Pearson Edexcel

INTERNATIONAL GCSE

Mathematics A (9-1)

EXEMPLARS WITH EXAMINER COMMENTARIES

PAPER 2

Pearson Edexcel International GCSE in Mathematics A (4MA1)

Contents

Introduction 1
1.1 About this booklet 1
1.2 How to use this booklet 1
1.3 Further support 1
Question 4 2
Exemplar response A 2
Exemplar response B 3
Question 5(a) 4
Exemplar response A 5
Exemplar response B 6
Question 5(b) 7
Exemplar response A 8
Exemplar response B 9
Question 8 10
Exemplar response A 11
Exemplar response B 12
Question 9 12
Exemplar response A 13
Exemplar response B 14
Question 12 15
Exemplar response A 17
Exemplar response B 18
Question 14 19
Exemplar response A 20
Exemplar response B 21
Question 16 22
Exemplar response A 23
Exemplar response B 24
Question 19 25
Exemplar response A 26
Exemplar response B 28
Question 20 30
Exemplar response A 31
Exemplar response B 32

Introduction

1.1 About this booklet

This booklet has been produced to support teachers delivering the Pearson Edexcel International GCSE in 4MA1 specification. The Paper 2 exemplar materials will enable teachers to guide their students in the application of knowledge and skills required to successfully complete this course. The booklet looks at questions 4, 5a, 5b, 8, 9, 12, 14, 16, 19 and 20 from the June 2019 examination series, showing real candidate responses to questions and how examiners have applied the mark schemes to demonstrate how student responses should be marked.

1.2 How to use this booklet

Each example covered in this booklet contains:

- Question
- Mark scheme
- Exemplar responses for the selected question
- Example of the marker grading decision based on the mark scheme, accompanied by examiner commentary including the rationale for the decision and where relevant, guidance on how the answer can be improved to earn more marks.

The examples highlight the achievement of the assessment objectives at lower to higher levels of candidate responses.

Centres should use this content to support their internal assessment of students and incorporate examination skills into the delivery of the specification.

1.3 Further support

A range of materials is available from the Pearson qualifications website to support you in planning and delivering this specification.

Centres may find it beneficial to review this document in conjunction with the Examiner's Report and other assessment and support materials available on the Pearson Qualifications website.

Question 4

A cylinder has diameter 14 cm and height 20 cm.

Work out the volume of the cylinder.
Give your answer correct to 3 significant figures.

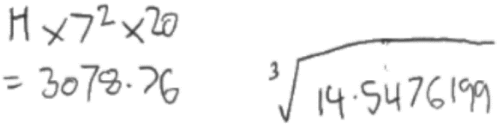
.....cm^3

(Total for Question 4 is 2 marks)

Mark scheme

$\pi \times 7^2 \times 20$ (= 3078.76...) **or** 980π			M1 for complete method to find volume
	3080	2	A1 for answer in range 3077.2 – 3080
			Total 2 marks

Exemplar response A



Examiner's comments:

This response was given 1 mark.

The student has interpreted the question correctly by correctly recalling the volume of the cylinder. The student was awarded M1 for the correct use of the formula to work out the volume with 7 and 20. They have correctly substituted into the formula and then they evaluate. The student was then awarded A0 as they have cube rooted their answer and obtained an incorrect answer.

NB If the candidate had written $\sqrt[3]{\pi \times 7^2 \times 20} = 55.48...$ then this would have gained M0. The method mark can still be awarded in this case because the further operation follows the evaluation of $\pi \times 7^2 \times 20$

Exemplar response B

$\pi r^2 h$

$\pi \times 14^2 \times 20 = 12,315.0432$

12,300 ..... cm^3

Examiner's comments:

This response was given 0 marks.

The student has interpreted the question correctly by correctly recalling the volume of the cylinder. A mark is not awarded for just stating the formula. The student was awarded M0 for substituting the value of the diameter instead of the radius even though they have substituted into the correct formula. As the student has not been awarded the M mark they are then awarded A0.

Question 5a

Josh buys and sells books for a living.

He buys 120 books for £4 each.

He sells $\frac{1}{2}$ of the books for £5 each.

He sells 40% of the books for £7 each.
He sells the rest of the books for £8 each.

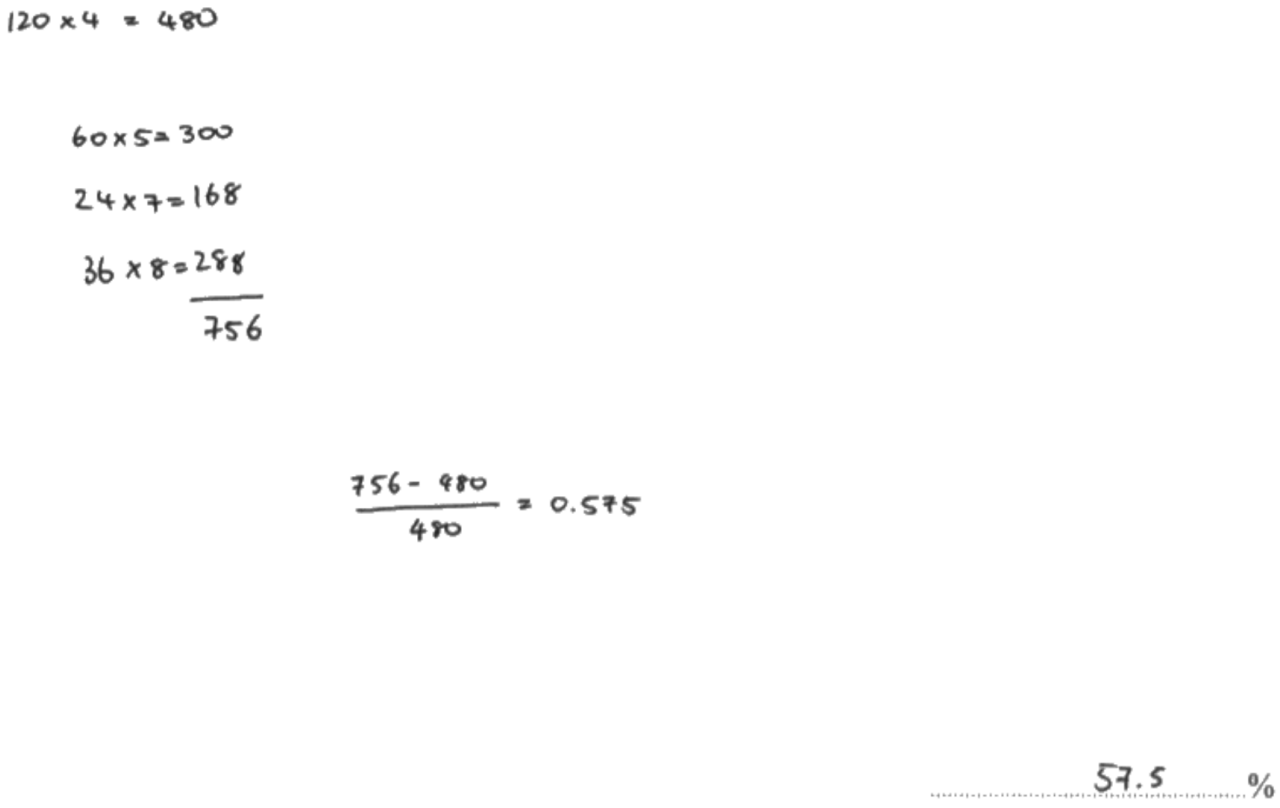
(*a*) Calculate Josh's percentage profit.

