Pearson Edexcel

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)
Mathematics (1MA1)

May/June 2022 Exemplar
1MA1-1H Paper 1 (Non-Calculator)
Higher Tier

Senior Examiner's feedback on student responses

Contents

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About this booklet

This document has been produced to support mathematics teachers delivering the new GCSE (9-1) Mathematics specification.

This document looks at a selection of questions from the June 2022 GCSE (9 - 1) Mathematics Higher tier examination. It shows real student responses to selected questions and how the examining team follow the mark schemes to demonstrate how the students would be awarded marks on these questions.

Our examining team have selected student responses to Higher tier questions and common questions that are in both the Higher tier and Foundation tier from the June 2022 examination.

Following each question, you will find the mark scheme for that question, examiner comment, data on how the question performed and then a range of student responses with accompanying examiner comments on how the mark scheme has been applied and the marks awarded, and on common errors for this sort of question.

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Question: 7 8 11 16 18 20 21 22 25 27 28 29

Question 7

Question | Mark Scheme | Examiner Comments | Performance | Response A | Response B | Response C

Question 7 - Question

7 Simon buys some candles.
Each candle costs £2

Simon pays with a £20 note.
He gets £6 change.

Work out the number of candles Simon buys.

(Total for Question 7 is 3 marks)

Question 7 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
7	7	P1	for 20 − 6 (= 14) **or** 20 ÷ 2 (=10) **and** 6 ÷ 2 (=3)	
		P1	for "14" ÷ 2 (= 7) **or** "10" − "3" (= 7)	
		A1	cao	

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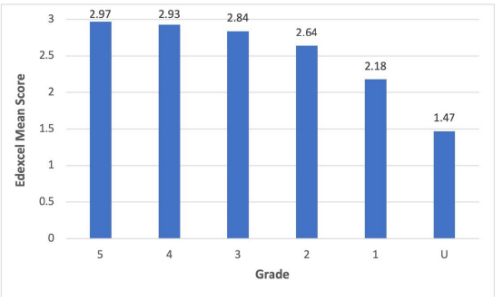
Question: 7 8 11 16 18 20 21 22 25 27 28 29

Question 7 - Examiner Comments

Generally well answered, some with minimal working shown. Careless arithmetic was a major reason for some students not gaining full marks in this question. 20 – 6 = 24 or 20 – 6 = 12 were the most common errors made but by dividing correctly by 2 to get 12 or 6, 2 out of the 3 marks available were possible. A common approach was to list costs of candles in multiples of 2. However, it was not uncommon for some multiples to be omitted, thus affecting the final number of candles bought. Some weaker students got no further than working out the number of candles that could be bought for £20. To gain any credit £6 ÷ 2 also needed to be seen. Giving an answer of 14 on the answer line was also common following correct calculations, with 7 candles often being an embedded answer.

Question 7 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade: ALL	5	4	3	2	1	U
2.70	3	90	2.70	2.97	2.93	2.84	2.64	2.18	1.47



Q7
A
B
C

General Examiner Feedback

This paper had a wide range of questions that gave students of all abilities the opportunity to demonstrate their mathematical knowledge and understanding. Students appeared well prepared for the paper and were able to select appropriate methods to solve problems, particularly those that used familiar situations, and apply techniques to more straightforward questions. Many questions were well attempted, especially those of a type regularly seen on papers in the past.

The earlier questions on the paper were generally answered very well, including Q3 which was the first of the problem solving questions. Students appeared familiar with topics such as inequalities, prime factors and cumulative frequency. There were also many well plotted quadratic graphs. However, some students still have common misconceptions as shown when estimating the mean in Q8 and when confusing area with volume in Q9. Students tended to struggle with the questions that were unfamiliar or more complex such as Q13, Q16 and Q21. Algebraic manipulation was a problem in Q19 and prevented many students from making progress.

Arithmetic errors were often the cause of lost marks when the methods and processes used were correct. Students should be encouraged to check their calculations as a significant number of simple arithmetic errors were made, especially in the easier and more straightforward questions.

It was pleasing that many students presented their answers in a clear and logical way that was easy for examiners to follow. The most successful students structured their work clearly and, in many cases, provided annotations which led to fewer missed steps. For some students, poor handwriting and layout of work remains a big problem. Figures were often written poorly which made it difficult for examiners to tell the difference between 3 and 5, between 4 and 9, between 1 and 7 and even between 0 and 6. Centres should emphasise the need for students to write figures clearly to avoid ambiguity and a possible loss of marks.

There were many cases across many different questions of students miscopying their own figures or misreading the numbers in questions. The latter was particular noticeable in Q15(a) where –10.5**e** was very often written as 10.5**e** and in Q19 where the denominators of the fractions were often written down incorrectly.

Question 3

Question 3 - Question

3 A delivery company has a total of 160 cars and vans.

the number of cars : the number of vans = 3 : 7

Each car and each van uses electricity or diesel or petrol.

$\frac{1}{8}$ of the cars use electricity.

25% of the cars use diesel.
The rest of the cars use petrol.

Work out the number of cars that use petrol.
You must show all your working.

.....

(Total for Question 3 is 5 marks)

Question 3 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
3	30	P1	for $160 \div (3+7)$ (= 16) **or** $\frac{3}{3+7}$ (= $\frac{3}{10}$)	
		P1	for "16" × 3 (= 48) **or** "$\frac{3}{10}$" × 160 (= 48)	
		P1	for a correct step using 48 eg "48" ÷ 8 (= 6) **or** "48" × 25 ÷ 100 (= 12) **or** (indep) for combining $\frac{1}{8}$ and 25%, eg $\frac{1}{8} + \frac{1}{4}$ (=$\frac{3}{8}$) or "0.125" + "0.25" (= 0.375) or "12.5"(%) + 25(%) (= 37.5(%))	
		P1	for a complete process to find the number of petrol cars, eg "48" – "6" – "12" oe **or** (1 – "$\frac{3}{8}$") × "48" oe **or** $\frac{3}{10}$ × (1 – "$\frac{3}{8}$") × 160 oe	
		A1	cao SC B2 for an answer of 100 if P0 scored	Award no marks for a correct answer with no supportive working

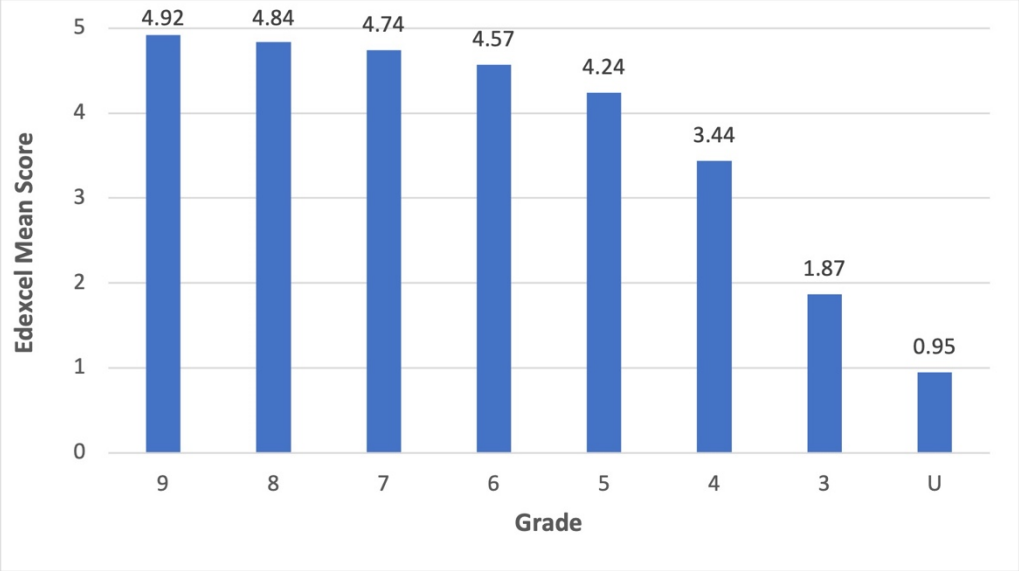
Question 3 - Examiner Comments

Most students made very good attempts at this multi-step question with many achieving full marks. It was pleasing to see many well presented solutions with working out that was easy to follow. The majority of students started by using the ratio 3 : 7 to work out that there were 48 cars and gained the first two marks. Many students completed the process by finding $\frac{1}{8}$ of 48 and 25% of 48 and subtracting the numbers of cars that use electricity and the number of cars that use diesel from 48 to find the number of cars that use petrol. Arithmetic errors were quite common and were often made at the final stage when subtracting 6 and 12 from 48. It was surprising that a significant number of students used a build up method such as 10% = 4.8, 10% = 4.8, 5% = 2.4, etc. to find 25% of 48.

