**OCR**
Oxford Cambridge and RSA

# GCSE (9–1)

*Exemplar Candidate Work*

# MATHEMATICS

**J560**
For first teaching in 2015

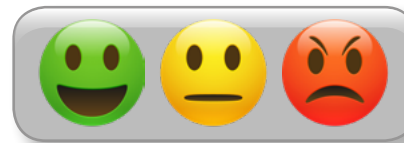# J560/04 Summer 2018 examination series

Version 1

# Contents

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# Introduction

These exemplar answers have been chosen from the summer 2018 examination series.

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

Please always refer to the specification 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 2018 Examiners' report or Report to Centres available from Interchange https://interchange.ocr.org.uk/Home.mvc/Index

The question paper, mark scheme and any resource booklet(s) will be available on the OCR website from summer 2019. 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 (a)

**1**  **(a)**  The ratio 2 centimetres to 5 metres can be written in the form 1 : $n$.

Find the value of $n$.

(a)  $n$ = .................................................... **[2]**

## Exemplar 1                                                    2 marks

5 metres = 500 cm

2 : 500
1 : 250

(a)  $n$ = ........250.................................. **[2]**

## Examiner commentary

There is a change of units stated at the beginning and the rest of the working can be clearly seen with the simplification and final answer as required by the question demand. Full marks are scored.

## Exemplar 2                                                    1 mark

C : M
2 : 5
÷2 ( ⟶ ) ÷2
1 : 2.5

(a)  $n$ = ........2.5.................................. **[2]**

## Examiner commentary

This response shows the ratio as 2 : 5 and then it is correctly simplified. They have, however, not considered the different units. SC1 is earned for figs 25 in the answer.

# Question 1 (b)

**(b)** Jay, Sheila and Harry share £7200 in the ratio 1 : 2 : 5.

How much does Harry receive?

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

## Exemplar 1            2 marks

$$1 : 2 : 5 = 8 \ parts$$

$$1 \ part = \frac{7200}{8} = £900$$

$$so \ 5 \ parts = 900 \times 5$$

$$= £4500$$

**(b)**    £ 4500 ........................................... **[2]**

## Examiner commentary

This response is clearly laid out with fully correct working. The total parts calculated have been shown, then the division to find one part and finally the multiplication to find the answer. Full marks are scored.
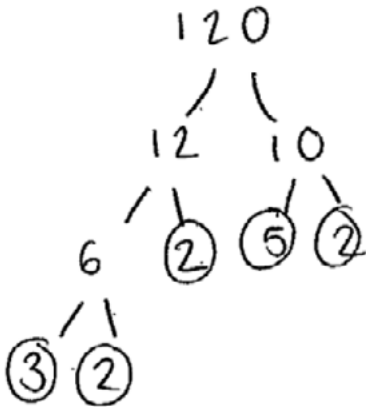
# Question 3 (a)(i)

3    (a)   (i)   Write 120 as a product of its prime factors.

(a)(i)   ......................................................... [3]

## Exemplar 1                                                    3 marks
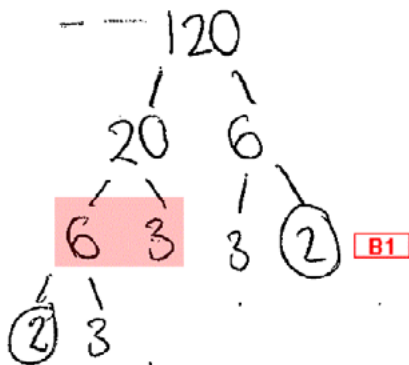


(a)(i)   $120 = 2^3 \times 3 \times 5$   [3]

## Examiner commentary

The factor tree has been drawn correctly, the required prime factors ringed and the answer written out fully for all 3 marks.

## Exemplar 2                                                    1 mark



$2+2=4$

(a)(i)   $4$   [3]

## Examiner commentary

This candidate has identified 2 and 3 as factors in the factor tree so score B1.

# Question 3 (a)(ii)

**(ii)** The lowest common multiple (LCM) of $x$ and 120 is 360.

Find the smallest possible value of $x$.

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

# Exemplar 1                                                            2 marks

$2^3 \times 3^2 \times 5$

$2 \times 3^2 \times 5$

$3^2$

(ii) ........ 90 : 9 ...................................... [2]

# Examiner commentary

Working in this part was rare, however, this candidate writes 360 as the product of its prime factors ($2^3 \times 3^2 \times 5$). They write down the prime factors of 90 ($2 \times 3^2 \times 5$) which is a possible answer then realise that the smallest number will be $3^2$.

# Question 3 (b)

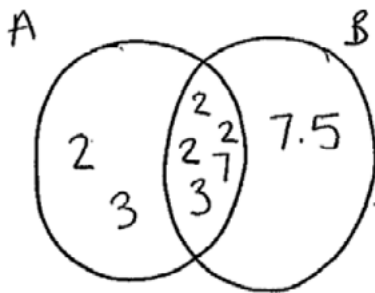**(b)** Two numbers, $A$ and $B$, are written as a product of prime factors.

$$A = 2^4 \times 3^2 \times 7^2 \qquad B = 2^3 \times 3 \times 5 \times 7$$

Find the highest common factor (HCF) of $A$ and $B$.

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

## Exemplar 1                                                    2 marks



SO  $2^3 \times 3 \times 7$
$= 168$

**(b)**  $168$  ....................................................... **[2]**

## Examiner commentary

A Venn diagram has been used to write all the prime factors in the two sets, showing the common prime factors and the answer has been found by multiplying them out. The use of the Venn diagram is the candidate's own choice. Full marks are scored.
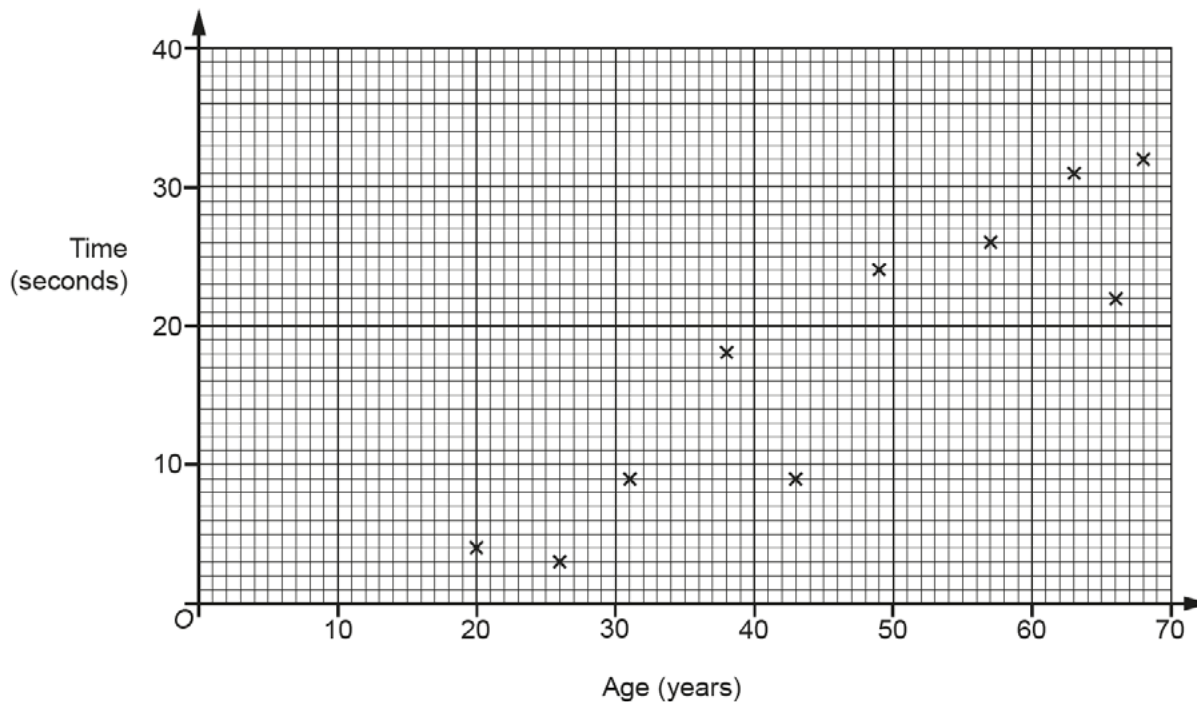
# Question 4 (b)

4    Lee wishes to find out if there is a relationship between a person's age and the time it takes them
     to complete a puzzle.

     Lee decides to conduct an experiment.
     She asks 12 people to complete the puzzle.
     She records each person's age and the time taken to complete the puzzle.

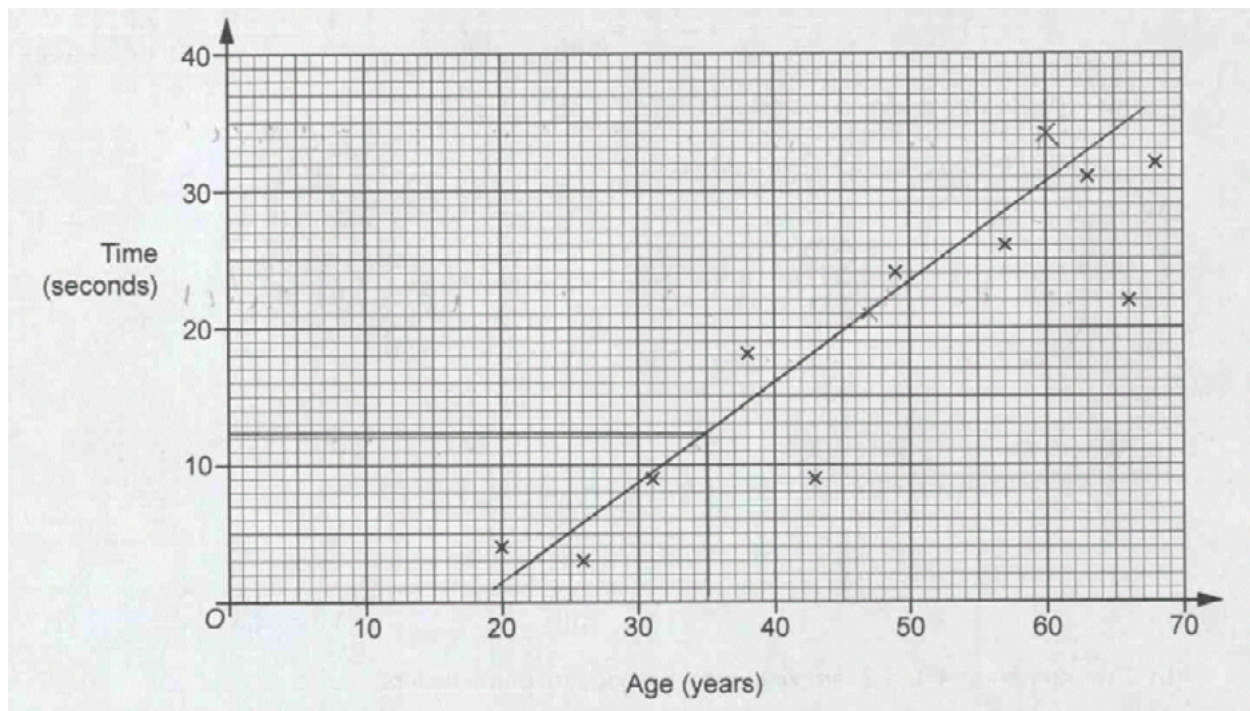**(b)**   This scatter diagram shows the results for ten of the people in Lee's experiment.