.....%
(5)

Mark scheme

$4 \times 120 (= 480)$			M1
e.g. $120 \div 2 \times 5 (= 300)$ **or** $120 \times 0.4 \times 7 (= 336)$ **or** $(120 - '60' - '48') \times 8 (= 96)$ **or** $120 \times 0.1 \times 8 (= 96)$			M1 for a method to find the income for one of the selling prices
e.g. $(120 \div 2 \times 5) + (120 \times 0.4 \times 7) + ((120 - '60' - '48') \times 8) (= 732)$ **or** $(120 \div 2 \times 5) + (120 \times 0.4 \times 7) + (120 \times 0.1 \times 8) (= 732)$ **or** $'300' + '336' + '96' (= 732)$			M1 for a complete method to find the total income
e.g. $\frac{'732' - '480'}{'480'} \times 100$ **or** $'252' \div '480' \times 100$ **or** $\left(\frac{'732'}{'480'} \times 100\right) - 100$ or $152.5 - 100$ **or** $\left(\frac{'732'}{'480'} - 1\right) \times 100$ or 0.525×100			M1 for a complete method to find the percentage profit
	52.5	5	A1 accept 53

Exemplar response A

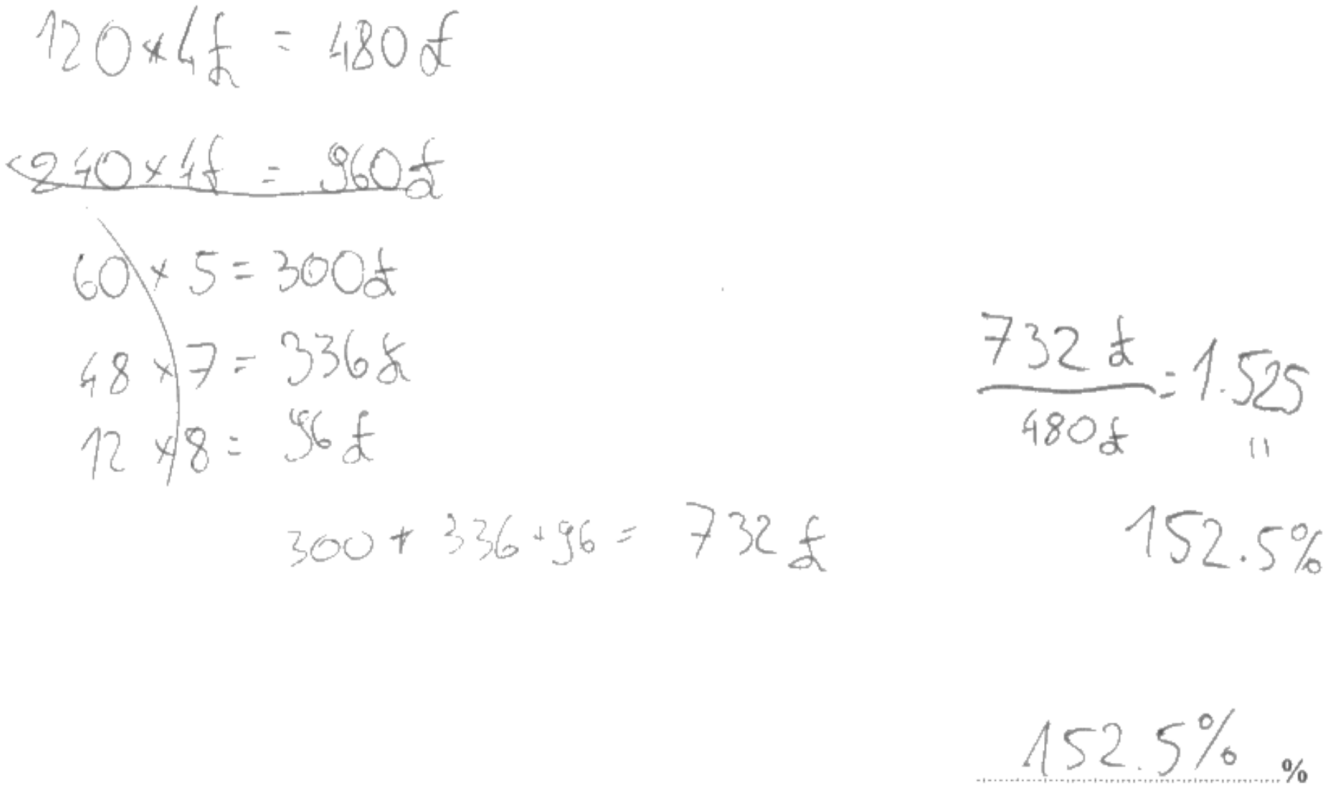


Examiner's comments:

This response was given 2 marks.

The student has used a correct method to find the total amount of money spent on the books by multiplying 4 with 120 and obtaining 480 so the first M1 is awarded. A correct method is used to find one of the incomes for one of the selling prices, in this case 300 so the second M1 is awarded. An incorrect method is used to work out the income for 40% of the books or 10% of the books so M0 is awarded. The student has worked out 40% of 60 and 10% of 60. They should have worked out 40% of 120 and 10% of 120 and then multiplied by the selling price of each. Working out 40% of 60 instead of 120 was a common incorrect method used by some students which stopped the students from gaining any further marks. The students are advised to read the question carefully. As the previous M mark is not awarded so the fourth M mark cannot be awarded. A0 for an incorrect answer.

Exemplar response B



Examiner's comments:

This response was given 3 marks.

The student has used a correct method to find the total amount of money spent on the books by multiplying 4 with 120 and obtaining 480 so the first M1 is awarded. A correct method is used to find one of the incomes for one of the selling prices, in this case 300 or 336 or 96 so the second M1 is awarded. A correct method is used to work out the total income of the books so the third M1 is awarded. The student does not use a complete method to find the percentage profit as they have not taken 1 from 1.525 or 100 from 152.5 thus losing the fourth M mark. A0 for an incorrect answer.

Question 5b

One book that Josh owns had a value of £15 on the 1st May 2019
The value of this book had increased by 20% in the last year.

(*b*) Find the value of the book on the 1st May 2018

£.....

(3)

Mark scheme

e.g. 1 + 0.2 (= 1.2) **or** 100(%) + 20(%) (= 120(%)) **or** $\frac{15}{120}$ (= 0.125) oe			M1
e.g. 15 ÷ 1.2 **or** 15 ÷ 120 × 100 **or** 15 × 100 ÷ 120			M1 dep
	12.5(0)	3	A1 accept (£)12.5, (£)12.50p, 1250p if the £ sign is crossed out

Exemplar response A

£ 18

Examiner's comments:

This response was given 1 mark.