Centres should note that incorrect statements such as 25% of 48 = 11 or $\frac{1}{8}$ of 48 = 5 can get no credit unless the method for finding 25% of 48 or $\frac{1}{8}$ of 48 is shown. Some students made the mistake of subtracting the number of cars using electricity from 48 and then finding 25% of 42, not 25% of 48. Instead of finding $\frac{1}{8}$ of 48 and 25% of 48 some students chose to combine $\frac{1}{8}$ and 25%, usually $\frac{3}{8}$ rather than 37.5%, and then worked with $\frac{3}{8}$ or $\frac{5}{8}$. The award of the SCB2 for finding the fraction and percentage correctly but not working with the ratio was relatively common.

Question 3 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
4.48	5	90	4.48	4.92	4.84	4.74	4.57	4.24	3.44	1.87	0.95



Question 3 - Response A

3 A delivery company has a total of 160 cars and vans.

the number of cars : the number of vans = 3 : 7

Each car and each van uses electricity or diesel or petrol.

$\frac{1}{8}$ of the cars use electricity.
25% of the cars use diesel.
The rest of the cars use petrol.

Work out the number of cars that use petrol.
You must show all your working.

# of cars = $\frac{160}{3+7} \cdot 3 = 16 \cdot 3 = 48$

$48 \times \left(1 - \frac{1}{8} - \frac{2}{8}\right) = 48 \times \frac{5}{8} = 30$

5 /5

P1 for dividing 160 by (3 + 7)

P1 for multiplying 3 by 16

P1 for combining 1/8 and 2/8 which is awarded at the stage 1 – 1/8 – 2/8

P1 for a complete process

A1 for the correct final answer
Note that an answer of 30 with no supportive working gets no marks (additional guidance).
.

Question 3 - Response B

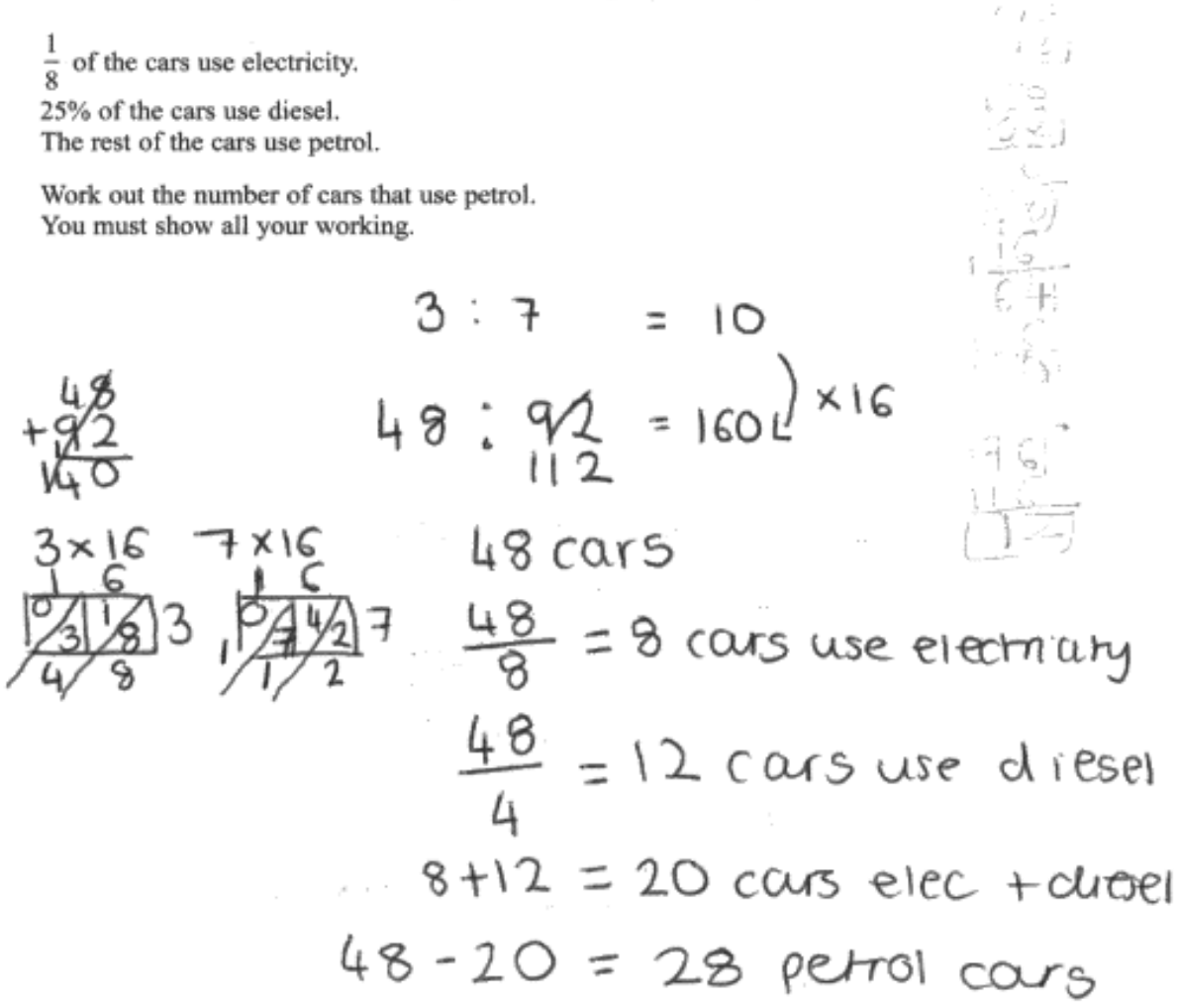
3 A delivery company has a total of 160 cars and vans.

the number of cars : the number of vans = 3 : 7

Each car and each van uses electricity or diesel or petrol.

$\frac{1}{8}$ of the cars use electricity.
25% of the cars use diesel.
The rest of the cars use petrol.

Work out the number of cars that use petrol.
You must show all your working.



Q3

A B C

4 /5

P1 for dividing 160 by 10 (implied by '×16')

P1 for multiplying 3 by 16

P1 as processes to find 1/8 of 48 and 25% of 48 are shown. Either is sufficient for this mark.

P1 for a complete process; 48 divided by 8 was evaluated incorrectly but the processes are all correct.

A0 as the final answer is incorrect due to an arithmetic error.