Here are the other two results.

| Age (years)     | 47 | 60 |
|-----------------|----|----|
| Time (seconds)  | 21 | 34 |

Plot these results on the scatter diagram.                                                      [2]

# Exemplar 1

# 2 marks



## Examiner commentary

Both points accurately plotted using a cross. Full marks are scored.

# Question 4 (d)

**(d)** Estimate the time it would take a person aged 35 to complete the puzzle.

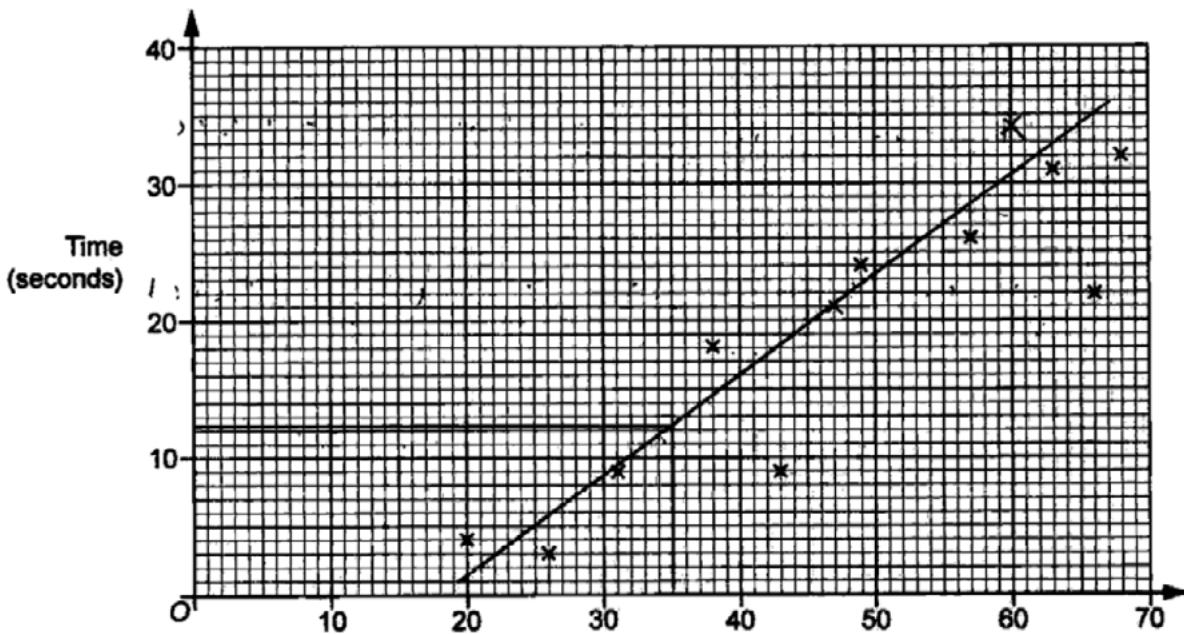Show your working to justify your answer.

(d) .......................................................... [2]

## Exemplar 1                                                                                        2 marks

Show your working to justify your answer.

(d) ...1.2...seconds......... [2]

**(b)** This scatter diagram shows the results for ten of the people in Lee's experiment.
*(handwritten above: Of 12 .)*



## Examiner commentary

A line of best fit has been correctly drawn and the figure read off has been indicated by drawing a vertical line and a horizontal line. Both marks are scored.

If the candidate had written an answer of 9 to 15 but had not drawn a line or a mark between (35, 9) and (35, 15) to indicate where their reading was taken then only one mark would have been earned.

# Question 4 (e)

(e) Lee says that at least 80% of the 12 people completed the puzzle in under 30 seconds.

Is Lee correct?
Show working to support your answer.

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

# Exemplar 1                                                           3 marks

3 people answered in over 30 seconds.

SO $\frac{12-3}{12} = \frac{\cancel{89}}{12} = \cancel{\frac{3}{4}}$ completed.

∴ it in under 30 seconds

Therefore ~~66~~ ~~76~~ 75% completed it in in under 30 seconds.

75 < 80 so Lee is not correct.

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

# Examiner commentary

The correct number of items (9) has been found and stated at the start of the answer, counting the 3 people who answered in over 30 seconds which is the easiest to count. This has been converted to a percentage, the correct decision has been made and the comparison of the two figures indicated as well. All 3 marks are earned.

# Exemplar 2                                                                              2 marks

(e)  Lee says that at least 80% of the 12 people completed the puzzle in under 30 seconds.

Is Lee correct?
Show working to support your answer.

9 people finished under 30 secs

3 people finished over 30 secs

80% of 12 = 12÷10 = 1.2 × 8 = 9.6 people

Lee is correct .................................................................... [3]

# Examiner commentary

This candidate has correctly counted the 9 people who finished in under 30 seconds so earns B1. They correctly work out 80% of 12 to be 9.6 and earn M1. However they have not understood what these figures represent so they make the incorrect conclusion and do not earn the final A1 mark.

# Question 5 (a)

5    The scale diagram below shows two cities, P and Q.
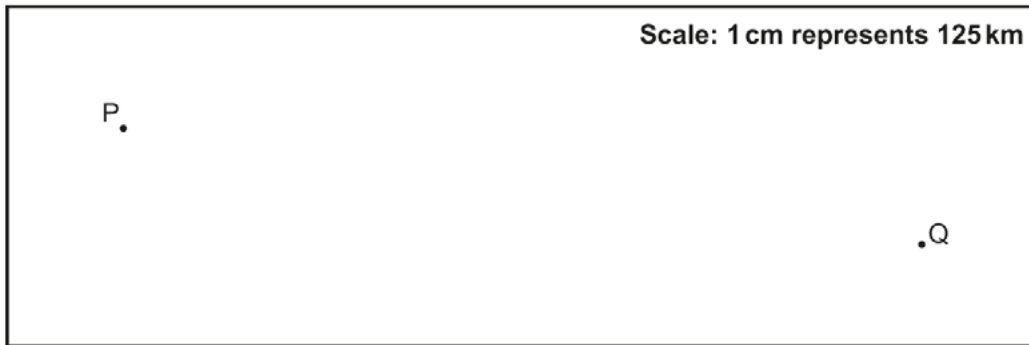
Scale: 1 cm represents 125 km

P.

.Q

A plane departs from P at 09 47 and arrives at Q at 12 07.

**(a)**   Work out the average speed, in kilometres per hour, of the plane.

(a)    ................................................... km/h  **[5]**

## Exemplar 1                                      5 marks

A plane departs from P at 09 47 and arrives at Q at 12 07.

(a)  Work out the average speed, in kilometres per hour, of the plane.

$2\frac{1}{3}$

$= \frac{7}{3}$

distance between P and Q = 11.6 cm

= 1450 km.

time between 0947 and 1207
is  2 hrs 20 mins.

so  1450 km in 2hr 20 mins  $\left(\frac{1450}{7/3}\right)$
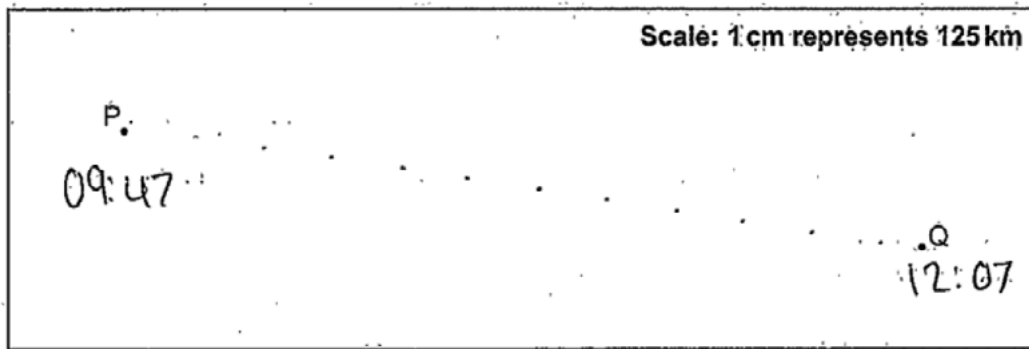
= 621.4285... km in 1 hr

= 621 km/h
  (3sf)

(a)  ....621........ km/h  **[5]**

## Examiner commentary

Each line of working has been explained and the working is all correct including the conversion of the time in hours and minutes to hours. The answer is rounded to a sensible degree of accuracy. All 5 marks are earned.

# Exemplar 2

# 4 marks

Scale: 1 cm represents 125 km

P.

09:47

.Q
12:07

A plane departs from P at 09 47 and arrives at Q at 12 07.

(a) Work out the average speed, in kilometres per hour, of the plane.

B1

$09:47 \rightarrow 12:07 = 2h \& 20m$

11.5 cm

B2

$11.5 \times 125 = 1437.5$

M1

$1437.5 \div 2.2 = 653.409$

(a) ............... 653 ............... km/h [5]

# Examiner commentary

The time is initially correct and they have a distance which is within tolerance. They also divide the two but in doing so they write the time of 2 hours 20 minutes as 2.2 hours which is incorrect and means the final mark (A1) cannot be earned. This is the only error they made but it was a common error amongst many candidates.