The student has correctly interpreted the question in that it is a percentage increase. They have correctly worked out the percentage increase as a decimal as 1.2 so the first M1 can be awarded. The next step is incorrect as they have multiplied rather than dividing to obtain the correct answer so the second M mark cannot be awarded. A0 for an incorrect answer.

Exemplar response B

£ 12

Examiner's comments:

This response was given 0 marks.

The student has incorrectly interpreted the question as a percentage decrease. They have subtracted 0.2 from 1 so the first M mark cannot be awarded. The second M mark cannot be awarded as it is dependent on the first M mark being awarded. A0 for an incorrect answer.

Question 8

Change a speed of x kilometres per hour into a speed in metres per second.
Simplify your answer.

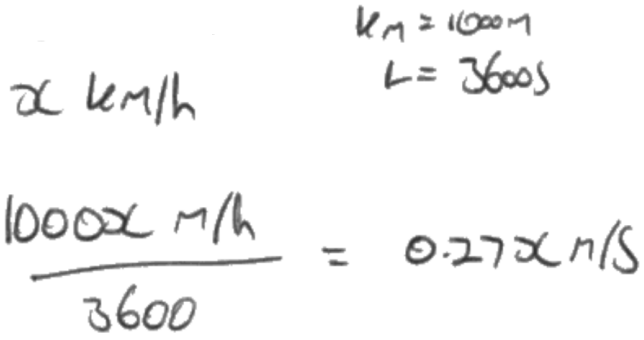
.....m/s

(Total for Question 8 is 3 marks)

Mark scheme

$(x) \times 1000$ **or** $(x) \div 60$ **or** $(x) \div 60 \div 60$ **or** $(x) \times 1000 \div 60$ oe			M1 for at least **one** of × 1000 **or** ÷ 60 **or** $\frac{5}{18}$ oe
$x \times \frac{1000}{60 \times 60}$ oe			M1 (dep) for a complete correct method
	$\frac{5}{18}x$	3	A1 accept $0.27\dot{x}$ **or** $0.2\overline{7}x$ **or** $\frac{x}{3.6}$ **or** $\frac{1}{3.6}x$
			Total 3 marks

Exemplar response A



0.278x m/s

Examiner's comments:

This response was given 2 marks.

The student has correctly recalled the conversion from kilometres per hour to metres per second. They have been awarded the first M mark for multiplying by 1000 or dividing by 60. The second M mark is awarded for multiplying *x* with $\frac{1000}{3600}$. The student has rounded their answer to 0.278 so losing the final A mark. For the student to gain the final A mark they should have left it as $\frac{5}{18}x$ or written the final answer as a recurring decimal, $0.2\dot{7}x$.

In this type of question, it is advisable to leave the answer as a fraction in its simplest form. The question did hint to leave your final answer in its simplest form.

Some students recalled the incorrect conversion of $\times\frac{3600}{1000}$ which gained no marks at all.

Exemplar response B

Speed = Distance / Time

Distance = 1 Kilometer = 1000 meters

Time = 1 hour = 60 minutes

minutes => second

60 x 60 = 3600s

$$\frac{1000 \text{ meters}}{3600 \text{ seconds}}$$

= 0.28 m/s

0.28 m/s

Examiner's comments:

This response was given 1 mark.

The student has correctly recalled the conversion from kilometres per hour to metres per second. They have been awarded the first M mark for multiplying by 1000 or dividing by 60. Although the student has written down the correct conversion $\frac{1000}{3600}$ they have not multiplied it with x so the second M mark is not awarded. The final A mark was not awarded as the answer must be in terms of x.

Question 9

Solve the simultaneous equations

$$x + 2y = -0.5$$

$$3x - y = 16$$

Show clear algebraic working.

$x =$.....

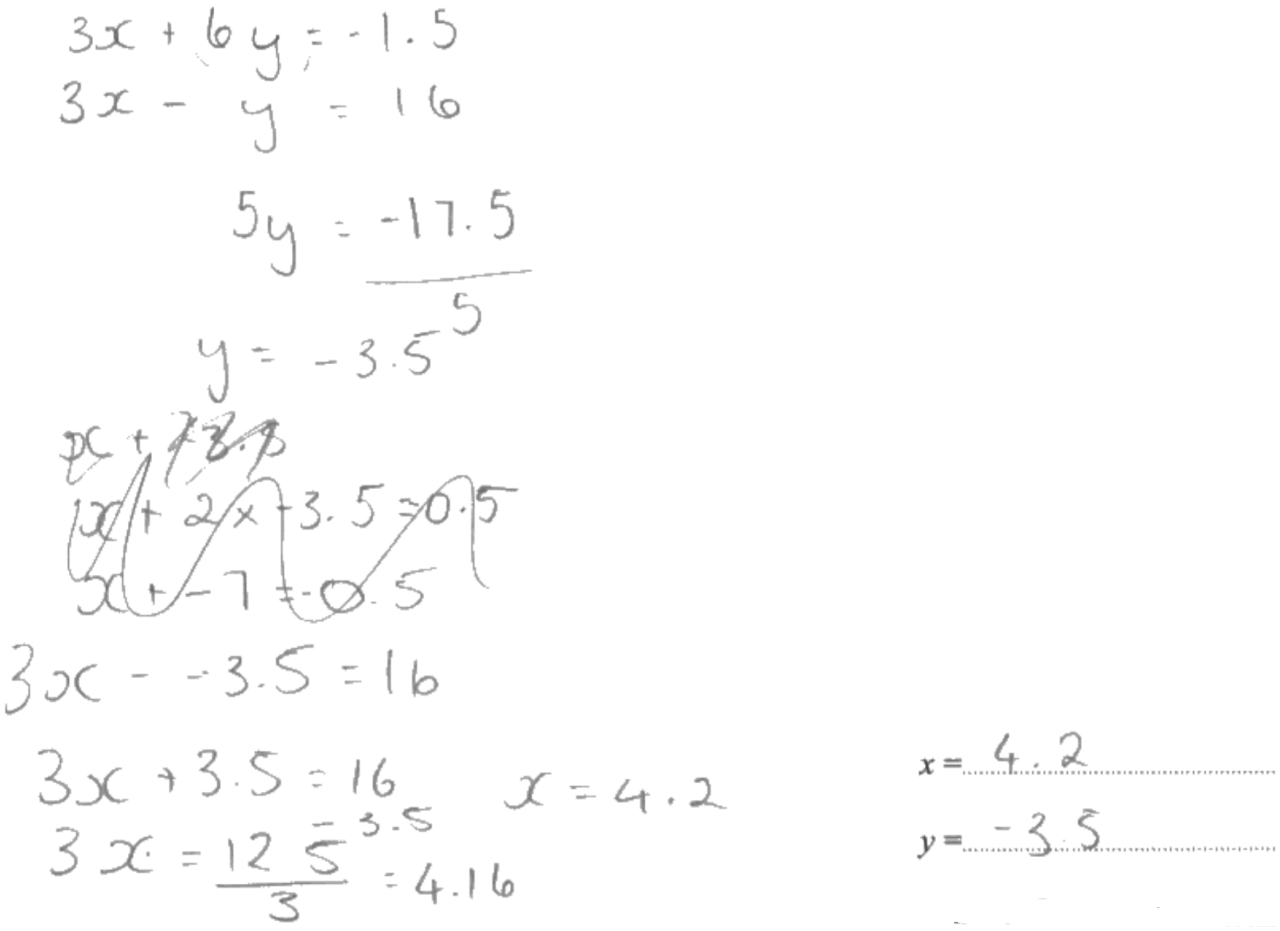
$y =$.....