Question 3 - Response C

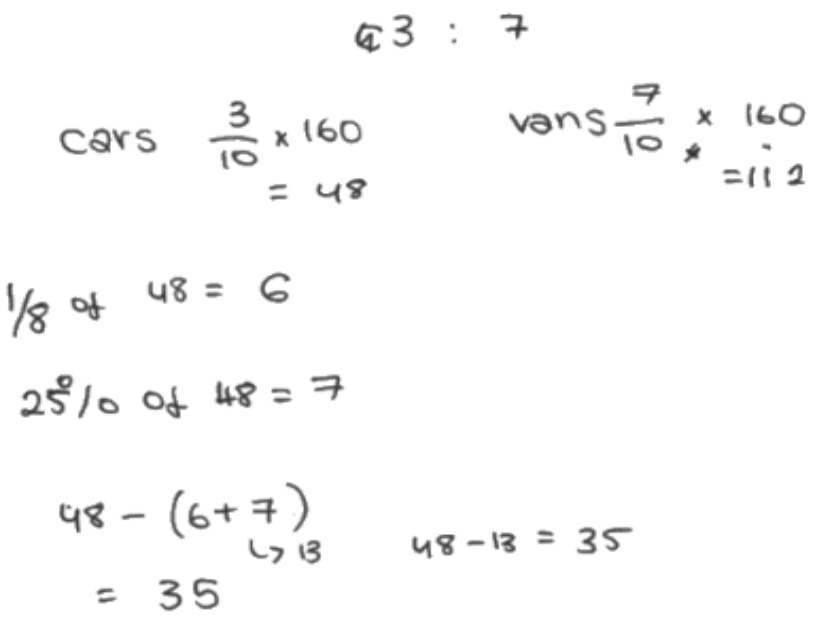
3 A delivery company has a total of 160 cars and vans.

the number of cars : the number of vans = 3 : 7

Each car and each van uses electricity or diesel or petrol.

$\frac{1}{8}$ of the cars use electricity.
25% of the cars use diesel.
The rest of the cars use petrol.

Work out the number of cars that use petrol.
You must show all your working.



Q3

A
B
C

3 /5

P1 for 3/10

P1 for 3/10 × 160

P1 for a correct step using 48; 1/8 of 48 = 6

P0 because there is not a complete process; 25% of 48 = 7 is incorrect and no process is shown.

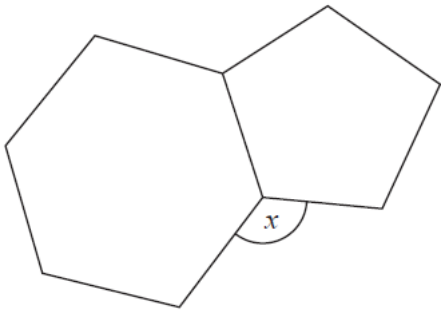
A0 as the final answer is incorrect.

Question 5

Question | Mark Scheme | Examiner Comments | Performance | Response A | Response B | Response C

Question 5 - Question

5 Here is a regular hexagon and a regular pentagon.



Work out the size of the angle marked x.
You must show all your working.

.....°

(Total for Question 5 is 3 marks)

Question 5 - Mark Scheme

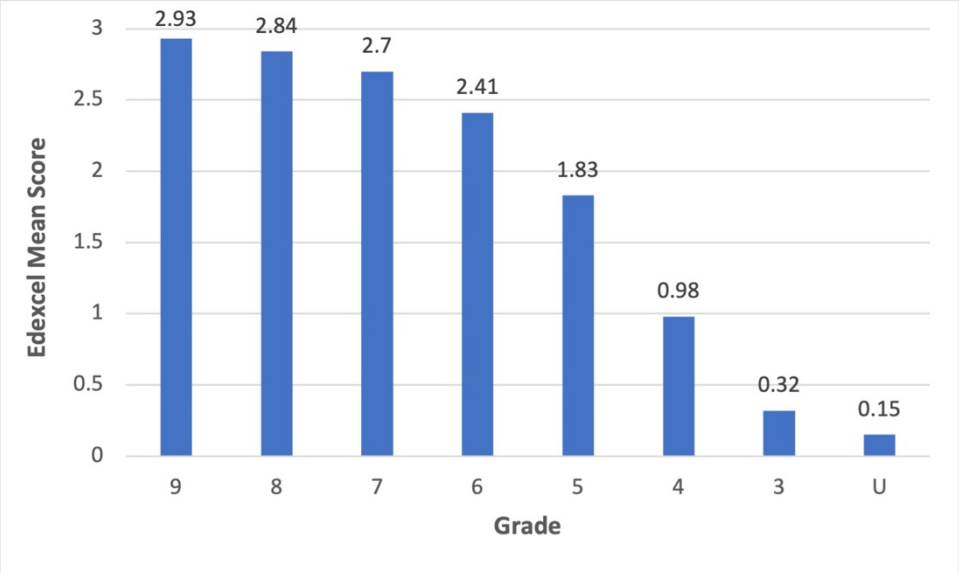
Question	Answer	Mark	Mark scheme	Additional guidance
5	132	M1	for finding an exterior angle eg 360 ÷ 6 (= 60) or 360 ÷ 5 (= 72) **or** an interior angle eg 180 × 4 ÷ 6 (= 120) or 180 × 3 ÷ 5 (= 108)	Angles may be shown on the diagram Only award this mark for an angle that is not contradicted
		M1	for a complete method eg 360 − "120" – "108" or "60" + "72"	
		A1	cao	Answer only award no marks

Question 5 - Examiner Comments

It was pleasing that many students gained full marks for finding the value of x, often making use of the diagram as part of their working. The first step for many was to use $(n - 2) \times 180°$ to find the sum of the interior angles of the hexagon or the pentagon and then divide by the number of sides to find the size of an interior angle. Students who used this approach to find the interior angles often went on to show a complete method. Arithmetic errors, particularly when dividing 540 by 5, were quite common. However, these students were still credited with the methods marks. The division of 540 by 5 sometimes resulted in 18 or 180 yet neither of these values is a sensible size for the interior angle of the pentagon and should have alerted students to a problem. Alternatively, some students started by working out $360 \div 6 = 60$ and $360 \div 5 = 72$. Those who realised that these calculations give the sizes of the exterior angles usually went on to get full marks but a significant number of students used them as interior angles and gained no marks. Contradictions on the diagram were common.

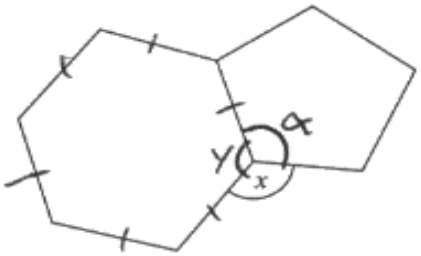
Question 5 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
2.32	3	77	2.32	2.93	2.84	2.70	2.41	1.83	0.98	0.32	0.15



Question 5 - Response A

5 Here is a regular hexagon and a regular pentagon.



Work out the size of the angle marked x.
You must show all your working.

1 $(6-2)\times 180 = 720°$

$(5-2)\times 180 = 540°$

$540° : 5 = 108°$

$720° : 6 = 120°$

$360 - 228 = 132$

$360° - 108° - 120° =$

132 °

3 /3

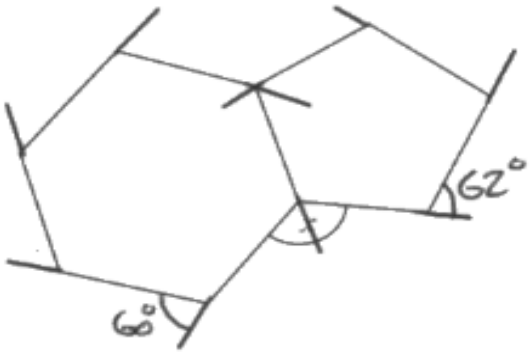
M1 for finding an interior angle; 540/5, or 720/6, scores this mark.

M1 for a complete method, 360 – 108 – 120

A1 for the correct final answer
Note that an answer of 132 with no working gets no marks (additional guidance).

Question 5 - Response B

5 Here is a regular hexagon and a regular pentagon.



Work out the size of the angle marked x.
You must show all your working.