# Exemplar 3     2 marks
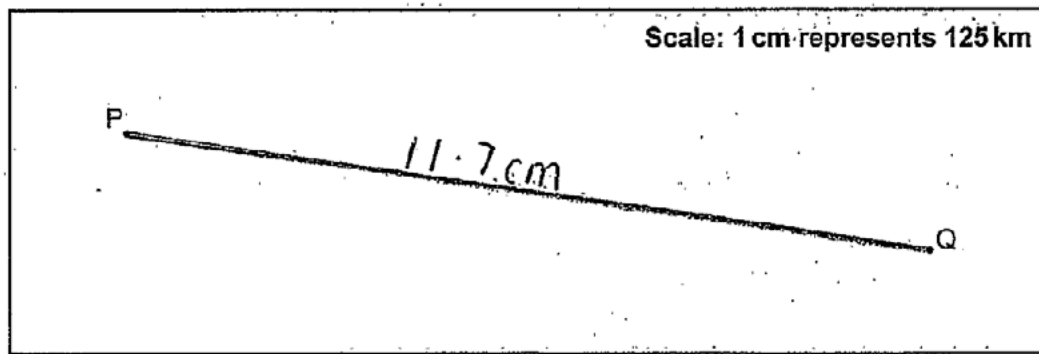
Scale: 1 cm represents 125 km

P

*11·7 cm*

Q

A plane departs from P at 09 47 and arrives at Q at 12 07.

**(a)** Work out the average speed, in kilometres per hour, of the plane.

$11·7$ cm $=$ $1462·5$ km   B2
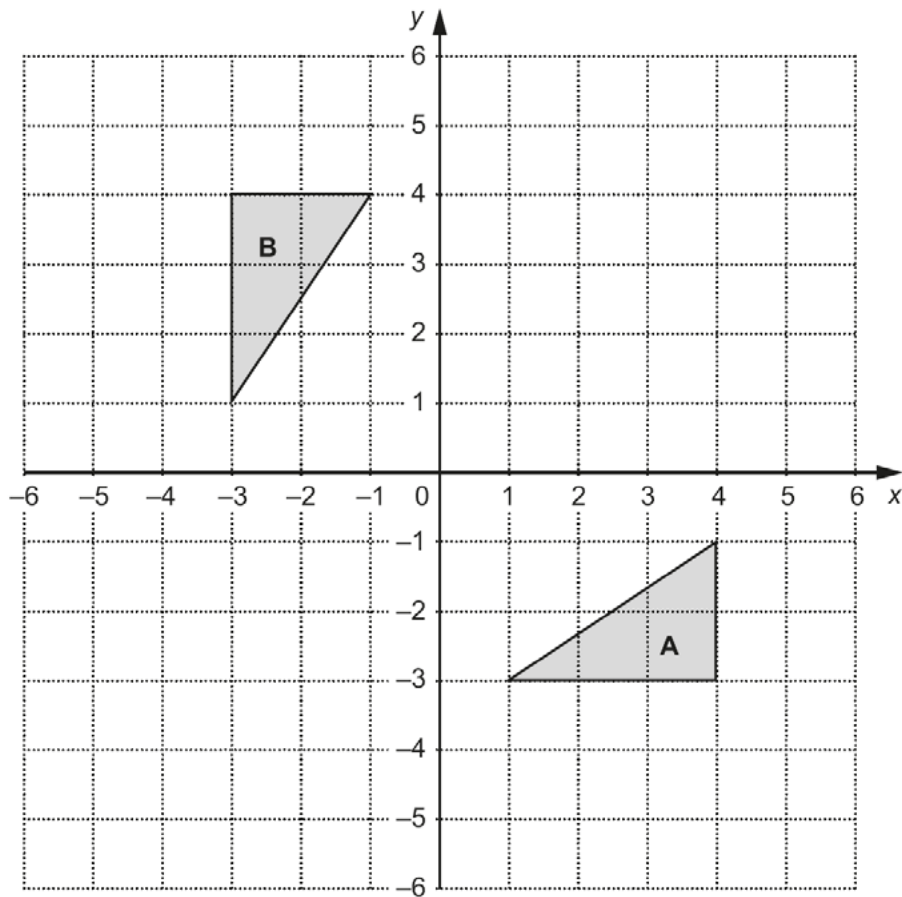
$1462·5 \times 160 = 234000$

(a) ....2.3.4.,.0.0.0........ km/h **[5]**

# Examiner commentary

The candidate has measured the distance within tolerance, 11.7 cm, and then multiplied this by 125 to give 1462.5 km so they gain B2. It is likely the 160 is their attempt at the time and it should be divided not multiplied, so no more credit is gained.

# Question 6 (a)

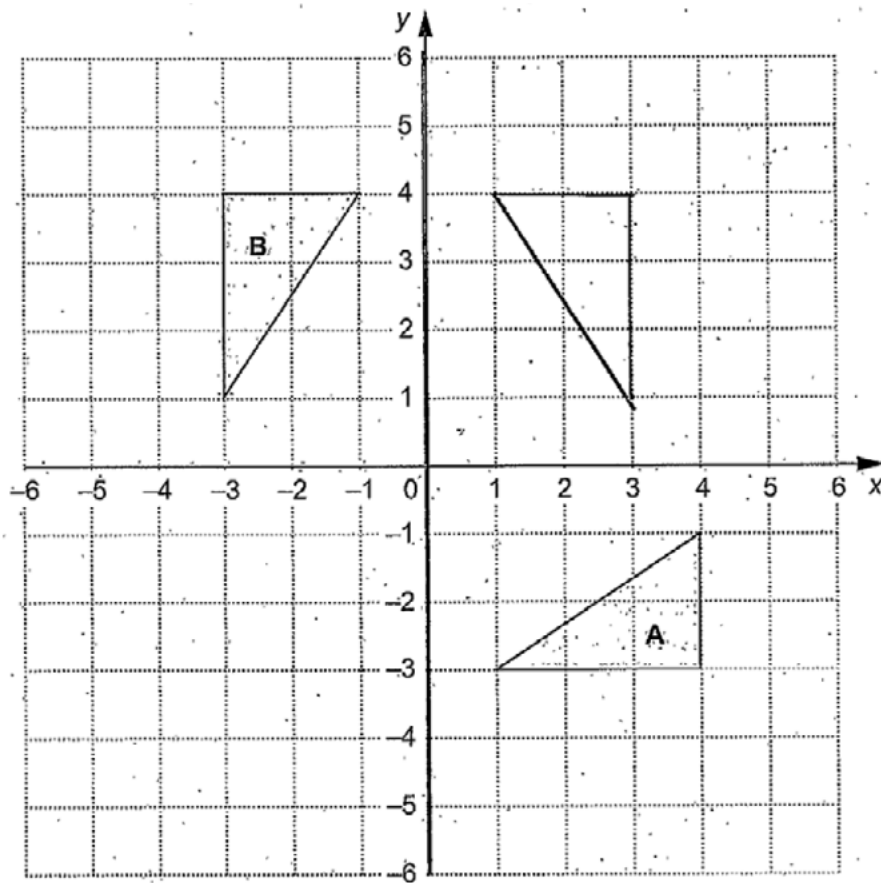**6**  Triangles **A** and **B** are drawn on a coordinate grid.



**(a)** Describe fully the **single** transformation that maps triangle **A** onto triangle **B**.

......................................................................................................................................

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

# Exemplar 1          2 marks



(a) Describe fully the **single** transformation that maps triangle **A** onto triangle **B**.

Rotationan Reflection in the line y=x

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

# Examiner commentary

The correct answer is written down after some thought, giving both the transformation and all the associated information. The equation of the line of reflection is clearly given so both marks are earned.

# Question 6 (b)

(b) Triangle **A** can also be mapped onto triangle **B** using a combination of two transformations:

- a transformation T, followed by
- a reflection in the line *x* = 0.

Describe fully transformation T.

............................................................................................................................................................

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

## Exemplar 1                                                             4 marks
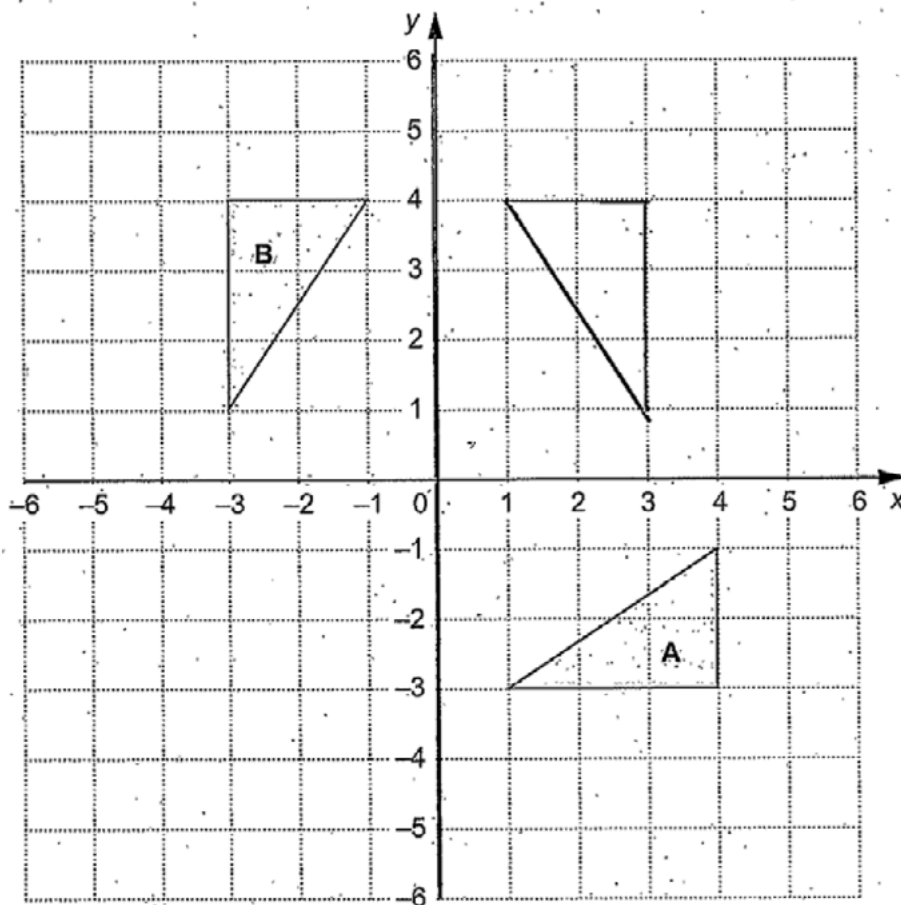


Rotation of 90° anticlockwise ~~with (0,0) as centre of rotation.~~ about the point (0,0).

............................................................................................................................................................

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

## Examiner commentary

On the grid the candidate has drawn the intermediary triangle which has enabled them to work out the transformation from triangle **A** to their triangle. The correct answer is then written down for full marks.