(Total for Question 9 is 3 marks)

Mark scheme

e.g. $x + 2y = -0.5$ $+ 6x - 2y = 32$ $(7x = 31.5)$	e.g. $3x + 6y = -1.5$ $- 3x - y = 16$ $(7y = -17.5)$			M1 for a correct method to eliminate x or y: coefficients of x or y the same **and** correct operation to eliminate selected variable (condone any one arithmetic error)
e.g. '4.5' + $2y = -0.5$ **or** $3 \times$ '4.5' $- y = 16$	e.g. $x + 2 \times$ '−2.5' $= -0.5$ **or** $3x -$ '−2.5' $= 16$			M1 (dep) for substituting their value found of one variable into one of the equations **or** for repeating above method to find second variable
		$x = 4.5$ $y = -2.5$	3	A1 (dep on first M1) for both solutions
				Total 3 marks

Exemplar response A



Examiner's comments:

This response was given 2 marks.

The student has used the elimination method to work out the values of x and y. This was the most common method used to answer this question. The student has correctly multiplied the first equation by 3 as to eliminate the x variable. They have decided to subtract the equations to eliminate the x variable. They have incorrectly subtracted $-y$ from $6y$ by writing down $5y$ rather than $7y$. This is considered to be one arithmetical error which is allowed so the student can be awarded the first M mark. The student then gains the second M mark by correctly substituting into the second equation to work out the variable y. As the values of x and y are incorrect, then A0 is awarded.

Exemplar response B

$x + 2y = -0.5 \xrightarrow{\times 3} 3x + 6y = -1.5$

$3x - y = 16 \xrightarrow{\times 1} 3x - y = 16$

$+$

$5y = 14.5$

$y = 2.9$

$x + 2(2.9) = -0.5$

$x + 5.8 = -0.5$

$x = 6.3$

$x =$ 6.3

$y =$ 2.9

Examiner's comments:

This response was given 0 marks.

The student has used the elimination method to work out the values of x and y. This was the most common method used to answer this question. The student has correctly multiplied the first equation by 3 as to eliminate the x variable. The student should have subtracted the equations; however, they have decided to add the two equations which is clearly shown by the + sign under the equations. The student cannot gain the second M mark as it is dependent on the first M mark. As the values of x and y are incorrect, then A0 is awarded.

Question 12

ABCD is a trapezium.

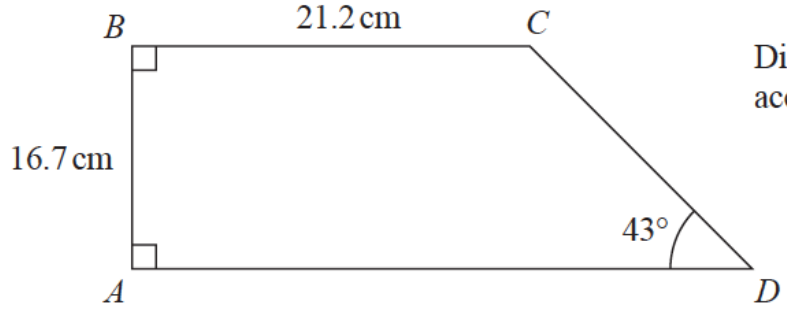


Diagram **NOT** accurately drawn

Calculate the perimeter of the trapezium.
Give your answer correct to 3 significant figures.

.....cm

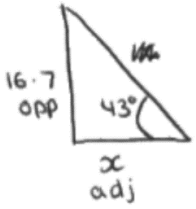
(Total for Question 12 is 4 marks)

Mark scheme

$(ED=)\frac{16.7}{\tan 43}$ (=17.90855...) **or** $(CD=)\frac{16.7}{\sin 43}$ (= 24.48686...)			M1 for a correct method to find length *CD* or *ED* (*E* is the point on line *AD* from where a vertical line is drawn downwards from point *C*) NB. Sine rule may be used
$(ED=)\frac{16.7}{\tan 43}$ (=17.90855...) **and** $(CD=)\frac{16.7}{\sin 43}$ (= 24.48686...)			M1 for a correct method to find both *CD* **and** *ED* **or** use of Pythagoras theorem $(CD=)\sqrt{16.7^2+'17.90....'^2}$ (= 24.48686...) $(ED=)\sqrt{'24.48....'^2-16.7^2}$ (=17.90855...) NB. Sine rule must be in the correct form to give the answer
16.7 + 21.2 × 2 + '24.5' + '17.9' (= 101.495...)			M1 (dep on M2) complete method with no extra sides
	101	4	A1 accept 101 – 102
			Total 4 marks

Exemplar response A

$(21.2 \times 2) + 16.7 = 59.1$ cm



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

$\tan 43 = \frac{16.7}{x}$

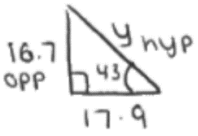
$x = \frac{16.7}{\tan 43}$

$x = 17.908\ldots$

$x = 17.9$ cm

$17.9 + 11.4 = 29.3$

$29.3 + 59.1 = 88.4$cm



$\sin\theta = \frac{\text{opp}}{\text{hyp}}$

$\sin 43 = \frac{y}{16.7}$

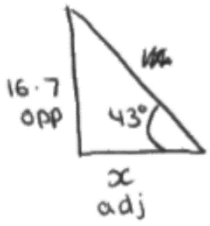
$16.7 \sin 43 = y$

$y = 11.3893\ldots$

$y = 11.4$ cm

88.4 cm

$(21.2 \times 2) + 16.7 = 59.1$ cm



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

$\tan 43 = \frac{16.7}{x}$

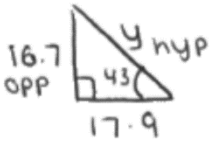
$x = \frac{16.7}{\tan 43}$

$x = 17.908\ldots$

$x = 17.9$ cm

$17.9 + 11.4 = 29.3$

$29.3 + 59.1 = 88.4$cm



$\sin\theta = \frac{opp}{hyp}$

$\sin 43 = \frac{y}{16.7}$

$16.7 \sin 43 = y$

$y = 11.3893\ldots$

$y = 11.4$ cm

88.4 cm

Examiner's comments:

This response was given 1 mark.