$360 \div 6 = 60°$

$360 \div 5 = 62°$

$60° + 62° = 122°$

$x = 122°$

$6\overline{)360} = 060$

$5\overline{)360} = 062$

Q5

2 /3

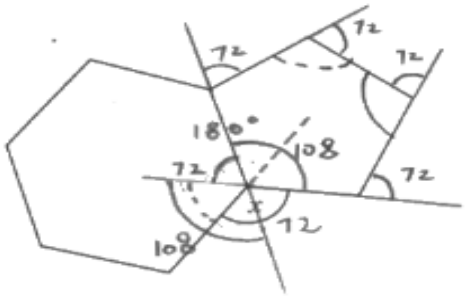
M1 for finding an exterior angle that is not contradicted; 360 ÷ 6, or 360 ÷ 5, scores this mark.

M1 for a complete method, 360 ÷ 6 + 360 ÷ 5

A0 as the final answer is incorrect due to an arithmetic error.

Question 5 - Response C

5 Here is a regular hexagon and a regular pentagon.



Work out the size of the angle marked x.
You must show all your working.

$\frac{360^\circ}{5} = 72$

$180^\circ - 72^\circ = 108^\circ$

$x = 126$

126 °

Q5

A
B
C

1 /3

M1 for finding the exterior angle (or interior angle) of the pentagon which is not later contradicted.

M0 because the rest of the method is incorrect

A0 as the final answer is incorrect

Question 6

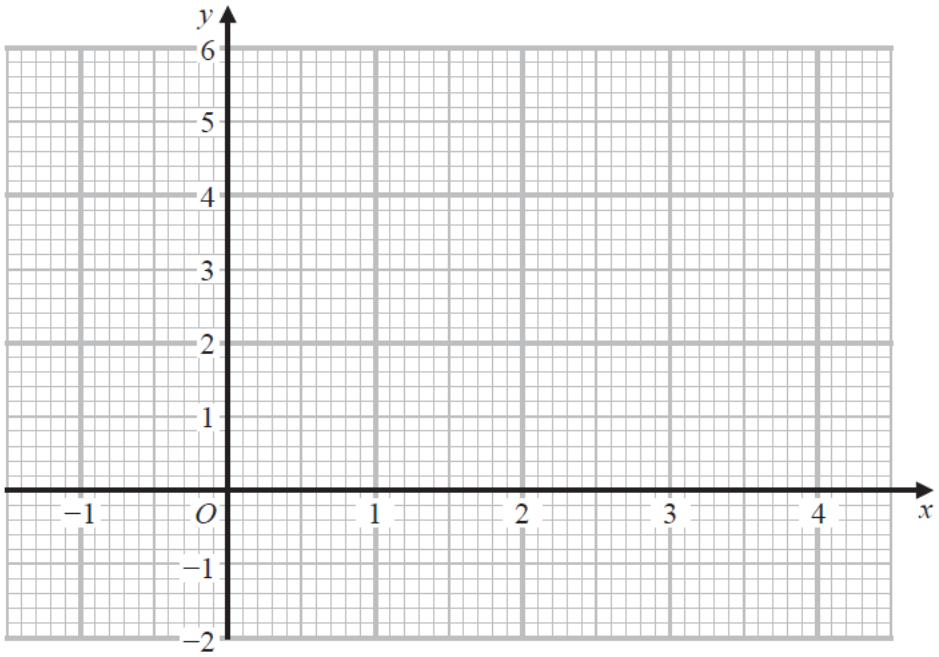
Question 6 - Question

6 (a) Complete the table of values for $y = x^2 - 3x + 1$

x	-1	0	1	2	3	4
y		1	-1			

(2)

(b) On the grid, draw the graph of $y = x^2 - 3x + 1$ for values of x from -1 to 4



(2)

(c) Using your graph, find estimates for the solutions of the equation $x^2 - 3x + 1 = 0$

.....

(2)

(Total for Question 6 is 6 marks)

Question 6 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
6 (a)	5,(1),(-1),-1,1,5	B2	for all 4 values correct	
		(B1	for 2 or 3 correct values)	
(b)	Graph drawn	B2	for a fully correct graph	Accept a freehand graph drawn that is not made of line segments Ignore anything drawn outside the required range
		(B1	ft (dep on B1in (a)) for plotting at least 5 of the points from their table correctly)	
(c)	0.3 to 0.5 and 2.5 to 2.7	M1	for a correct method, eg marking intercepts with x-axis **or** one correct solution **or** both solutions given as a coordinates, eg (0.4, 2.6) **or** (0.4, 0) **and** (2.6, 0)	ft their graph for this mark Accept these coordinates reversed
		A1	for answers in the range 0.3 to 0.5 and 2.5 to 2.7 **or** ft their graph with at least 2 solutions	

Question 6 - Examiner Comments

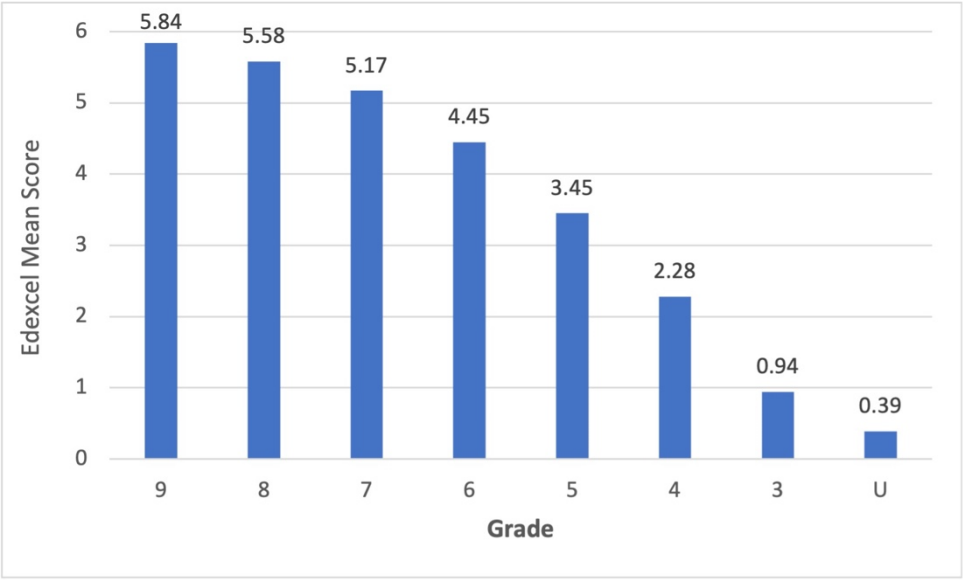
This question was well answered by the majority of students. The table in part (a) was often completed correctly. Most errors occurred with the substitution of $x = -1$ into the equation and $y = 3$ and $y = -1$ were common incorrect values of y.

In part (b) the plotting of the points was usually accurate. Most students realised that a curve was needed to join the points and it was pleasing to see freehand curves drawn with an appropriate turning point. Some students, however, drew a graph with a flat bottom which resulted in the loss of a mark. Few graphs consisting solely of line segments were seen. These can get at most one mark. Curves that were sloppy and missed a point also gained at most one mark. Students should be encouraged to make sure that their curve passes through all of the points and doesn't consist of more than one curve between any two points.

Part (c) was answered quite well although some students did not know how to use their graph to find estimates for the solutions of the equation. A common error was giving the solutions as coordinates rather than as values. Some students gave the coordinates of the turning point and others gave the values when $y = 1$. Centres should encourage students to mark the intercepts with the x-axis to show where they are attempting to read off values, few students did this. Some students attempted to answer this part of the question by trying to factorise the quadratic rather than reading from the graph as the question asked. Inevitably their factorising was incorrect and they received no marks.