# Exemplar 2      2 marks
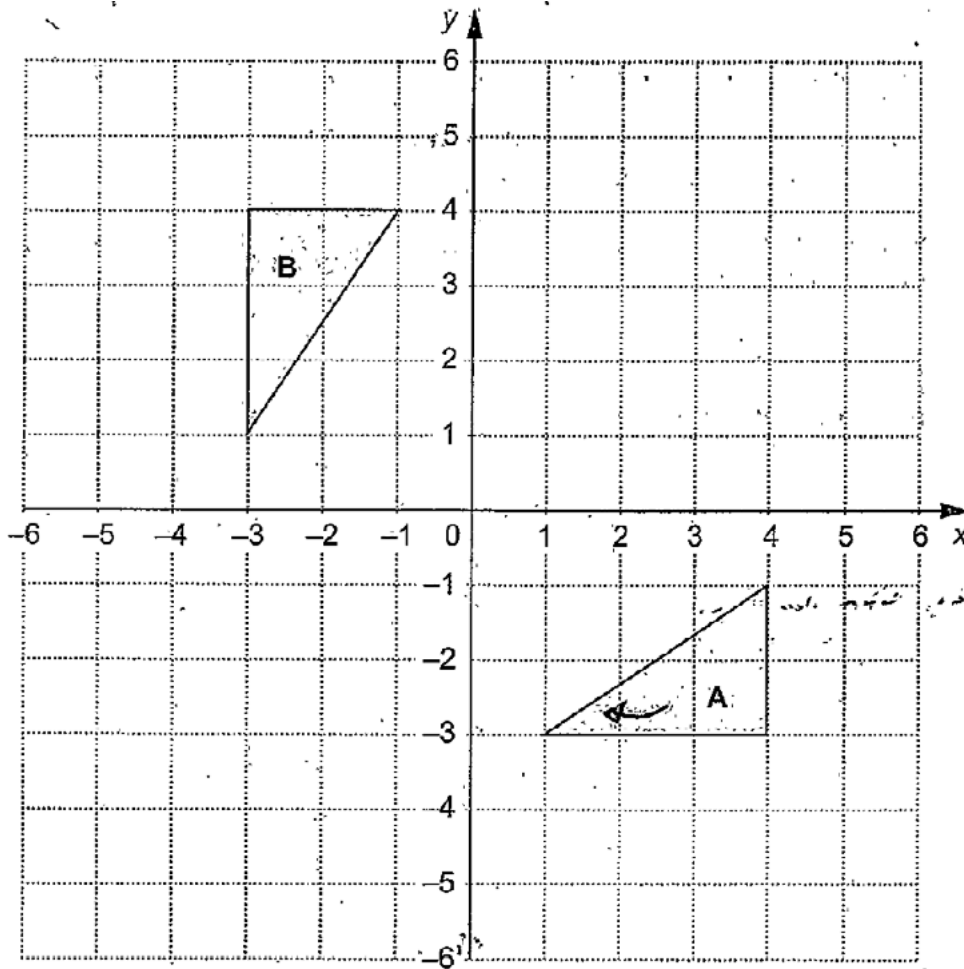


180°. ~~Clockwise~~ Clockwise ~~rotation~~ votation au about (0,2)

[4]

# Examiner commentary

In this response the candidate has identified the correct transformation for 2 marks but they do not have the correct centre or the correct angle. On the diagram there is very little evidence of any supporting work which would have helped them to find the desired information.

# Question 7 (a)

7    The scale diagram below shows towns, A, B and C.
     Line AB represents the road from A to B and line AC represents the road from A to C.

     A shopping centre is to be built so that it is

       •    nearer to the road from A to B than the road from A to C,
       •    less than 14 km from town C.

  **(a)**  Using construction, shade the region where the shopping centre could be built.
       Show all your construction lines.

**Scale: 1 cm represents 2 km**



[5]
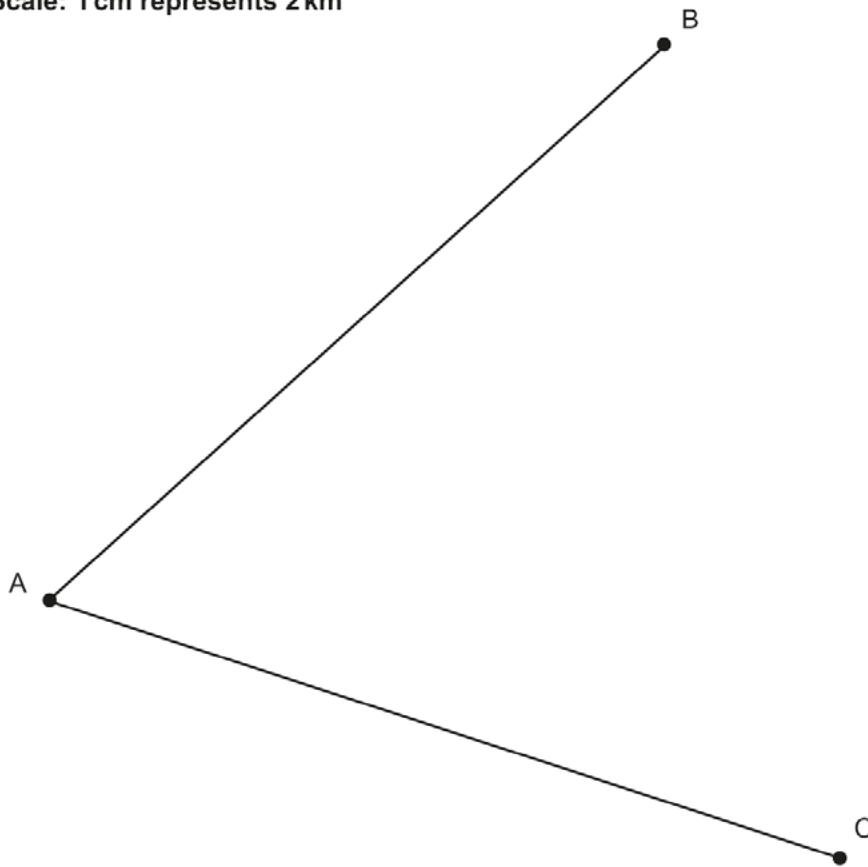
# Exemplar 1            5 marks

14    Km = 7 cm

**Scale: 1 cm represents 2 km**



[5]
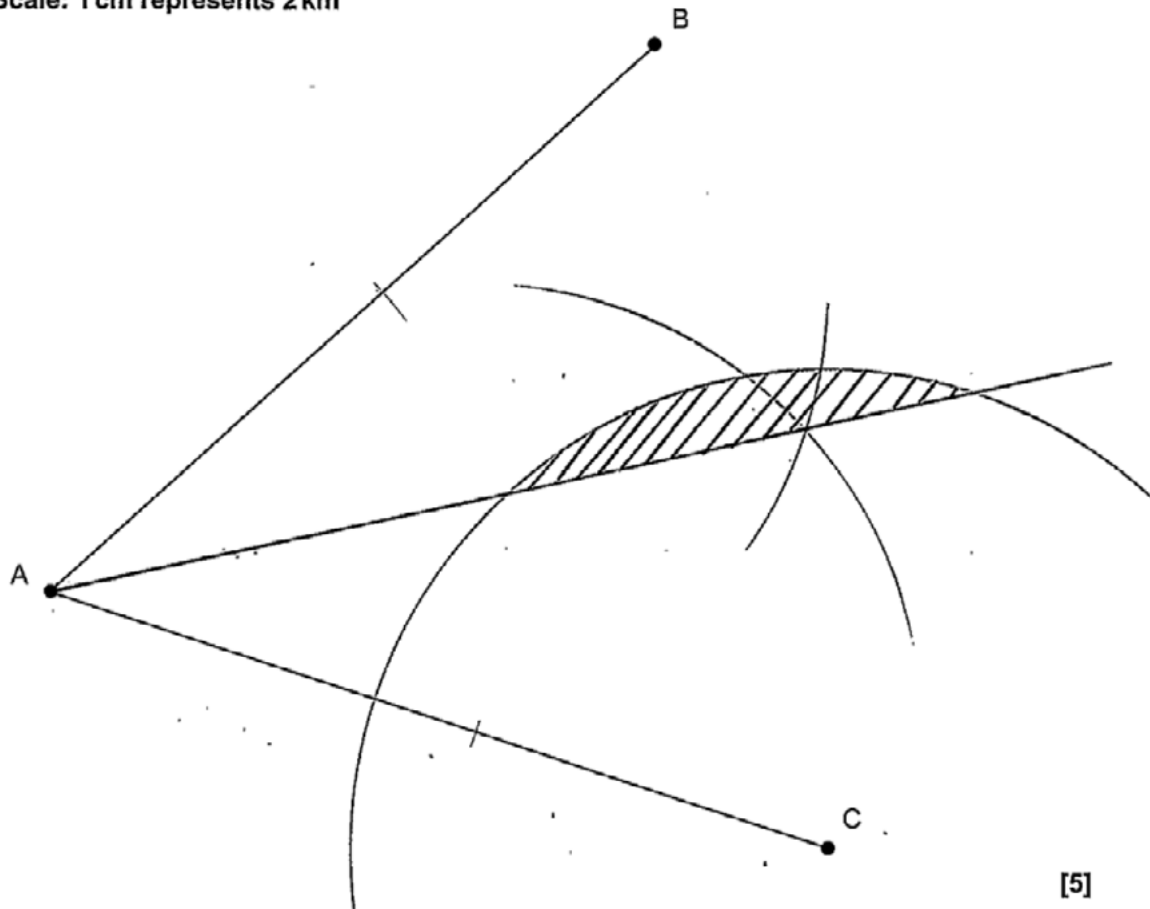
# Examiner commentary

This exemplar shows a fully correct response. The angle bisector is correct and has 2 pairs of correct arcs. The radius for the circle in the second constraint is stated at the start of the response and is then accurately drawn. Finally the correct region is indicated.

# Exemplar 2

# 4 marks

14 Rm = 7cm



B.