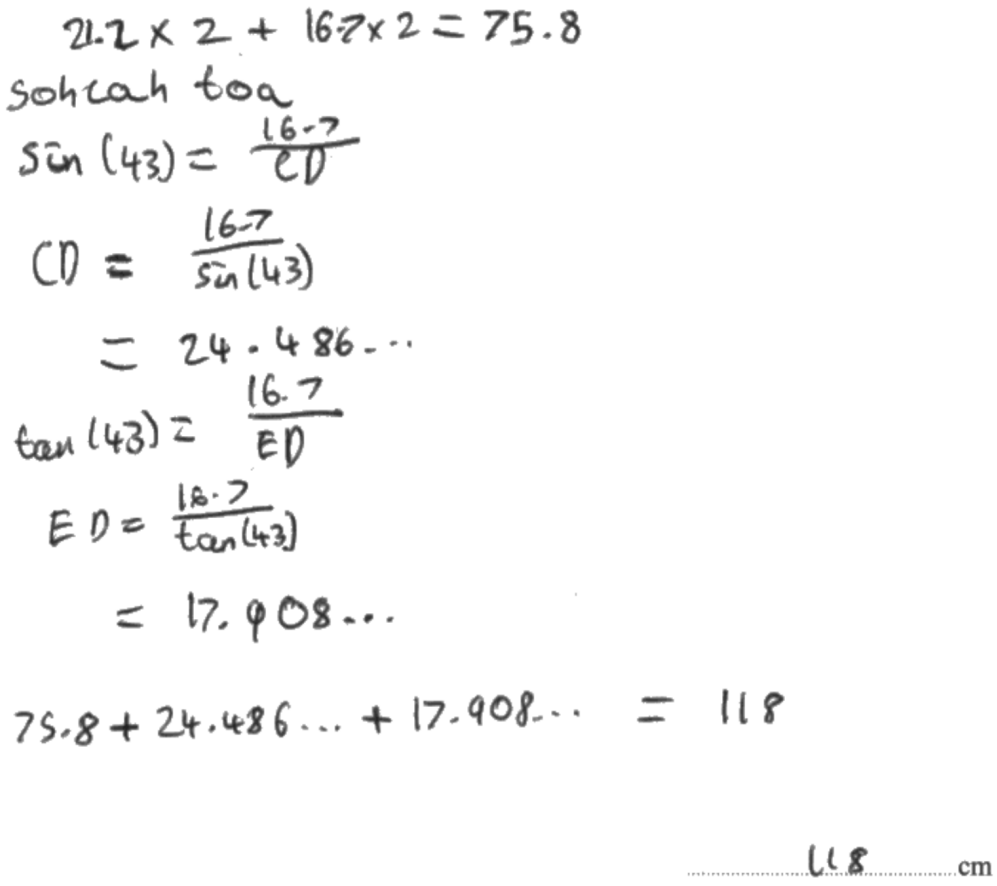
The student has interpreted the question correctly by trying to work out the lengths of *ED* and *CD*. The student uses the correct trigonometrical ratio to work out *ED* so the first M mark can be awarded.

The student has written down the incorrect trigonometrical ratio, $\sin 43 = \frac{y}{16.7}$, rather than $\sin 43 = \frac{16.7}{y}$. In order to award this mark the student should have written down $\frac{16.7}{\sin 43}$. The third M mark cannot be awarded as both of the two previous M marks have not been awarded. A0 for an incorrect answer.

NB Many students identified the correct trigonometrical ratios to work out *ED* and *CD*.

They wrote the following $\sin 43 = \frac{16.7}{CD}$ and $\tan 43 = \frac{16.7}{ED}$. However, they failed to rearrange correctly resulting in students writing down $CD = \sin 43 \times 16.7$ and $ED = \tan 43 \times 16.7$ thus losing all four marks.

Exemplar response B



Examiner's comments:

This response was given 2 marks.

The student has interpreted the question correctly by trying to work out the lengths of *ED* and *CD*. The student uses the correct trigonometrical ratios to work out *ED* and *CD* so the first two M marks can be awarded. The student then tries to work out the perimeter of the trapezium but makes an error by including 16.7 twice so the third M mark is not awarded. A0 for an incorrect answer.

Question 14

Here are two vectors.

$$\overrightarrow{AB} = \begin{pmatrix} 6 \\ -9 \end{pmatrix} \qquad \overrightarrow{CB} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$$

Find the magnitude of $\overrightarrow{AC}$

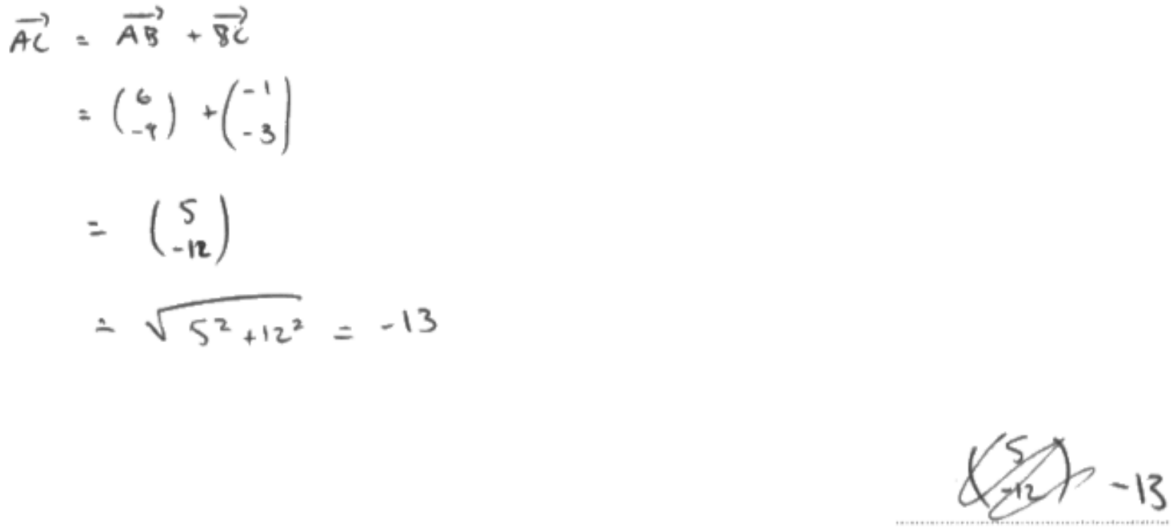
.....