Question 6 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
4.47	6	75	4.47	5.84	5.58	5.17	4.45	3.45	2.28	0.94	0.39



Question 6 - Response A

6 (a) Complete the table of values for $y = x^2 - 3x + 1$

x	−1	0	1	2	3	4
y	5	1	−1	−1	+1	5

$-3x-1=3$

$-1^2-3x-1+1$

$1+3-1$

$-1x-1=1$

$2^2-3x2+1$

$4-6+1$

-2

$3^2-3x3+1$

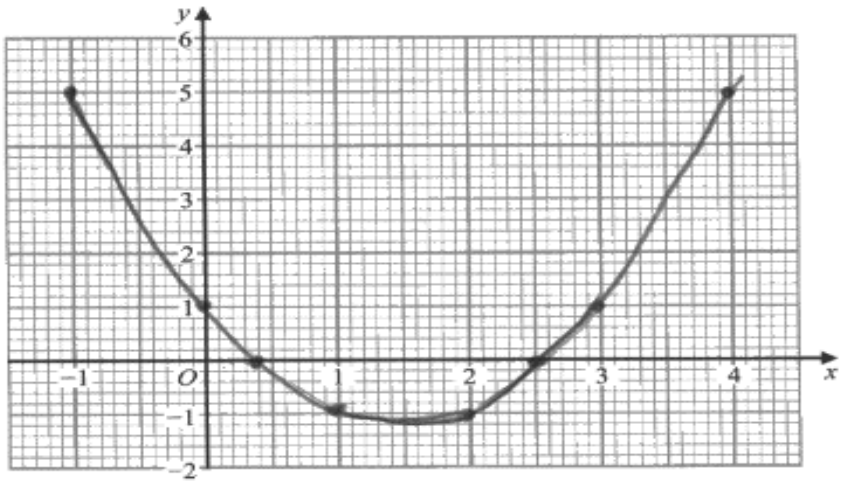
$9-9+1$

$4^2-3x4+1$

$16-12+1$

(2)

(b) On the grid, draw the graph of $y = x^2 - 3x + 1$ for values of x from −1 to 4



(2)

(c) Using your graph, find estimates for the solutions of the equation $x^2 - 3x + 1 = 0$

0.4, 2.5

(2)

Q6

A B C

6 /6

Part (a)
B2 for all 4 correct values

Part (b)
B2 for a fully correct graph

Part (c)
M1 for one correct solution or for marking the intercepts with the x-axis.
A1 for answers in the range 0.3 to 0.5 and 2.5 to 2.7

Question 6 - Response B

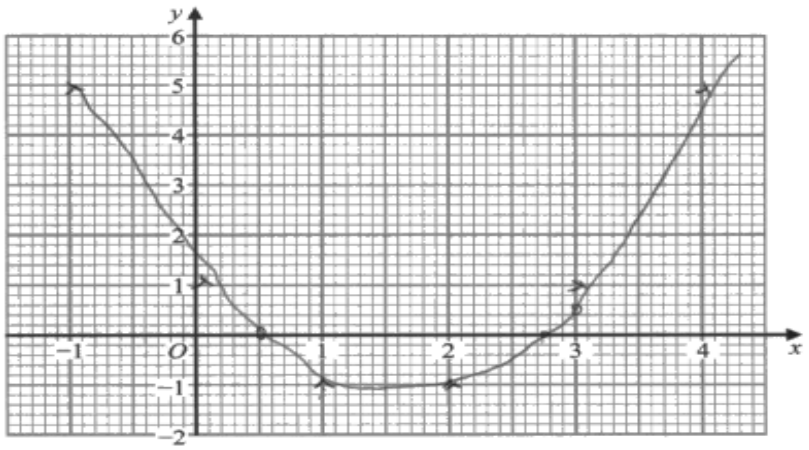
6 (a) Complete the table of values for $y = x^2 - 3x + 1$

x	−1	0	1	2	3	4
y	5	1	−1	−1	1	5

$3^2 = 9 - 3 \times 3 = 1$
$9 - 9 = 1$
$-1^2 = 1 + 3 = 4 + 1 = 5$
$4^2 = 16 - 12 + 1$
$= 5$
$2^2 = 4 - 3 \times 2$
$= -2$
$+1$
$= -1$

(2)

(b) On the grid, draw the graph of $y = x^2 - 3x + 1$ for values of x from −1 to 4



(2)

(c) Using your graph, find estimates for the solutions of the equation $x^2 - 3x + 1 = 0$

(0, 0.5) (0, 2.5)

4 /6

Q6

A
B
C

Part (a)
B2 for all 4 correct values

Part (b)
B1 for plotting at least 5 points from the table correctly. The graph is not fully correct as the curve clearly misses 3 of the points.
Note that the gap between the curve and the line $y = -1$ is just big enough had the graph been drawn correctly.

Part (c)
M1 A0 for both solutions given as coordinates (we can accept the incorrect order within the brackets).
Although 2.75 is outside the given range in the mark scheme it follows through correctly from the graph.
Note that the marks on the graph at the intercepts with the x-axis are also sufficient for this mark.

Question 6 - Response C

6 (a) Complete the table of values for $y = x^2 - 3x + 1$

x	−1	0	1	2	3	4
y	5	1	−1	−1	1	4

1 + 3 + 1 = 5

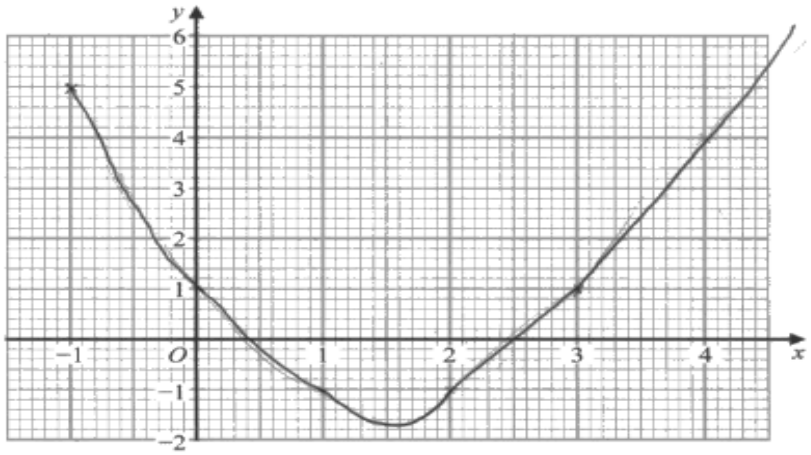
4 − 6 + 1 = 4 − 5 = −1

9 − 9 + 1 = 1

18 − 12 + 1 = 16 − 11 = 4

(2)

(b) On the grid, draw the graph of $y = x^2 - 3x + 1$ for values of x from −1 to 4



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(2)

(c) Using your graph, find estimates for the solutions of the equation $x^2 - 3x + 1 = 0$

x = 0.4 , x = 2.4

Q6

A B C

3 /6

Part (a)
B1 for 3 correct values

Part (b)
B1 for plotting at least 5 points from the table correctly. Note that this mark is dependent on at least B1 in (a).

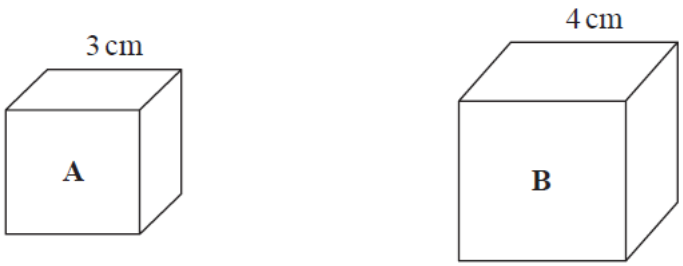
Part (c)
M1 for one correct solution within range, $x = 0.4$
A0 as the other solution, $x = 2.4$, is not in the required range and it does not follow through from the graph.

Question 7

Question | Mark Scheme | Examiner Comments | Performance | Response A | Response B | Response C

Question 7 - Question

7 Here are two cubes, **A** and **B**.



Cube **A** has a mass of 81 g.

Cube **B** has a mass of 128 g.

Work out

the density of cube **A** : the density of cube **B**

Give your answer in the form $a : b$, where a and b are integers.

.....

