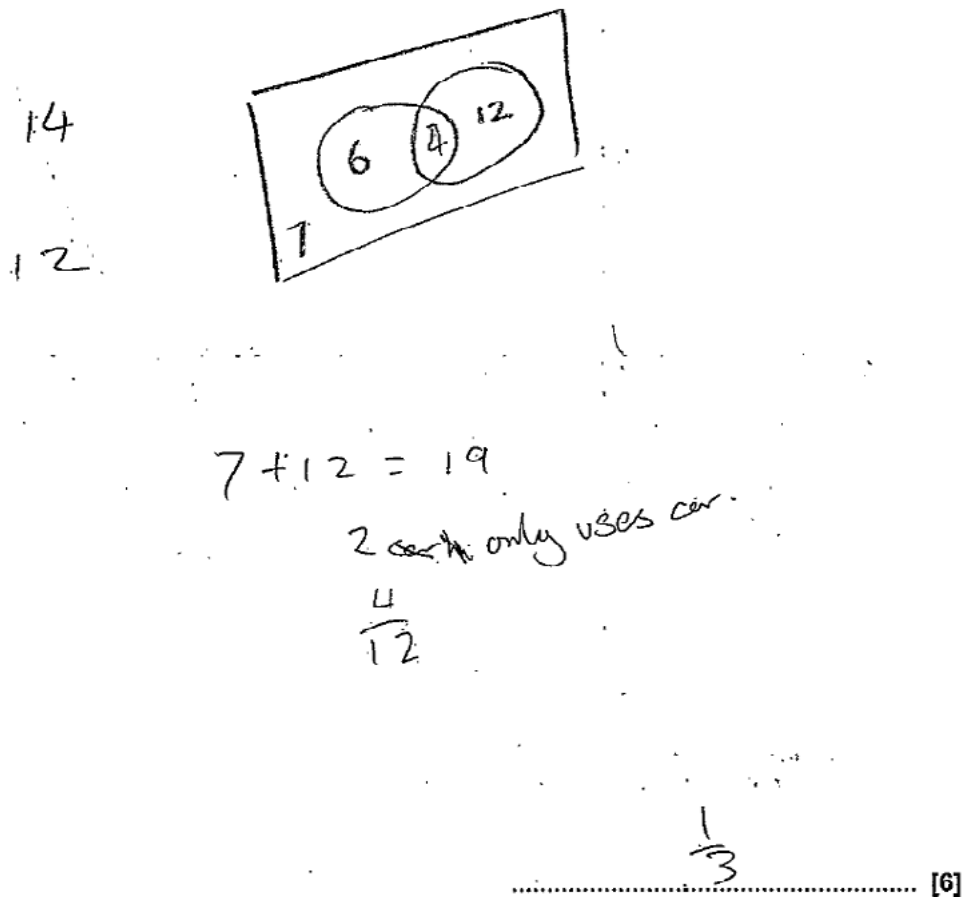
..... [6]

## Examiner commentary

A fully correct answer with clear supporting working. The candidate has given a fraction in its simplest form for the answer which is not necessary to earn 6 marks as the mark scheme allows any fraction (or decimal or percentage equivalent) equal to  $\frac{12}{132}$  to earn full marks.

## Exemplar 2

4 marks



## Examiner commentary

The candidate uses a Venn diagram to represent the information provided in the question although this contains errors when completed. They do however recover to provide a correct probability of  $\frac{4}{12}$  for one person chosen at random from those who used a train who also used a car. The mark scheme allows B4 for this probability.

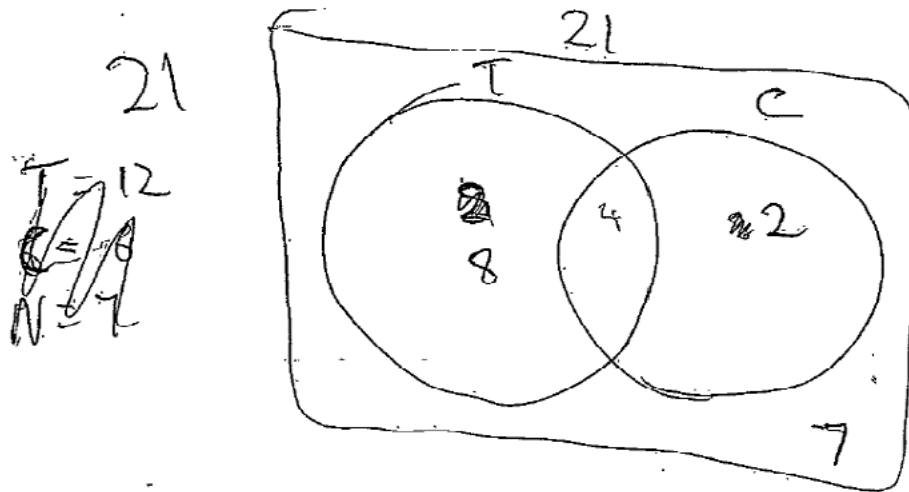
No attempt is made to look at combined probabilities for two people so 4 marks are scored in total.

Candidates are advised to re-read the demand and check they have fully answered the question before moving on to the next question.