(Total for Question 14 is 3 marks)

Mark scheme

			M2 for $\sqrt{5^2+(-12)^2}$ **or** $\sqrt{(-5)^2+12^2}$ **or** $\sqrt{5^2+12^2}$ If not M2 then M1 for $\begin{pmatrix} 6 \\ -9 \end{pmatrix}-\begin{pmatrix} 1 \\ 3 \end{pmatrix}$ or $\begin{pmatrix} 6 \\ -9 \end{pmatrix}+\begin{pmatrix} -1 \\ -3 \end{pmatrix}\left(=\begin{pmatrix} 5 \\ -12 \end{pmatrix}\right)$ **or** or $\begin{pmatrix} 1 \\ 3 \end{pmatrix}-\begin{pmatrix} 6 \\ -9 \end{pmatrix}$ or $\begin{pmatrix} 1 \\ 3 \end{pmatrix}+\begin{pmatrix} -6 \\ 9 \end{pmatrix}\left(=\begin{pmatrix} -5 \\ 12 \end{pmatrix}\right)$
	13	3	A1
			Total 3 marks

Exemplar response A



Examiner's comments:

This response was given 2 marks.

The student has interpreted the question correctly by writing down the correct statement $\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$. They have represented $\overrightarrow{BC}$ as $\begin{pmatrix} -1 \\ -3 \end{pmatrix}$ equivalent to $-\overrightarrow{CB}$. The second line in the working is awarded the first M mark. The student then uses Pythagoras theorem correctly and the second M mark is awarded. The negative sign of 12 is not written down but is condoned in the working for Pythagoras theorem. The answer is incorrect and it should be 13 so A0 is awarded.

Exemplar response B

$$\begin{pmatrix} 6 \\ -9 \end{pmatrix} + \begin{pmatrix} 1 \\ 3 \end{pmatrix} = \begin{pmatrix} 7 \\ -6 \end{pmatrix}$$

$$\begin{pmatrix} 7 \\ -6 \end{pmatrix}$$

Examiner's comments:

This response was given 0 marks.

The student has not interpreted the question correctly as they have added the two vectors together rather than subtracting them so the first M mark is not awarded. As the first M mark is not awarded due to an incorrect method the second M mark cannot be awarded here. A0 for an incorrect answer.

Question 16

Show that $\frac{4+\sqrt{8}}{\sqrt{2}-1}$ can be written in the form $a + b\sqrt{2}$, where a and b are integers.

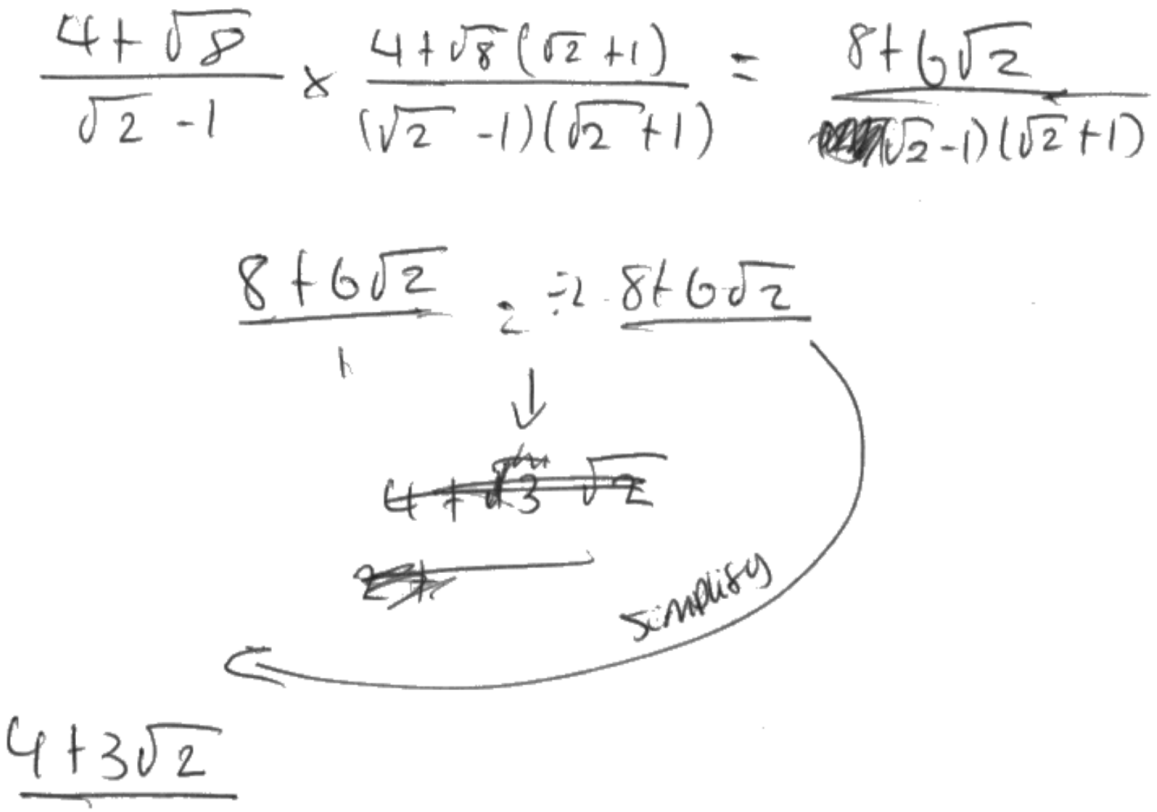
Show each stage of your working clearly and give the value of a and the value of b.

(Total for Question 16 is 3 marks)

Mark scheme

$\frac{4+\sqrt{8}}{\sqrt{2}-1}\times\frac{(\sqrt{2}+1)}{(\sqrt{2}+1)}$			M1 for rationalising the denominator by multiplying numerator and denominator by $\sqrt{2}$ + 1 (or $-\sqrt{2}-1$) condone missing brackets
e,g, $\frac{4\sqrt{2}+4+\sqrt{8}\sqrt{2}+\sqrt{8}}{2-1}$ **or** $\frac{4\sqrt{2}+4+4+\sqrt{8}}{2-1}$ **or** $\frac{4\sqrt{2}+4+\sqrt{16}+\sqrt{8}}{2-1}$ **or** $= 4\sqrt{2}+4+4+\sqrt{8}$ oe			M1 (dep) for expansion of numerator with at least 3 terms correct oe Using $-\sqrt{2}-1$ e.g. $\frac{-4\sqrt{2}-4-\sqrt{8}\sqrt{2}-\sqrt{8}}{-2+1}$ **or** $\frac{-4\sqrt{2}-4-4-\sqrt{8}}{-2+1}$ **or** $\frac{-4\sqrt{2}-4-\sqrt{16}-\sqrt{8}}{-2+1}$
	$8 + 6\sqrt{2}$	3	A1 (dep on M2) or for stating $a = 8$ and $b = 6$
			Total 3 marks

Exemplar response A



Examiner's comments:

This response was given 1 mark.

The student has rejected their first expression by writing a cross after it. They have correctly written an expression to rationalise the denominator so the first M mark can be awarded. We have condoned the missing brackets around $4+\sqrt{8}$. The student has made no attempt to expand the numerator as there are no terms seen although they have a correct answer. To be awarded the second M mark we must see at least three correct terms out of four. As this is not the case, the second M mark is not awarded. A0 is awarded for the final mark as it is dependent on the first two M marks.

NB It looks like that the student has used their calculator to work out the answer. For questions which say 'Show each stage of your working clearly' students must show their working explicitly otherwise they will be awarded zero marks.