A

C

[5]
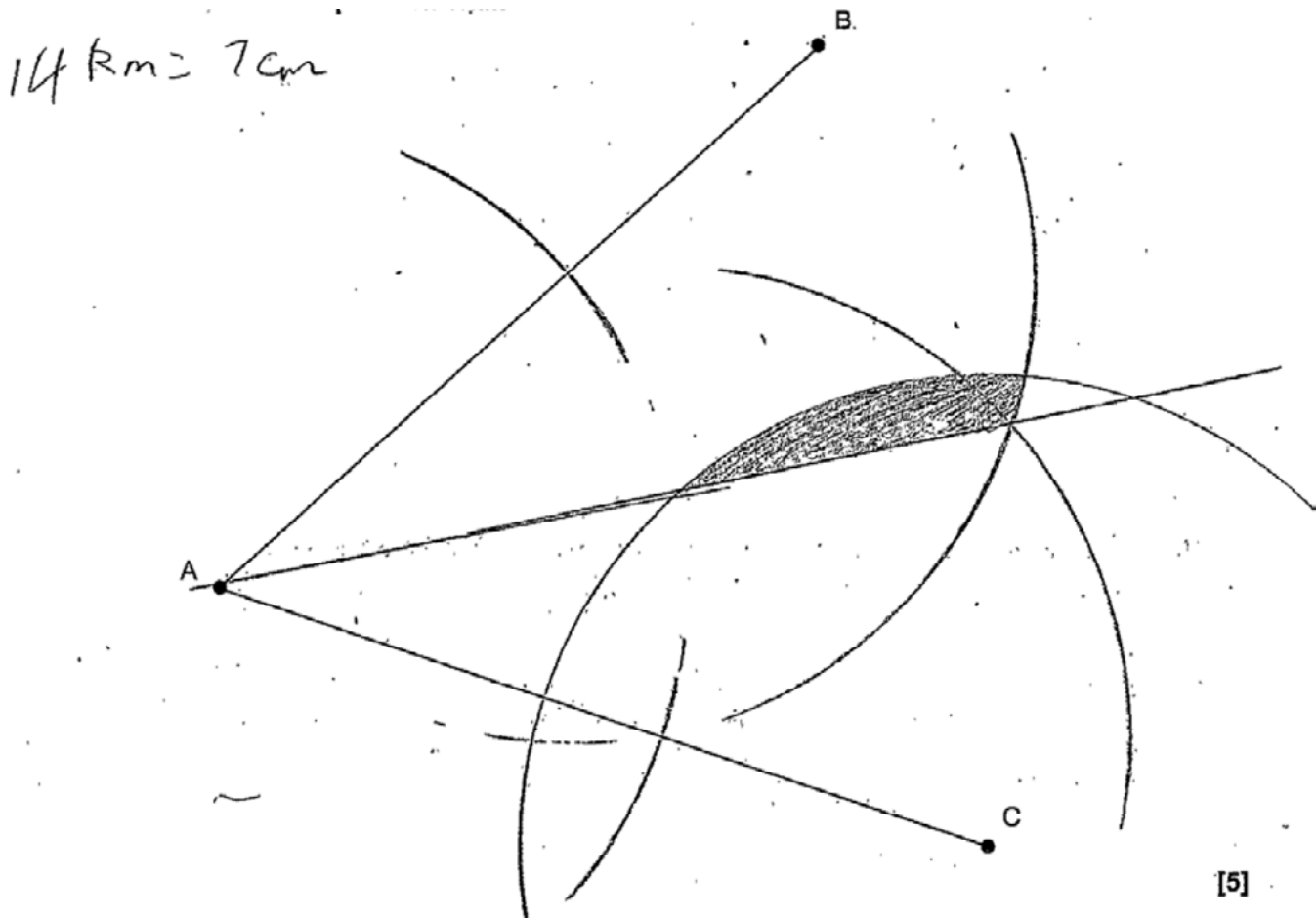
# Examiner commentary

The construction is good here. The arcs are particularly long so that the intersections are clearly defined but the region is not completely identified which means the final mark is not earned.
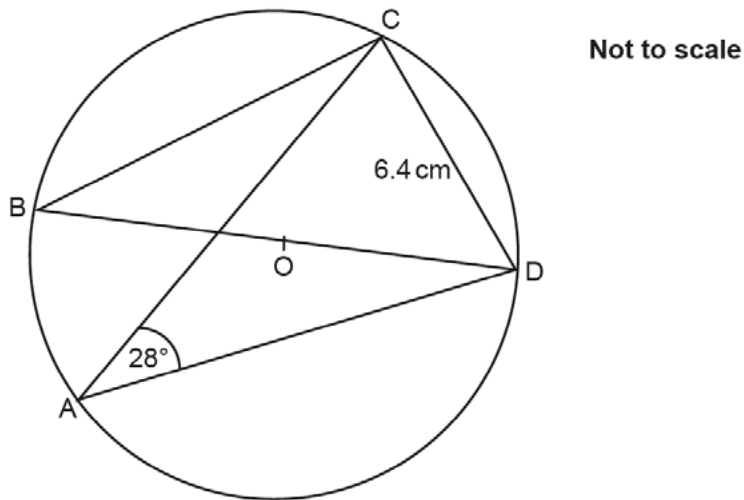
# Exemplar 3

# 3 marks



Scale: 1 cm represents 2 km

[5]
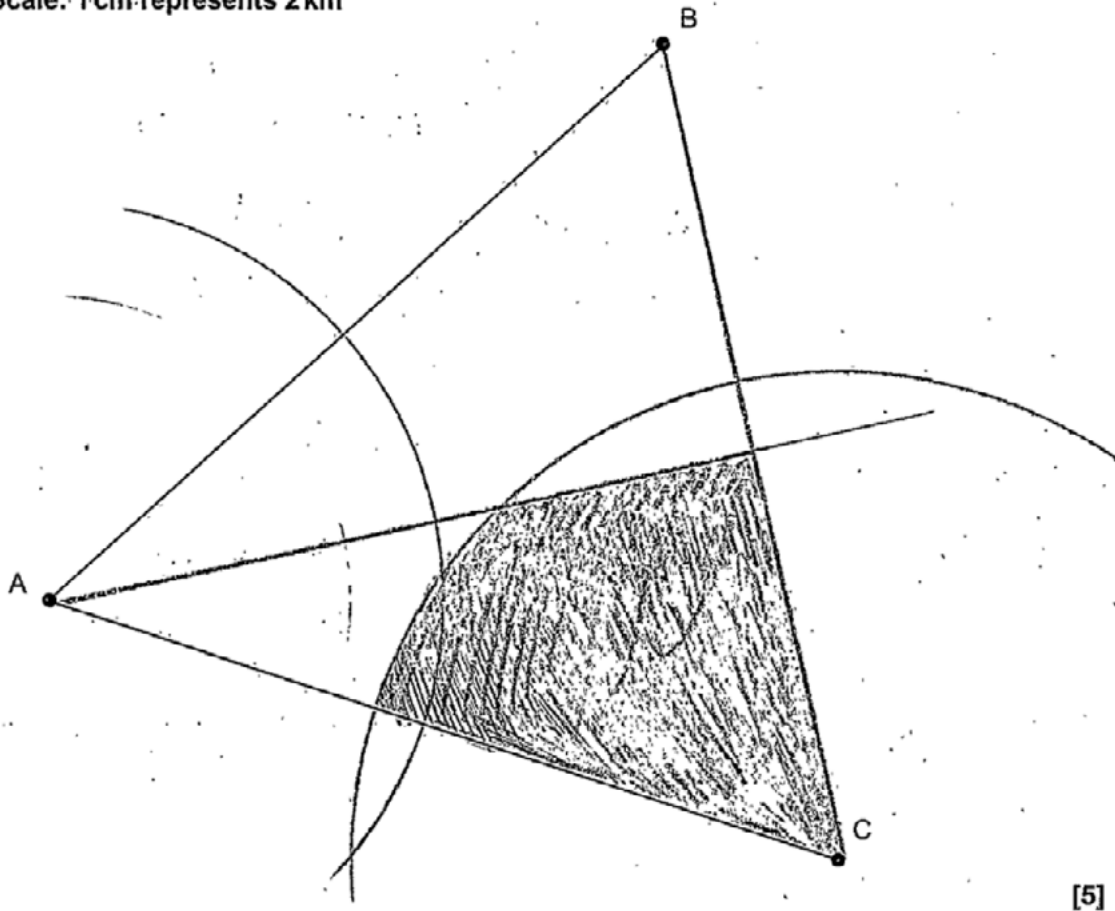
## Examiner commentary

The arc centred on C is accurate for 2 marks. The angle bisector is accurate too but as it does not have the full construction arcs only 1 mark is earned. It is also too short and does not intersect with the arc in two places as it should do, therefore the candidate is unable to identify the correct region successfully for the final mark.

# Question 8

8    A, B, C and D are points on the circumference of a circle, centre O.



**Not to scale**
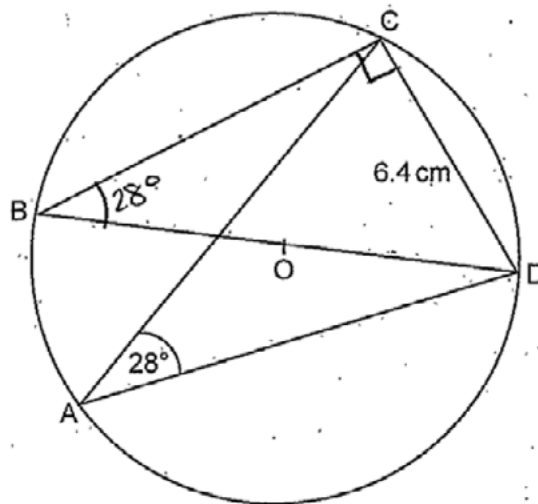
Angle CAD = 28° and CD = 6.4 cm.
BD is a diameter of the circle.

Calculate the area of the circle.

.................................................... cm² **[5]**

# Exemplar 1          5 marks

8    A, B, C and D are points on the circumference of a circle, centre O.



**Not to scale**

Angle CAD = 28° and CD = 6.4 cm.
BD is a diameter of the circle.

Calculate the area of the circle.

CBD = 28° (angles in same segment)
BCD = 90° (angles in semi circle).

$$\frac{BD}{\sin 90} = \frac{6.4}{\sin 28°}$$

$$BD = \frac{6.4}{\sin 28°} \times \sin 90° = 13.6323486$$

↑ diameter.

$$Area = \pi r^2$$

$$= \pi \times 6.8161742 98^2$$

$$= 145.9591237$$

_____146_____ cm² **[5]**

## Examiner commentary

This exemplar is fully correct and scores 5 marks. First they write any other angles that they can work out on the diagram and then give reasons for their working. They work out the diameter of the circle using the correct notation. They use the correct formula ($\pi r^2$) to find the area of the circle, rounding their answer correctly to three significant figures.

# Exemplar 2                                                                    1 mark
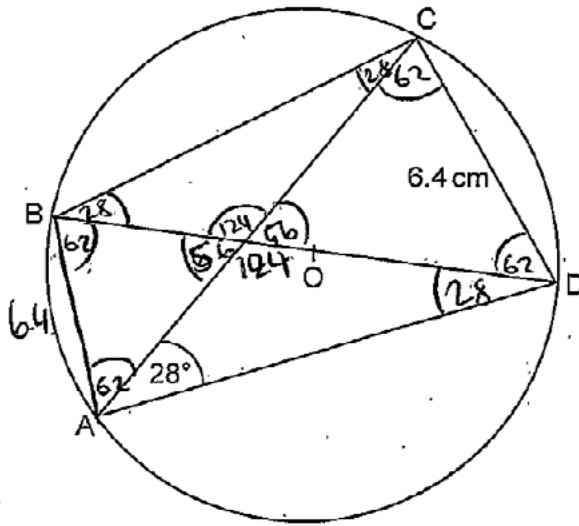


Angle CAD = 28° and CD = 6.4 cm.
BD is a diameter of the circle.