(Total for Question 29 is 3 marks)

Question 7 - Mark Scheme

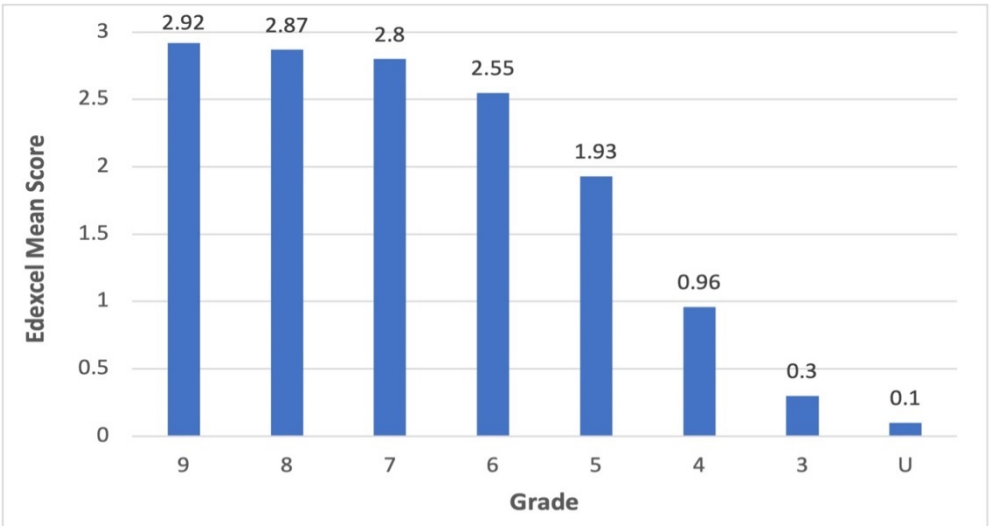
Question	Answer	Mark	Mark scheme	Additional guidance
7	3 : 2	P1	for a process to find either volume eg 3^3 (= 27) or 4^3 (= 64)	
		P1	for showing density **A** = 81 ÷ "27" (= 3) or density **B** = 128 ÷ "64" (= 2)	
		A1	for 3 : 2 oe	Ignore units quoted

Question 7 - Examiner Comments

The majority of students gained the first mark for a process to find a volume and many went on to give a correct answer. The final mark was sometimes lost because of arithmetic errors, these occurred most often when dividing 81 by 27 or dividing 128 by 64. Having found the volume of each cube some students gained no more marks because they were unable to use density = mass ÷ volume. It was common to see mass × volume and volume ÷ mass being used. Some students did not realise that it was necessary to find the volume of each cube and scored no marks at all. Often these students simply used the figures in the question, dividing 81 by 3 and dividing 128 by 4 or multiplying 81 by 3 and 128 by 4. There were also some students who calculated the surface area of the cubes and attempted to divide the mass by the surface area and gained no credit. Some students included units in their final answer but they were not penalised.

Question 7 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
2.39	3	80	2.39	2.92	2.87	2.80	2.55	1.93	0.96	0.30	0.10



Question 7 - Response A

7 Here are two cubes, **A** and **B**.

Cube **A** has a mass of 81 g.

Cube **B** has a mass of 128 g.

Work out

the density of cube **A** : the density of cube **B**

Give your answer in the form $a : b$, where a and b are integers.

$\rho = \frac{m}{V}$

A

m 81g
V 27

$d = \frac{81}{27}$

$d = 3\,g/cm^3$

B

m = 128
V = 64

$d = \frac{128}{64}$

$d = 2\,g/cm^3$

$3\,g/cm^3 : 2\,g/cm^3$

Q7

3 /3

P1 for a process to find either volume

P1 for 81/27 or for 128/64

A1 for the correct ratio
Note that any units within the ratio can be ignored.

Question 7- Response B

7 Here are two cubes, **A** and **B**.

Cube **A** has a mass of 81 g.

Cube **B** has a mass of 128 g.

Work out

the density of cube **A** : the density of cube **B**

Give your answer in the form $a : b$, where a and b are integers.

$D = \frac{m}{V}$

	A	B
D	9	2
M	81	128
V	9	64

$\frac{81}{9} = 9$ $\frac{128}{64} = 2$

9:2

2 /3

Q7

A
B
C

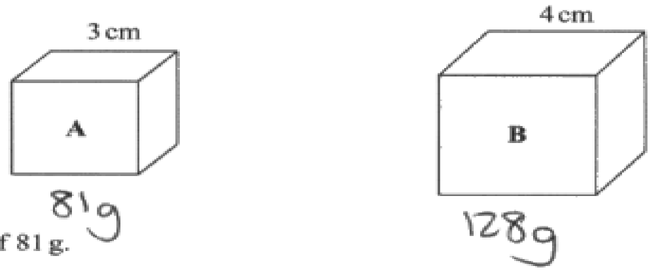
P1 for the correct volume of cube **B**

P1 for dividing 128 by 64; note that this mark would not be awarded for 81/9 because we don't know whether 9 comes from a correct process.

A0 as the final answer is incorrect

Question 7 - Response C

7 Here are two cubes, **A** and **B**.



Cube **A** has a mass of 81 g.

Cube **B** has a mass of 128 g.

Work out

the density of cube **A** : the density of cube **B**

Give your answer in the form $a : b$, where a and b are integers.

density = volume × mass

$3 \times 3 \times 3 = 27$

$4 \times 4 \times 4 = 64$

2187 : 8192

2187 : 8192

1 /3

P1 for a process to find either volume

P0 because mass × volume is not a correct process to find density

A0 as the final answer is incorrect

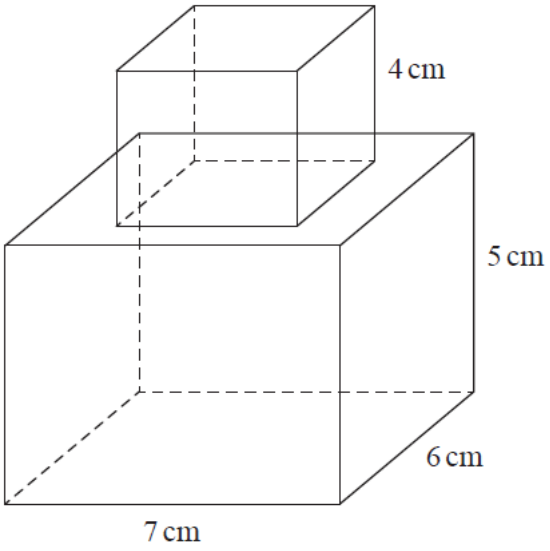
Q7
A
B
C

Question 9

Question | Mark Scheme | Examiner Comments | Performance | Response A | Response B | Response C

Question 9 - Question

9 A cube is placed on top of a cuboid, as shown in the diagram, to form a solid.



The cube has edges of length 4 cm.
The cuboid has dimensions 7 cm by 6 cm by 5 cm.

Work out the total surface area of the solid.