Exemplar response B

$$\frac{4+\sqrt{8}}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1} = \frac{4\sqrt{2} + (\sqrt{8} \times \sqrt{2}) + 4 + \sqrt{8}}{\sqrt{2}^2 - 1}$$

$$= \frac{4\sqrt{2} + (2\sqrt{2} \times \sqrt{2}) + 4 + 2\sqrt{2}}{2-1}$$

$$= \frac{4\sqrt{2} + 3\sqrt{2} + 4 + 2\sqrt{2}}{1}$$

$$= 4 + 9\sqrt{2}$$

$a = 4$

$b = 9$

Examiner's comments:

This response was given 2 marks.

The student has correctly written an expression to rationalise the denominator so the first M mark can be awarded. The student has made a very good attempt to multiply out the two brackets however has made one error. They have incorrectly multiplied $\sqrt{8}$ with $\sqrt{2}$ by giving an answer of $3\sqrt{2}$. The second M mark can be awarded as they have all four correct terms in the first line of working. Their final answer is wrong and A0 is awarded.

Question 19

ABCD is a quadrilateral.

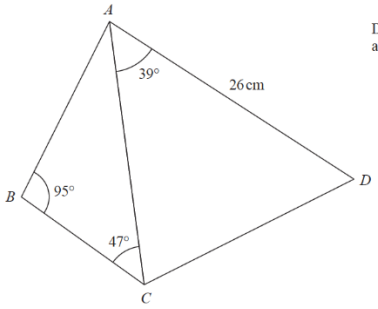


Diagram **NOT** accurately drawn

The area of triangle *ACD* is 250 cm^2

Calculate the area of the quadrilateral *ABCD*.
Show your working clearly.
Give your answer correct to 3 significant figures.

.....cm^2

(Total for Question 19 is 6 marks)

Mark scheme

$250 = 0.5 \times 26 \times AC \times \sin(39)$ oe			M1 for using the area formula correctly If this mark is awarded then ft on the remaining M marks
(*AC*=) 30.5(5579...) or 30.6			A1
$\frac{(AB)}{\sin 47} = \frac{'30.56'}{\sin 95}$ oe **or** $\frac{(BC)}{\sin(180-95-47)} = \frac{'30.56'}{\sin 95}$ oe			M1 dep on M1 for correct substitution into sine rule
$(AB =) \frac{'30.56'}{\sin 95} \times \sin 47$ (= 22.4(3407...)) **or** $(BC =) \frac{'30.56'}{\sin 95} \times \sin(180-95-47)$ (= 18.8(8524...))			M1 (dep on previous M marks) for a correct method to find a missing length **or** sight of values in the ranges 22.39 – 22.47 for *AB* 18.8 – 18.92 for *BC*
250 + 0.5 × '30.56' × '22.43' × sin(180 – 95 – 47) (= 461.03....) **or** 250 + 0.5 × '30.56' × '18.88' × sin(47) (= 461.03....)			M1 for a complete method to find total area
	461	6	A1 accept 461 - 462
			Total 6 marks

Exemplar response A

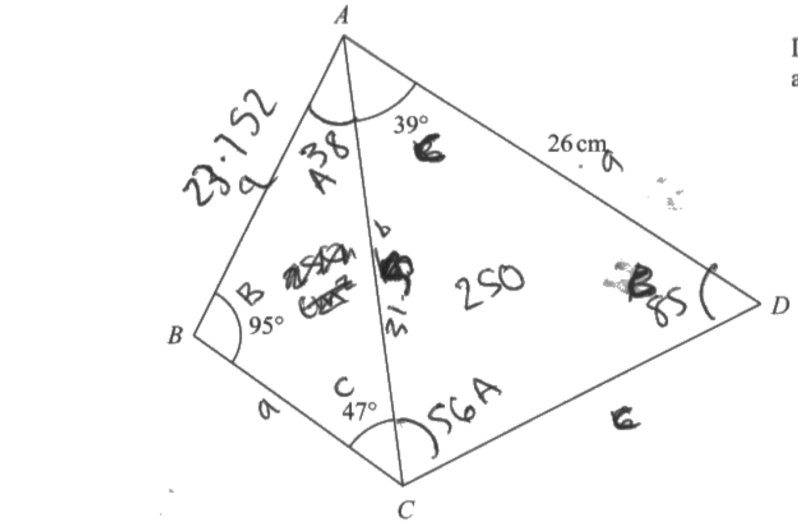


Diagram **NOT** accurately drawn

$250 = \frac{1}{2} \times 26 \times b \times \sin 39$

$\text{area} = \frac{1}{2} ab \sin C$

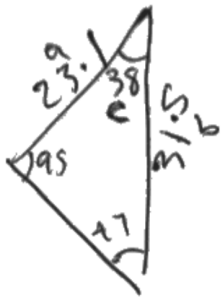
$b = \frac{250}{\frac{1}{2} \times 26 \times \sin 39}$

$b = 31.53585062$

$\frac{b}{\sin B} = \frac{a}{\sin A} \rightarrow \frac{31.53585062}{\sin 95} = \frac{a}{\sin 47}$

$a = \frac{31.5\ldots}{\sin 95} \times \sin 47 = 23.15196129$

area = 0.5 ab x sinC



= 0.5 x 23.1..... x 31.5..... x sin 38

= 224.7523 909

224.7523909 + 250

= 474.7523909

= 475

475 cm²

Examiner's comments:

This response was given 4 marks.

The student has used the correct strategy in trying to work out the area of the given shape. The first M mark is awarded as they have correctly substituted into the formula for the area of a triangle. The first A mark is not awarded as the value 31.535..... is incorrect. At this stage all the M marks are still available as the first M mark has been awarded. The student uses the sine rule correctly as they have followed through correctly by using their value of *AC* so the second M mark can be awarded. The sine rule is rearranged correctly so that the length *AB* is obtained. The student uses the formula for the area of a triangle correctly in order to find the area of triangle ABC and adds 250 to this value. A0 is awarded as the answer is incorrect.
NB If a student makes an error and follows through their value all the M marks are still available provided the method is clearly shown.