Calculate the area of the circle.

$$28 + 28 = 56$$
$$180 - 56 = 124.$$

$$124 \times 2 = 248$$
$$360 - 248 = 112$$
$$112 \div 2 = 56.$$

$$180 - 56 = 124.$$
$$124 \div 2 = 62.$$

$$6.4 \times 28 = 179.2.$$

........179.2........... cm² [5]

## Examiner commentary

This candidate has identified angle DBC as 28° which scores B1. They have made the incorrect assumption that all four triangles are isosceles which is not correct. They have not noticed that the angle at C is a right angle; this would have opened up this question enabling them to use triangle BCD as a right-angled triangle to find BD and hence the radius of the circle and from that the area of the circle.

# Question 9

9    The dimensions, in centimetres, of this rectangle are shown as algebraic expressions.

$5x - y - 8$

**Not to scale**
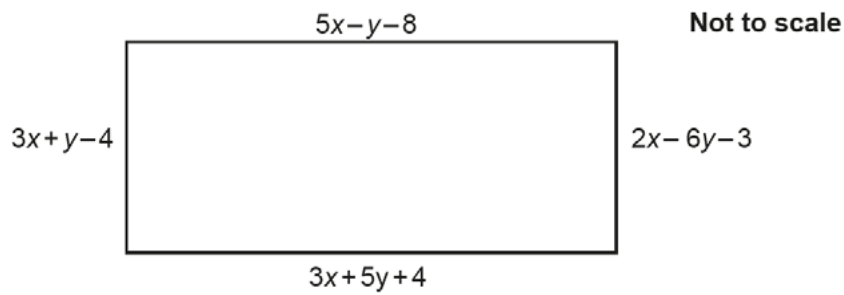
$3x + y - 4$

$2x - 6y - 3$

$3x + 5y + 4$

Work out the length and width of the rectangle.

length = .............................................. cm

width = ............................................... cm

**[6]**

# Exemplar 1             6 marks

length :

$$3x + 5y + 4 = 5x - y - 8$$
$$3x + 6y + 4 = 5x - 8$$
$$3x + 6y + 12 = 5x$$
$$① \quad 6y + 12 - 2x = 0$$

width :

$$3x + y - 4 = 2x - 6y - 3$$
$$3x + 7y - 1 = 2x$$
$$② \quad x + 7y - 1 = 0$$

$$②×2 = \quad 2x + 14y - 2 = 0$$
$$① \quad + \quad 6y + 12 - 2x = 0$$
$$\overline{\quad\quad\quad 20y + 10 = 0}$$
$$20y = -10$$
$$y = \frac{-10}{20} = -0.5$$

$$x + 7y - 1 = 0$$
$$x + 7\left(\frac{-10}{20}\right) - 1 = 0$$
$$x = \cancel{4.5} \quad 5$$
$$4.5$$

length =
$$3x + 5y + 4 =$$
$$3(4.85) + 5\left(\frac{-1}{2}\right) + 4$$
$$=$$

width =
$$3x + y - 4$$

length = .......~~16.7~~.......15........ cm

width = ......~~14~~....9............. cm

[6]

## Examiner commentary

This exemplar is fully correct and scores 5 marks. This candidate creates the two linear equations from equating the widths and lengths separately. The working is clearly annotated and well set out. The two equations are then written out together and solved as simultaneous equations by multiplying one equation by 2 then adding them together. This gives the value of *y* which is used to find the value of *x*. These are then used to find the width and length using the expressions from the diagram.

# Exemplar 2      5 marks

[B2]

$3x + y - 4 = 2x - 6y - 3$

$-2x \qquad -2x$

$x + y - 4 = -6y - 3$

$+6y \qquad +6y$

$x + 7y - 1 = width$

$-7y \qquad x - 1 = -7y$ [M1]

$+1$

$x = -7y + 1$

$5x - y - 8 = 3x + 5y + 4$

$-3x \qquad -3x$

$2x - y - 8 = 5y + 4$

$+y$

$2x + 8 = 6y + 4$

$-8 \qquad -8$

$\dfrac{2x}{2} = \dfrac{6y - 4}{2}$

$x = 3y - 2$

$x = 3y - 2$ [M1]

$x = -7y + 1$

$3y - 2 = -7y + 1$ [M1]

$+3y \qquad +3y$

$-2 = -10y + 1$

$-1 \qquad -1$

$\dfrac{-3}{-10} = \dfrac{-10y}{-10}$

$y = 0.75$ → $0.3$

$x = 3 \times 0.75 - 2$

$x = 0.25$ → $(-1.1)$

$\begin{aligned}&\dfrac{3 \times 0.75}{} \\ &3 \times 0.25 + 0.75 - 2 = 0.5 \\ &2 \times 0.25 - 6 \times 0.75 - 3 = -7 \\ &3x - 1.1 + 0.3 - 4 = -7 \\ &2x - 1.1 - 6 \times 0.3 - 3 = -7\end{aligned}$

$5x - 1.1 - 0.3 - 8$

$= -13.8$

$3x - 1.1 + 5 \times 0.3 + 4$

$=$

length = .................................... cm

width = .....7.................... cm

**[6]**

# Examiner commentary

In this response, the candidate equates both pairs of expressions and are credited the B2 marks (only one pair is needed to score B2). They simplify one pair correctly, hence M1 is awarded, but make a small error in the second pair as they should have added 8 and not subtracted 8. They then score M1 and M1 because they correctly solve their simultaneous equations to find their values of *x* and *y*.

# Exemplar 3

# 3 marks

$$3x + 5y + 4 = 5x - y - 8$$

$(+y)$

$$3x + 6y + 4 = 5x - 8$$

$(-3x)$

$$6y + 4 = 2x - 8$$

$(+8)$

$$6y + 12 = 2x$$

## Examiner commentary

This response shows the minimum required for 3 marks. The candidate has equated one pair of expressions, scoring B2, and then been awarded M1 for producing a correct linear equation. However, that is where they stop; they should have done the same to the other pair of expressions.

# Question 10

10   60% of the people in a town are males.
     20% of the males are left-handed.
     21.6% of all the people are left-handed.

     Work out the percentage of the people who are not male who are left-handed.

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

# Exemplar 1                              5 marks

60 male 40 female

500 people → 300 male, 200 female.

20% of 300 = 60

21.6% of 500 = 108

108 − 60 = 48

$$\frac{48}{200} = 0.24 = 24\%$$

........................ 24 ........................ % **[5]**

# Examiner commentary

This response is fully correct and scores 5 marks. The candidate uses the first line of information to work out how many males and not males there are. They use the second line to work out the number of left-handed males. They use the third line to find the total number of left-handed people and therefore to find the number of left-handed people who are not males. They then find the percentage of not males who are left-handed. Each stage is set out on a new line and explained making it easy to follow.

# Exemplar 2                                      3 marks

male       Fem
0.60      0.40     $\frac{100}{60}$

        [M1]

0.006    1% males left hand
×20       ×20

0.12%    20% males 'left hand.
 [M1]

12% of whole Population = male left handers.

             [M1]

21.6 – 12 = 9.6% other left handed

                           9.6         % [5]

## Examiner commentary

The working is annotated quite well. The proportion of not males (0.4) is seen and labelled for M1. They can be seen working out $0.6 \times 0.2 = 0.12$ or 12% of the population are left-handed males and despite the incorrect figure 0.12% they do recover with the correct figure so they score M1. They have also found the percentage of the population that are left-handed not males by working out 21.6 – 12 = 9.6% for the award of M1. They have all the information they need to complete the question but stop at this point.

# Exemplar 3          1 mark

60% = people in a town are male = 0.6

20% = males = left

21.6% = people are left handed

40% = people in town are females   [M1]

$$\frac{21.6}{100} \times 100 = 21.6$$

$$\frac{21.6}{40\%} = 0.54\%$$

.................... 0.54 .................... % [5]

## Examiner commentary

The percentage of not males is correctly recorded as 40% so they are credited M1. They produce no other correct relevant information so no further credit is given.

# Question 11

11   $y$ is directly proportional to the square of $x$.

Find the percentage increase in $y$ when $x$ is increased by 15%.

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

## Exemplar 1                            4 marks

$$y \propto x$$
$$y = Kx^2$$

$$1 \cdot 15^2 = 1 \cdot 3225$$

SO   $32 \cdot 25$ % increase

............. $32 \cdot 25$ ............. % [4]

## Examiner commentary

This exemplar is fully correct and scores full marks. The relationship between the two variables is stated at the beginning of the response. The percentage increase is written as a decimal and then squared, and the final answer is taken from that figure. This method is very efficient.

## Exemplar 2                            1 mark

$$y \propto x^2$$

$$y = kx^2$$

**B1**

$$100 + 15 = 115$$
$$\frac{}{100} = 1 \cdot 15$$

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

## Examiner commentary

The candidate shows that they understand the nature of the relationship with the equation $y = kx^2$ and they have written a 15% increase as the multiplier 1.15 for which they score B1. They do no further work so no more marks are credited.

# Question 12 (c)

12    The value of a car, £V, is given by

$$V = 16\,500 \times 0.82^n$$

where $n$ is the number of years after it is bought from new.

(c)   Show that the value of the car after 4 years is less than half its value when new.          [2]

# Exemplar 1                                                            2 marks

When new: £16500

after 4 years: $16500 \times 0.82^4$

$= 7460.00...$

$\dfrac{7460.00...}{16500} \times 100 = 45.21...\% \text{ of}$

original value

$45.21...\% < 50\%$

# Examiner commentary

This exemplar is fully correct and scores 2 marks. The value after 4 years is calculated from the formula which is clearly written. This is then converted to a percentage of the initial value, which is compared to 50% and the correct conclusion is reached. This is one of a number of methods seen and is probably the most efficient one.

# Question 13 (a)

13   A menu has

- 6 starters
- 10 main dishes
- 7 desserts.

(a) A three-course meal consists of a starter, a main dish and a dessert.

How many different three-course meals are possible?

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

## Exemplar 1                                                2 marks

$$6 \times 10 \times 7$$
$$= 420$$

(a) ............420............ [2]

## Examiner commentary

This exemplar is fully correct and scores 2 marks. The working is written down and the correct answer obtained.