..... cm^2

(Total for Question 9 is 3 marks)

Question 9 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
9	278	P1	for working out at least 3 areas from 5 × 7 (= 35) 5 × 6 (= 30) 7 × 6 (= 42) 4 × 4 (= 16)	
		P1	for a complete process, eg "35"× 2 + "30"× 2 + "42" + ("42" – "16") + "16" × 5 oe or "35"× 2 + "30"× 2 + "42" × 2 + "16" × 4 **OR** for a process to find the total surface area of at least 5 faces for each solid, eg "35"× 2 + "30"× 2 + "42" **and** "16"× 6 or "35"× 2 + "30"× 2 + "42"× 2 **and** "16"× 5	Total surface area of cuboid = 214 Total surface area of cube = 96
		A1	cao	

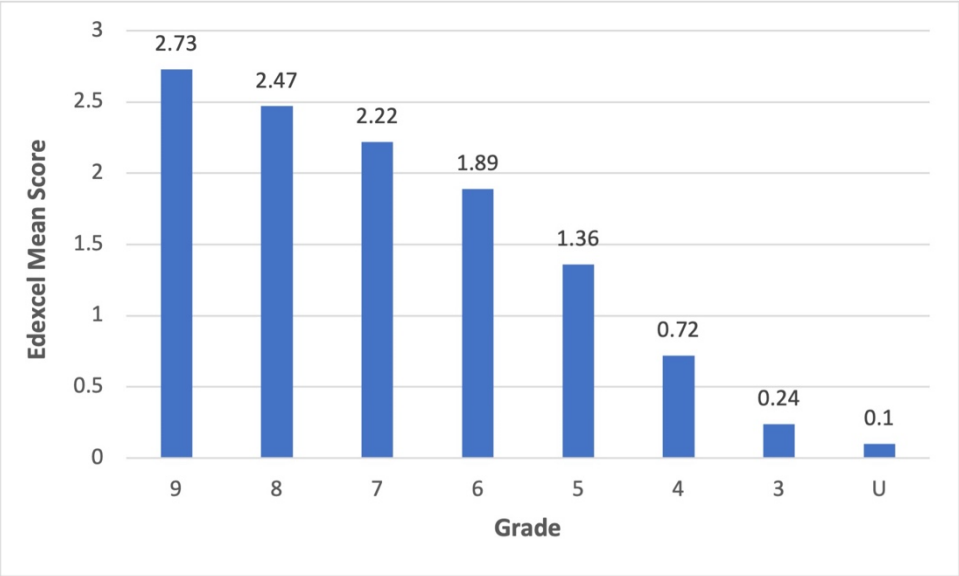
Question 9 - Examiner Comments

This question was well answered with many students gaining at least two of the three marks.

It was pleasing that most students worked with area and attempted to find the total surface area of the solid. Many students showed a correct process to find the total surface area of at least five faces for each solid and gained the first two marks. Those who showed a complete process to find the total surface area of the solid often gained full marks but some solutions were spoilt by arithmetic errors. The main stumbling block to a correct final answer was not dealing correctly with the parts of the cube and cuboid that are hidden. Many students worked out the total surface area of the cube and the total surface area of the cuboid and added them together, leading to the common incorrect answer of 310. Some added the total surface area of five faces of the cube to the total surface area of the cuboid and got an answer that was 16 cm^2 too big. Students who made the mistake of including four 5 cm by 6 cm faces or four 7 cm by 5 cm faces in the surface area calculation for the cuboid gained one mark only. Some students did not read the question with enough care and worked with volume instead of with area. This question benefited from a systematic approach and there were some very good solutions from students who clearly identified what they were calculating. However, there were many solutions that had calculations dotted around the page making the working difficult to follow.

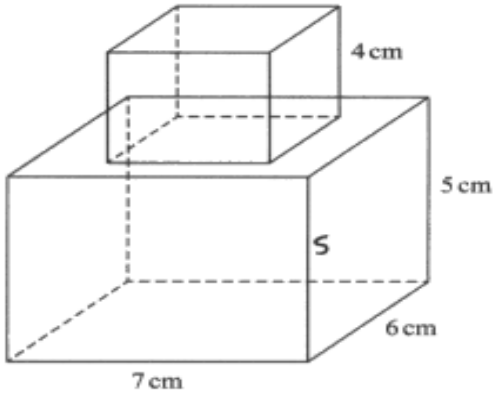
Question 9 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
1.90	3	63	1.90	2.73	2.47	2.22	1.89	1.36	0.72	0.24	0.10



Question 9 - Response A

9 A cube is placed on top of a cuboid, as shown in the diagram, to form a solid.



16 x 5
5
30
80

The cube has edges of length 4 cm.
The cuboid has dimensions 7 cm by 6 cm by 5 cm.

Work out the total surface area of the solid.

Cuboid - on its own

T+b 7 x 6 = 42 x 2 = 84
F+b 7 x 5 = 35 x 2 = 70
L+R 6 x 5 = 30 x 2 = 60
+ 214cm²

Cube with out out

214 - 16 = 198cm²

Cube - 5 sides on its own

4 x 4 = 16
16 x 5 = 80 cm²

198cm² + 80cm²
=
278cm²

278 cm²

Q9

A
B
C

3 /3

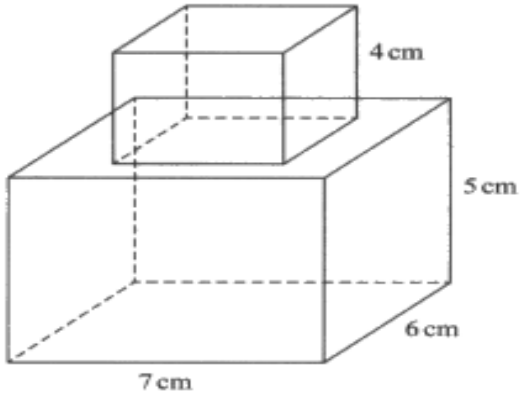
P1 for working out at least 3 areas

P1 for a complete process

A1 for the correct total surface area

Question 9- Response B

9 A cube is placed on top of a cuboid, as shown in the diagram, to form a solid.



The cube has edges of length 4 cm.
The cuboid has dimensions 7 cm by 6 cm by 5 cm.

Work out the total surface area of the solid.

4×4=16
5
80

~~7×6=42×2=84~~
7×6=42×2=84
6×5=30×2=60
5×7=35×2=70
214
+80
294

294 cm²

2 /3

P1 for working out at least 3 areas

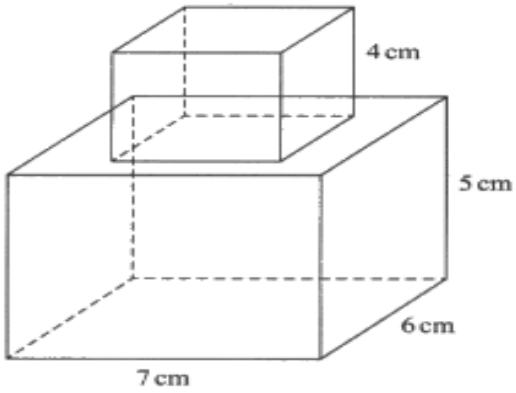
P1 for finding the total surface area of at least 5 faces for each solid

A0 as the final answer is incorrect

Note: Failing to subtract one 4×4 area and getting an answer of 294, as in this response, was quite common

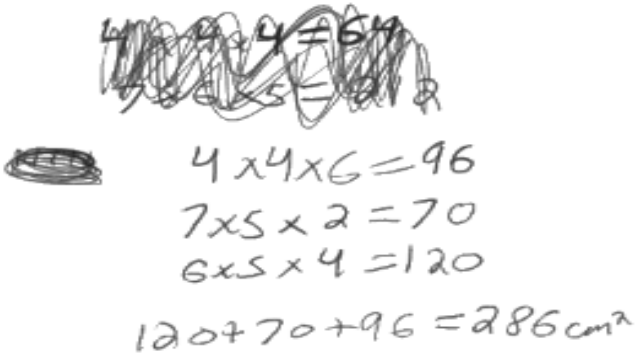
Question 9 - Response C

9 A cube is placed on top of a cuboid, as shown in the diagram, to form a solid.



The cube has edges of length 4 cm.
The cuboid has dimensions 7 cm by 6 cm by 5 cm.

Work out the total surface area of the solid.



286 cm²

1 /3

Q9

A
B
C

P1 for working out 3 areas - note that 4×4×6 is sufficient

P0 as there is neither a complete process nor a process to find the total surface area of at least 5 faces for each solid. Incorrectly assumes that the cuboid has 4 of the 6×5 faces so the areas of only 4 faces are given for the cuboid.