Exemplar response B

$250\text{cm}^2 = \frac{1}{2} a \times 26\text{cm} \times \sin(38)$

~~$250\text{cm}^2 = \frac{1}{2} a \times 16$~~

$95 + 47 = 142$

$180 - 142 = 38$

$\angle BAC = 38^\circ$

$38 + 38 = 76$

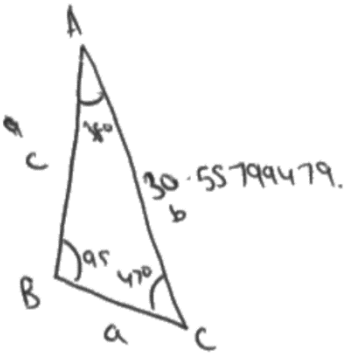
$\frac{250}{0.5} = 500\text{cm}^2$

$500\text{cm}^2 = a \times 26\text{cm} \times \sin(38)$

$500\text{cm}^2 = a \times 16.36233017.$

$\frac{500\text{cm}^2}{16.36233017} = a$

$a = 30.55799479.$



$\frac{b}{\sin B} = \frac{c}{\sin C}$

$\frac{30.55799479}{\sin(38)} = \frac{c}{\sin(47)}$

$\frac{30.55799479}{\sin(38)} \times \sin(47) = c$

$c = 36.30031032.$

Area $= \frac{1}{2} a b \sin C.$

Area $= \frac{1}{2} \times 30.55799479 \times 36.30031032 \times \sin(38)$

Area $= 341.4657689\text{cm}^2$

Area of quadrilateral $= 341.4657689 + 250\text{cm}^2$

Area of quadrilateral $= 591.4657689.$

$= 591\text{cm}^2$

Examiner's comments:

This response was given 2 marks.

The student has used the correct method to work out the length of *AC* by writing down $250 = \frac{1}{2} \times a \times 26 \times \sin 39$ then working out the correct answer of 30.55 so the first 2 marks can be awarded. From their diagram, it can be clearly seen that the student has labelled *AC* correctly as 30.55. They apply the sine rule incorrectly. They have written $\frac{30.55}{\sin 38} = \frac{c}{\sin 47}$ but should have written down $\frac{30.55}{\sin 95} = \frac{c}{\sin 47}$ thus losing the second M mark. Even though they go on and use the correct formula for the sine rule to work out the area of triangle *ABC* the third M mark cannot be awarded as the second M mark was not awarded. Similarly, the fourth M mark is not awarded as the third M mark has been not awarded. A0 for the final answer.

Question 20

The equation of the line **L** is $y = 9 - x$
The equation of the curve **C** is $x^2 - 3xy + 2y^2 = 0$

L and **C** intersect at two points.

Find the coordinates of these two points.
Show clear algebraic working.

(..... , ...) and (..... , ...)

(Total for Question 20 is 5 marks)

Mark scheme

$x^2 - 3x(9-x) + 2(9-x)^2$ $(= 0)$	$(9-y)^2 - 3y(9-y) + 2y^2$ $(= 0)$			M1 substitution of linear equation into quadratic
e.g. $6x^2 - 63x + 162$ $(= 0)$ **or** $2x^2 - 21x + 54$ $(= 0)$ allow $2x^2 - 21x = -54$ oe	e.g. $6y^2 - 45y + 81$ $(= 0)$ **or** $2y^2 - 15y + 27$ $(= 0)$ allow $2y^2 - 15y = -27$ oe			A1 (dep on M1) writing the correct quadratic expression in form $ax^2 + bx + c$ $(= 0)$ allow $ax^2 + bx = c$
e.g. $(2x - 9)(x - 6)$ $(= 0)$ $x = \frac{-(-21) \pm \sqrt{(-21)^2 - 4\times2\times54}}{2\times2}$ e.g. $2\left(\left(x - \frac{21}{4}\right)^2 - \left(\frac{21}{4}\right)^2\right) = -54$	e.g. $(2y - 9)(y - 3)$ $(= 0)$ $y = \frac{-(-15) \pm \sqrt{(-15)^2 - 4\times2\times27}}{2\times2}$ e.g. $2\left(\left(x - \frac{15}{4}\right)^2 - \left(\frac{15}{4}\right)^2\right) = -27$			M1 (dep on M1) for a complete method to solve their 3-term quadratic equation (allow one sign error and some simplification – allow as far as $\frac{21 \pm \sqrt{441 - 432}}{4}$)
$x = 4.5$ and $x = 6$	$y = 4.5$ and $y = 3$			A1 (dep on M1) both x-values **or** both y-values

	(4.5, 4.5) and (6, 3)	5	A1 (dep on M1) oe Must be paired correctly
			Total 5 marks

Exemplar response A

$x^2 - 3x(9-x) + 2(9-x)(9-x) = 0$

$x^2 - 27x + 3x^2 + 2(81 - 9x - 9x + x^2) = 0$

$x^2 - 27x + 3x^2 + 162 - 36x + 2x^2 = 0$

$6x^2 - 63x + 162 = 0$

$6x^2 - 36x - 27x + 162 = 0$

$6x(x-6) - 27(x-6) = 0$

$(6x-27)(x-6) = 0$

$x = -4.5$ or 6

$9 - 4.5 = 13.5$

$(-4.5, 13.5)$

$9 - 6 = 3$

$(6, 3)$

(-4.5 , 13.5) and (6 , 3)

Examiner's comments:

This response was given 3 marks.

The student has correctly identified that the linear equation must be substituted into the quadratic equation. They have correctly substituted the linear equation into the quadratic equation so the first M mark can be awarded. The equation is correctly multiplied out and simplified to obtain the correct quadratic equation in *x* only so the first A mark can be awarded. The student has correctly factorised the quadratic so the second M mark can be awarded. One of the answers to *x* is incorrect so the second A mark cannot be awarded and then the final A mark cannot be awarded.

NB This is a very good example of how students should set their working out by showing all the stages required.

Exemplar response B

$x = \dfrac{-(-64) \pm \sqrt{(-64)^2 - 4(162)(3)}}{2(3)}$

$= 18.4$

$= 2.9$

$y = 9 - 18.4 = -9.4$

$y = 9 - 2.9$

(18.4 , -9.4) and (2.9 , 6.1)

$x^2 - 3xy + 2y^2 = 0$

$x^2 + 2y^2 = 3xy$

~~$x^2 + 2y^2 = 3y(3x)$~~

$y = 9 - x$

$x^2 - 3xy + 2y^2 = 0$

$(9-x)(9-x) = 81 - 18x + x^2$

$x^2 - 3x(9-x) + 2(9-x)^2 = 0$

$x^2 - 27x - 3x^2 + 2(9-x)^2 = 0$

$x - 27x - 3x^2 + 2(x^2 - 18x + 81) = 0$

$x - 27x - 3x^2 + 2x^2 - 36x + 162 = 0$

$-x^2 - 62x + 162 = 0$

$x = \dfrac{62 \pm \sqrt{-62^2 - 4 \times -1 \times 162}}{-2}$

$= \dfrac{62 \pm \sqrt{8844 + 648}}{-2}$

$= \dfrac{62 \pm 67.4269}{-2}$

~~$x = -79.71$ or 77.71~~

$x = -64.71$ or 2.71

(-64.71 , 73.71) and (2.71 , 6.29)

Examiner's comments:

This response was given 2 marks.

The student has correctly substituted the linear equation into the quadratic equation so the first M mark can be awarded. The equation is multiplied out and simplified to obtain a quadratic equation in x only (it is incorrect), however, an error is made so the first A mark cannot be awarded. They have used the quadratic formula correctly for attempt to work out the values of x. The final two A marks cannot be awarded.

NB One sign error is allowed when students substitute values into the formula and some simplification of terms. This is a very good example of how an error is made and all the M marks are still available.

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