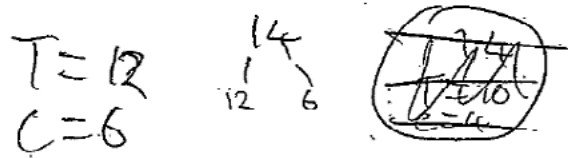
**Exemplar 3**

**3 marks**

$$21 - 7 = 14$$

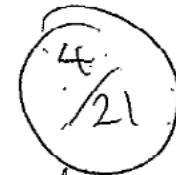


21  
~~T = 12~~  
~~C = 6~~  
~~N = 7~~

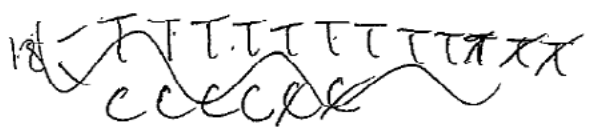


$$14 - 6 = 8$$

$$14 - 12 = 2$$



..... [6]



**Examiner commentary**

The candidate uses a Venn diagram to represent the information provided in the question and correctly completes the Venn diagram. The probability  $\frac{4}{21}$  is incorrect as this is the probability from all of the people travelling to the meeting not from those who used a train.

The mark scheme allows B3 for identifying 8 use the train only and 4 use train and car and this is shown on the tree diagram.

3 marks are awarded.

# Question 19 (b) (i) and (ii)

(b) The equation  $x^3 - x^2 + 5x - 6 = 0$  can be solved by finding the intersection of the graph of  $y = x^3 - x^2 - 2$  and the line  $y = ax + b$ .

(i) Find the value of  $a$  and the value of  $b$ .

(b)(i)  $a = \dots\dots\dots$   
 $b = \dots\dots\dots$  [2]

(ii) Hence, use the graph to solve the equation  $x^3 - x^2 + 5x - 6 = 0$ .  
 Give your answer correct to 1 decimal place.

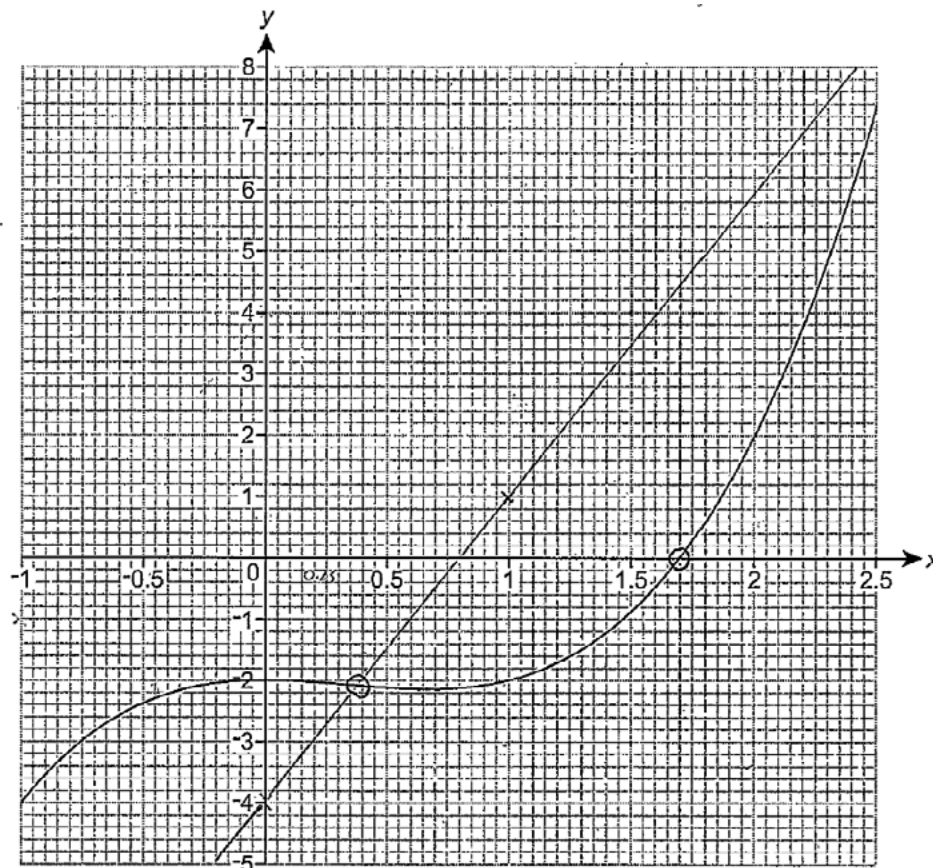
(ii)  $x = \dots\dots\dots$  [3]

## Exemplar 1

2 marks out of 5

$5x - 4$

(b)(i)  $a = \dots 5 \dots\dots\dots$   
 $b = \dots -4 \dots\dots\dots$  [2]



(ii)  $x = \dots 0.4 \dots\dots\dots$  [3]



## Examiner commentary

Candidates generally found these final two parts of the last question in the examination very difficult.

In this case, the candidate has given an incorrect answer to part (b)(i) and scored no marks.

Part (b)(ii) was strict follow through from part (b)(i) and candidates could gain credit by drawing a ruled line with their value of  $a$  and their value of  $b$ . The candidate has correctly drawn the line  $y = 5x - 4$  which follows through from their answers to part (b)(i) and the line crosses the curve and so earns M2.

Two marks are awarded for part (b)(ii).

This illustrates the importance of attempting a part which the next part relies upon as there is the possibility of then earning follow through marks.

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