# Question 13 (b)

(b) A two-course meal consists either of a starter with a main dish, a starter with a dessert or a main dish with a dessert.

Show that there are 172 possible different two-course meals. [3]

## Exemplar 1                                                                                   3 marks

$$6 \times 10 = 60$$
$$6 \times 7 = 42$$
$$10 \times 7 = 70$$

$$60 + 42 + 70 = 172$$

∴ there is 172 possible two course meals.

## Examiner commentary

This exemplar is fully correct and scores 3 marks. Each possibility is written down as a product and then they are added to get the final answer. A statement is made, which is not essential but is helpful.

## Exemplar 2                                                                                   1 mark

6 Main Courses

$$6 \times 7 = 42 \quad \boxed{M1}$$

## Examiner commentary

The candidate shows one correct product so scores M1.

# Question 14 (b)

14 The Venn diagram shows the number of students studying Mathematics (M) and the number of students studying Physics (P) in a college.
35 students do not study either subject.
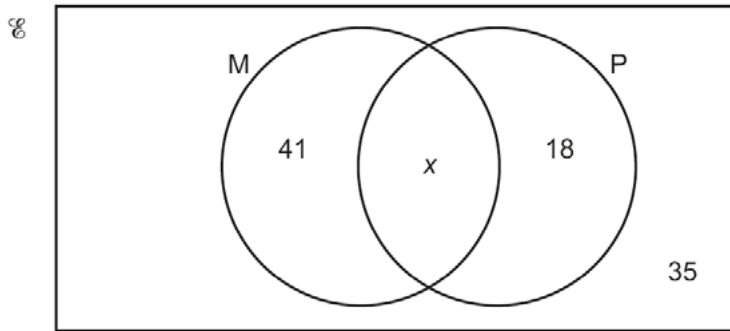


(b) One of the 121 students is selected at random.

Find the probability that this student studies Mathematics, given that they study Physics.

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

# Exemplar 1                                                           2 marks

number study physics: 27 + 18 = 45

$\frac{27}{45} = \frac{3}{5} = 0.6$

(b) ............0.6............ [2]

# Examiner commentary

This exemplar is fully correct and scores 2 marks. The number of students studying physics is worked out, then the correct probability is written down and simplified.

# Question 15 (a)

15   (a)   Write $x^2 - 8x + 25$ in the form $(x - a)^2 + b$.

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

# Exemplar 1                            3 marks

$(x-4)^2 + 9$

$(x-4)^2 = 16$

(a)   $(x - 4)^2 + 9$   [3]

## Examiner commentary

This exemplar is fully correct and scores 3 marks. The candidate writes the answer down straight away and then checks their answer with $(-4)^2 = 16$. It is clear that $9 + 16 = 25$ which is the number on the end of the expression.

# Exemplar 2                            1 mark

$x^2 - 8x + 25$

$\downarrow$ half of 8

$(x - 4)^2 + 25$

(a)   $(x-4)^2 + 25$   [3]

## Examiner commentary

The candidate has written the correct square bracket so B1 is credited. The number on the end of the expression is incorrect so no further marks are earned.

# Question 15 (b)

**(b)** Write down the coordinates of the turning point of the graph of $y = x^2 - 8x + 25$.

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

# Exemplar 1                                                         2 marks

**(b)**  ( ............4............ , ............9............ ) **[2]**

# Examiner commentary

This exemplar is fully correct and scores 2 marks. For the turning point, the $x$ coordinate is the value that makes the bracket zero and the number at the end of the completed square term is the $y$ coordinate.

# Question 15 (c)

(c) Hence describe the single transformation which maps the graph of $y = x^2$ onto the graph of $y = x^2 - 8x + 25$.

...................................................................................................................................................

...................................................................................................................................................

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

# Exemplar 1                                                      2 marks

(c) Hence describe the single transformation which maps the graph of $y = x^2$ onto the graph of $y = x^2 - 8x + 25$.                                                   $x = 0$   $y = 0$.

4 to the right
9 up.

Translation by vector $\begin{pmatrix} 4 \\ 9 \end{pmatrix}$   **[2]**

$y = x^2$
$1 = 1$
$4 = 2$
$9 = 3$
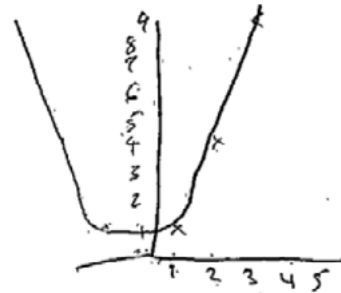
# Examiner commentary

This exemplar is fully correct and scores 2 marks. One of the advantages of using completed square form is that you can get the information about the translation that has taken place. This is demonstrated by this response.

# Question 16

16  Solve by factorisation.

$$3x^2 + 11x - 20 = 0$$

$x = $ ................... or $x = $ ................... [3]

## Exemplar 1                                                3 marks

$$3x^2 + 11x - 20 = 0$$
$$3x - 20 = -60$$
$$3x^2 + 15x - 4x - 20 = 0$$
$$3x(x + 5) \; -4(x + 5) = 0$$
$$(3x - 4)(x + 5) = 0$$
$$x = \frac{4}{3} \qquad x = -5$$

$x = \frac{4}{3}$ or $x = -5$ [3]

## Examiner commentary

This exemplar is fully correct and scores 3 marks. The candidate uses the method they have been taught by splitting the middle term up and factorising in pairs, before using the common bracket to complete the factorisation. The two correct solutions are then written down.

# Exemplar 2     2 marks

$$3x^2 + 11x - 20 = 0$$

$$3x - 20 = -60$$

$$\frac{60}{}$$

1 × 60
2 × 30
3 × 20
(4 × 15)

$$3x^2 - 15x + 4x - 20 = 0$$

$$3x(x - 5) + 4(x - 5) = 0$$

$$(3x + 4)(x - 5) \quad \boxed{B1}$$

$$3x + 4 = 0 \implies 3x = -4 \implies x = -1.\dot{3}$$
$$\;\;\; -4 \;\; -4 \qquad \div 3 \;\; \div 3$$

$$x - 5 = 0 \implies x = 5$$
$$+5 \;\; +5$$

$$\boxed{FT}$$

$$\boxed{B1}$$

$$x = \underline{-1.\dot{3}} \quad \text{or} \quad x = \underline{5} \quad \text{[3]}$$

## Examiner commentary

Here, the candidate uses the technique of splitting the middle term of $11x$ into $-15x + 4x$ which unfortunately adds to $-11x$ instead of $+11x$. They produce the correct factors from their new expression and their two factors will give two correct terms so they are awarded B1. They produce the correct solutions from their factors so they are awarded B1FT. This emphasises the need to check work thoroughly as work progresses.

# Question 17 (a), (b) and (c)

**17** For each graph below, select its possible equation from this list.

$$y = \frac{1}{x} \qquad y = \cos x \qquad y = x^2 \qquad y = \left(\frac{1}{2}\right)^x \qquad y = 2^x$$

$$y = \sin x \qquad y = 2^{-x} \qquad y = \tan x \qquad y = x^3 \qquad y = \frac{1}{x^2}$$

**(a)**
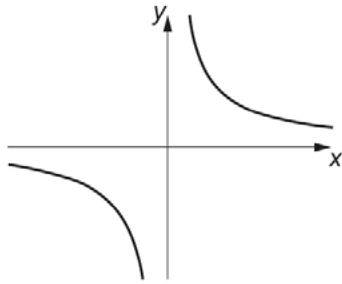
(a)  $y = $ ....................................

**(b)**
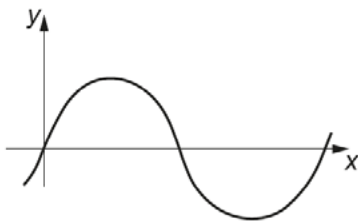
(b)  $y = $ ....................................

**(c)**
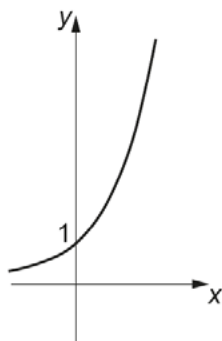
(c)  $y = $ ....................................

**[3]**

# Exemplar 1

# 3 marks

**(a)**



(a) $y = \dfrac{1}{x}$

**(b)**



(b) $y = \sin x$

**(c)**
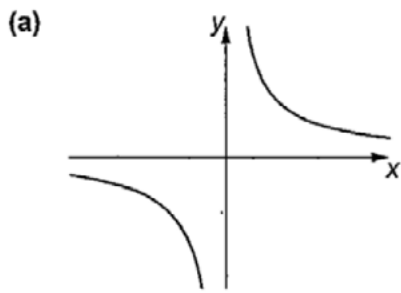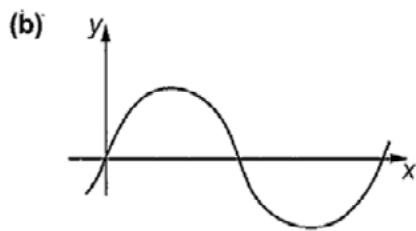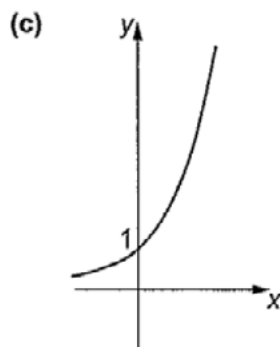


(c) $y = 2^x$

[3]

## Examiner commentary

This exemplar is fully correct and scores 3 marks. The correct equations are identified from the shape of the curves.

# Question 18

**18** Calculate the area of this triangle.

**Not to scale**

5.8 cm          3.9 cm

6.4 cm

.................................................. cm$^2$ **[6]**

# Exemplar 1                                       6 marks

**Not to scale**

5.8 cm          3.9 cm

$\theta$

6.4 cm
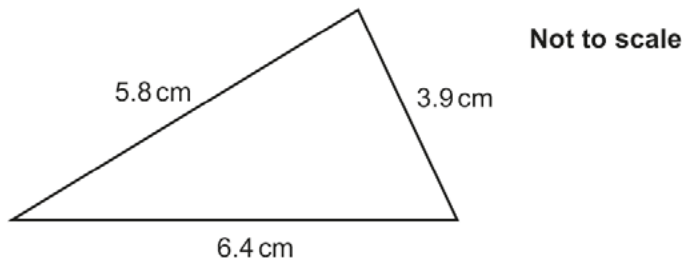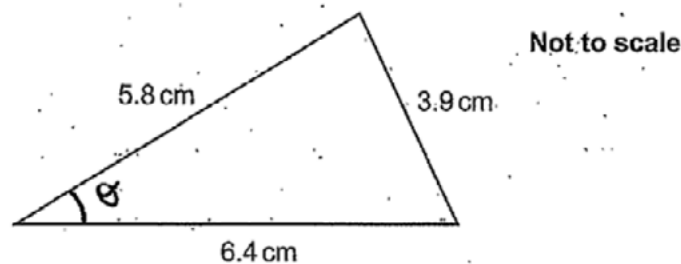
$$a^2 = b^2 + c^2 - 2bc \cos A$$
$$3.9^2 = 5.8^2 + 6.4^2 - 2 \times 5.8 \times 6.4 \times \cos\theta$$
$$15.21 = 74.6 - 74.24 \cos\theta$$
$$-59.39 = -74.24 \cos\theta$$
$$\cos\theta = 0.79997306\ldots$$
$$\theta = 36.87247\ldots$$

$$\frac{1}{2}ab \sin C$$

$$\frac{1}{2} \times 5.8 \times 6.4 \times \sin 36.87247 = 11.14 \quad (2dp)$$

11.14
....................................................... cm$^2$ **[6]**

# Examiner commentary

This exemplar is fully correct and scores 6 marks. The candidate shows us which angle they are finding, which was rare. They use the cosine rule to find this angle and then the area of the triangle using the sine formula (½*ab*sin*C*). They maintain a high level of accuracy throughout the response which should be encouraged; many candidates rounded their figures too soon.

                                        

# Exemplar 2            4 marks



**Not to scale**
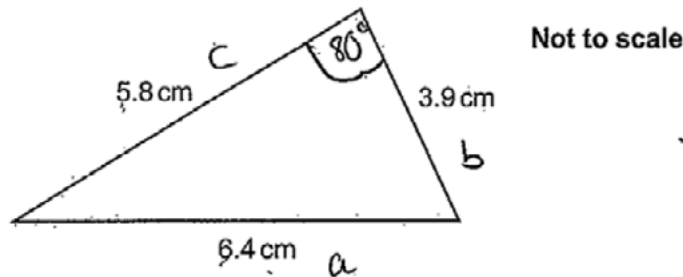
$$a^2 = b^2 + c^2 - 2bc \cos A \qquad \boxed{\text{M2}}$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc} = \frac{3.9^2 + 5.8^2 - 6.4^2}{2 \times 3.9 \times 5.8} \qquad \boxed{\text{M1}}$$

$$= \frac{7.89}{45.24}$$

$$= 0.1744031\ldots$$

$$= 0.17$$

$$\cos^{-1} 0.17\ldots = 79.956\ldots \;✓$$

$$= 80°$$

$$\tfrac{1}{2} ab \sin C$$

$$\tfrac{1}{2} \times 6.4 \times 3.9 \times \sin 80 \qquad \boxed{\text{M1}}$$

$$= 12.290 \dot{t} 00 \bar{7}6$$

$$= 12.29$$

<u>       12.29          </u> cm² **[6]**

## Examiner commentary

The candidate uses the cosine rule to correctly find the angle opposite 6.4, which they conveniently labelled, and were awarded M3. The angle is rounded to 2 significant figures which is considered to be too little accuracy at this stage. They use the sine formula to find the area of the triangle but they also substitute one incorrect value into it as well as the rounded angle so this attempt was awarded M1. They write the formula as ½*ab*sin*C* when the angle they have found is *A* and not *C*. They should have written the formula as ½*bc*sin*A*.

# Exemplar 3                 2 marks

**18** Calculate the area of this triangle.

**Not to scale**

$a$ 5.8 cm    3.9 cm $b$

6.4 cm

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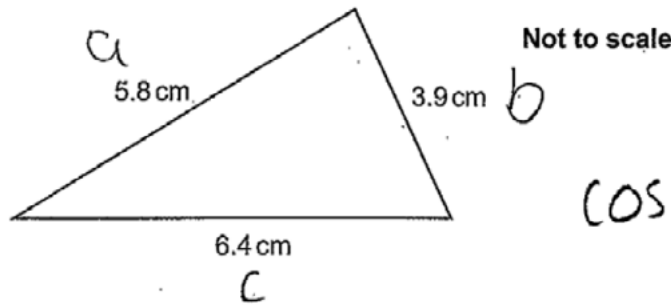
$$\cos A = \frac{b^2 + c^2 - a^2}{-2bc}$$

$$= -0.451$$

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

$$-1$$

$$c \circ \frac{a^2 - b^2 - c^2 \cdot 2c \quad -u}{2bc}$$

$$1 \cdot 799$$

$$5 \cdot 8^2$$

$$\frac{1}{2} ab \widehat{\sin} c$$

$$\cos A =$$

$$\frac{1}{2} \times 5.8 \times 6.4 \times \sin C$$

$$18.56 \times \sin C$$

$$5.8^2 = 3.9^2 + 6.4^2 - 2 \times 3.9 \times 6.4 \times \cos A \quad \boxed{M2}$$

$$33.64 = 56.17 - 49.92$$

$$= 6.25 \times \cos A$$

$$\div 6.25$$

$$\frac{33.64}{6.25} = 5.3824$$

$$\cos^{-1}$$

.................................................. cm² **[6]**

## Examiner commentary

After a number of false starts, the candidate writes a correct version of the cosine rule and substitutes the correct values in so were awarded M2. They also correctly labelled the triangle. The next stage would be to rearrange the equation to find the angle which they did not do correctly. The final stage would be to use the sine formula for the area using that angle.

# Question 19

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

$$0 \qquad 9 \qquad 22 \qquad 39$$

The $n$th term can be written as $an^2 + bn + c$.

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

a = ..........................

b = ..........................

c = ..........................

**[4]**

## Exemplar 1                                                                                        4 marks



a = $2$

b = $3$

c = $-5$

**[4]**

## Examiner commentary

This exemplar is fully correct and scores 4 marks. This candidate uses a common technique by finding the first and second differences and hence finding the first term of $2n^2$. They subtract these terms from the given sequence to find the remaining values they need to find which is a linear sequence and they then find the other two terms. This proved to be the most successful method; other candidates created simultaneous equations but many did not progress much beyond that.

# Exemplar 2

# 3 marks

$$0 \quad 9 \quad 22 \quad 39$$

$$9 \quad 13 \quad 17$$

$$4 \quad 4$$

$$2n^2 = 2 \quad 8 \quad 18 \quad 32$$

$$-2 \quad 1 \quad 4 \quad 7$$

$$3 \quad 3 \quad 3$$

$$2n^2 + 3n = 5 \quad 14 \quad 27 \quad 44$$

$$5 - 0 = 5 \qquad 2n^2 + 3n + 5$$
$$14 - 9 = 5$$
$$27 - 22 = 5$$
$$44 - 39 = 5$$

$a =$ ......2......

$b =$ ......3......

$c =$ ......5......

[4]

## Examiner commentary

Despite the lack of explanation it is easy to follow the working. They find the second differences and the first term of $2n^2$ for which they are awarded B2. They subtract these terms from the original sequence to produce the revised differences and they are awarded M1 and find the next term $3n$. They then write down the sequence formed by $2n^2 + 3n$ and give $+5$ as the final term when it should have been $-5$.

# Question 20

20  Solve this equation, giving your answers correct to 1 decimal place.

$$\frac{5}{x+2} + \frac{3}{x-3} = 2$$

x = .................... or x = .................... [6]

# Exemplar 1                                                                6 marks

$$\frac{5(x-3)}{(x+2)(x-3)} + \frac{3(x+2)}{(x-3)(x+2)} = 2$$

$$\frac{5x-15+3x+6}{(x-3)(x+2)} = 2$$

$$\frac{8x-9}{(x-3)(x+2)} = 2 \qquad \frac{8x-9}{x^2-x-6} = 2$$

|   | x | − 3 |
|---|---|-----|
| x | x² | −3x |
| +2 | +2x | −6 |

$$8x-9 = 2x^2 - 2x - 12$$

$$8x = 2x^2 - 2x - 3$$

$$2x^2 - 10x - 3 = 0$$

$$x = \frac{10 + \sqrt{10^2 - 4 \times 2 \times -3}}{2 \times 2} = 5.3$$

$$x = \frac{10 - \sqrt{10^2 - 4 \times 2 \times -3}}{2 \times 2} = -0.3$$

x = ....5.3.... or x = ....−0.3.... [6]

# Examiner commentary

This exemplar is fully correct and scores 6 marks. This is a typical example of this topic. The fractions are combined by using common denominators (many candidates reached this stage successfully). The candidate multiplies by this common denominator and simplifies to reach a quadratic equation (it was at this stage that errors were usually made). Here, the candidate spreads out their work so that it is easy to read and follow. The accuracy in the question suggests that use of the formula is appropriate whereas many tried to factorise. The correct answers are then reached.

# Exemplar 2

# 3 marks

$$\frac{5(x-3) + 3(x+2)}{(x+2)(x-3)} = 2 \quad \boxed{M1}$$

$$\frac{5x - 15 + 3x + 6}{(x+2)(x-3)} = 2 \quad \boxed{B1}$$

$$\frac{8x - 9}{(x+2)(x-3)} = 2$$

$$8x - 9 = 2(x+2)(x-3)$$

$$8x - 9 = 2(x^2 - 3x + 2x - 6)$$

$$8x - 9 = 2(x^2 - 6x - 6)$$

$$8x - 9 = 2x^2 - 12x - 12$$

$$0 = 2x^2 - 12x - 12 - 8x - 9$$

$$0 = 2x^2 - 20x - 21 \quad \boxed{M1}$$

$$0 =$$

x = ................. or x = ................... [6]

# Examiner commentary

In three steps the candidate successfully combines the two fractions so was awarded M1 for the correct method for the numerator and B1 for the correct denominator. They multiply by the denominator correctly but when expanding the two brackets they make an arithmetic error. They then make an error in rearranging the equation. They make two errors in forming their quadratic equation so were awarded M1. The remaining step is to use the formula to find the two solutions of the quadratic equation.

# Exemplar 3

# 2 marks

$$\frac{5}{x+2} + \frac{3}{x-3}$$

$$5(x-3) + 3(x+2)$$

$$5x - 15 + 3x + 6 \quad \boxed{M1}$$

$$\frac{8x - 9}{(x+2)(x-3)} = 2 \quad \boxed{B1}$$

1, 8    1, 9
2, 4    3, 3

x = ................... or x = ................... [6]

## Examiner commentary

This candidate correctly combines the fractions with a common denominator and was awarded M1 for the correct method for the numerator and B1 for the correct denominator. They are unable to proceed any further. Many candidates were unable to answer this question.

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