A0 as the final answer is incorrect

Question 11

Question | Mark Scheme | Examiner Comments | Performance | Response A | Response B | Response C

Question 11 - Question

11 Cormac has some sweets in a bag.
The sweets are lime flavoured or strawberry flavoured or orange flavoured.

In the bag

number of lime flavoured sweets : number of strawberry flavoured sweets : number of orange flavoured sweets $= 9 : 4 : x$

Cormac is going to take at random a sweet from the bag.

The probability that he takes a lime flavoured sweet is $\frac{3}{7}$

Work out the value of x.

$x =$ .....

(Total for Question 11 is 3 marks)

Question 11 - Mark Scheme

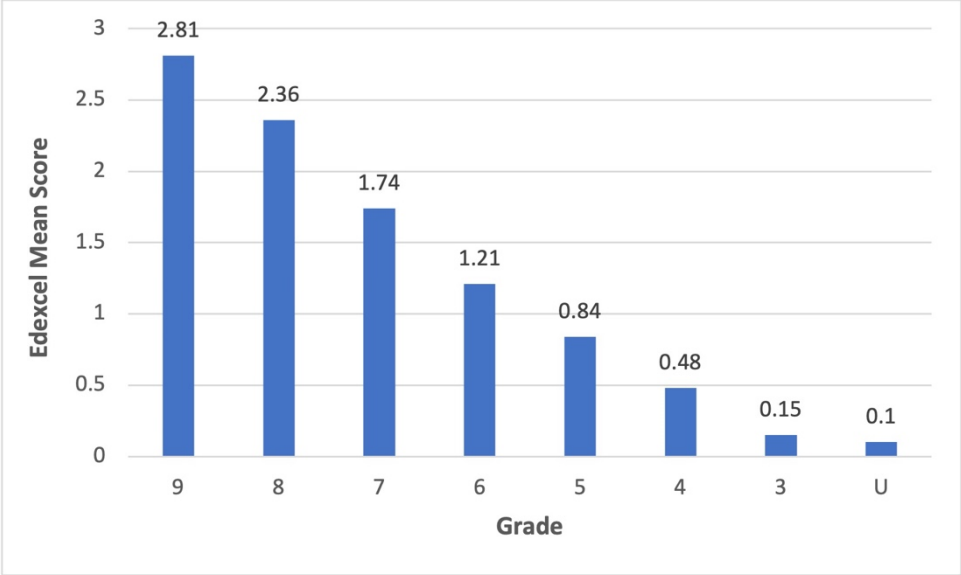
Question	Answer	Mark	Mark scheme	Additional guidance
11	8	P1	for a start to the process, eg $\frac{9}{9+4+x}$ **or** $(\frac{3}{7} =) \frac{9}{21}$	
		P1	**or** states that the total number of sweets is 21 for forming a correct equation without fractions, eg $9 \times 7 = 3(9 + 4 + x)$ **or** $21 = 9 + 4 + x$ **OR** for $21 - 9 - 4$ oe **or** $1 - \frac{9}{21} - \frac{4}{21}$ $(= \frac{8}{21})$	
		A1	cao	

Question 11- Examiner Comments

In order to make progress students needed to link the probability of taking a lime flavoured sweet with the ratio 9 : 4 : x. Those who started by writing $\frac{3}{7}=\frac{9}{21}$ or formed an equation such as $\frac{9}{13+x}=\frac{3}{7}$ were usually able to show a complete process to work out the value of x.
Some marks were lost through careless arithmetic errors and those using an algebraic approach sometimes made mistakes when solving their equation, such as expanding $3(13 + x)$ incorrectly or incorrectly simplifying $13 + x$ to $13x$. Of the students not scoring full marks few made the connection between $\frac{3}{7}$ and $\frac{9}{21}$.

Question 11 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
1.50	3	50	1.50	2.81	2.36	1.74	1.21	0.84	0.48	0.15	0.10



Question 11 - Response A

11 Cormac has some sweets in a bag.
The sweets are lime flavoured or strawberry flavoured or orange flavoured.

In the bag

$$\text{number of lime flavoured sweets} : \text{number of strawberry flavoured sweets} : \text{number of orange flavoured sweets} = 9 : 4 : x$$

Cormac is going to take at random a sweet from the bag.

The probability that he takes a lime flavoured sweet is $\frac{3}{7}$

Work out the value of x.

$\frac{3}{7} \times 3 = 9$

$\frac{3}{7} \times 3 = 21$

Total sweets must = 21

$9 + 4 = 13$

$21 - 13 = 8$

$x = 8$

$x =$ 8

3 /3

P1 for equating the relative frequency with 9/21, implied by working, or for stating total sweets = 21

P1 for 21 – 9 – 4

A1 for the correct answer

Question 11 - Response B

11 Cormac has some sweets in a bag.
The sweets are lime flavoured or strawberry flavoured or orange flavoured.

In the bag

number of lime flavoured sweets : number of strawberry flavoured sweets : number of orange flavoured sweets $= 9 : 4 : x$

Cormac is going to take at random a sweet from the bag.

The probability that he takes a lime flavoured sweet is $\frac{3}{7}$

Work out the value of x.

$\frac{9}{13+x} = \frac{3}{7}$

$9 \times 7 = 3(13+x)$

$63 = 39 + 3x$

$4 = 3x$

$x = \frac{4}{3}$

$x = \frac{4}{3}$

2 /3

Q11

A
B
C

P1 for a start to the process, $\frac{9}{13+x}$

P1 for forming a correct equation without fractions, $9 \times 7 = 3(13+x)$

A0 as the final answer is incorrect

Question 11 - Response C

11 Cormac has some sweets in a bag.
The sweets are lime flavoured or strawberry flavoured or orange flavoured.

In the bag

number of lime flavoured sweets : number of strawberry flavoured sweets : number of orange flavoured sweets $= 9 : 4 : x$

Cormac is going to take at random a sweet from the bag.

The probability that he takes a lime flavoured sweet is $\frac{3}{7}$

Work out the value of x.

9 : 4 : x
L : S : O

3 = 9
~~9 = 3~~
1 = 3

$\frac{3}{7} \overset{\times 3}{=} \frac{9}{21}$

21 − 4 orange =

$x =$ 17

1 /3

P1 for (3/7 =) 9/21

P0 because there is no complete process to find the value of x

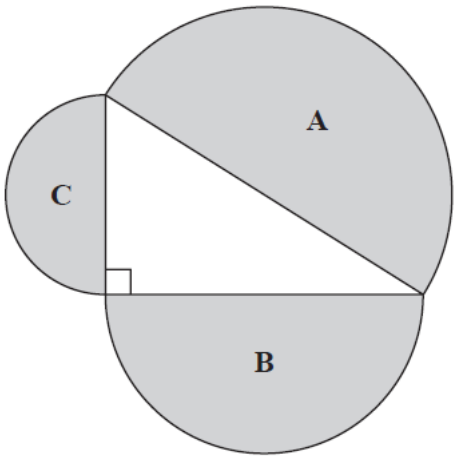
A0 as the final answer is incorrect

Q11
A
B
C

Question 13

Question 13 - Question

13 A right-angled triangle is formed by the diameters of three semicircular regions, **A**, **B** and **C** as shown in the diagram.



Show that

area of region **A** = area of region **B** + area of region **C**

(Total for Question 13 is 3 marks)

Question 13 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
13	Relationship shown	M1	for use of Pythagoras' theorem, eg $d_A^2 = d_B^2 + d_C^2$ **or** $a^2 = b^2 + c^2$ **or** $(2x)^2 = (2y)^2 + (2z)^2$ **or** $a = \sqrt{b^2 + c^2}$ **or** uses a 3, 4, 5 triangle	May be seen at any stage Where d_A, a, $2x$, etc are their diameters Could be any Pythagorean triple
		M1	for forming correct expressions for the areas of at least 2 of the 3 semicircles, eg at least two of $\frac{1}{2}\pi\left(\frac{a}{2}\right)^2$, $\frac{1}{2}\pi\left(\frac{b}{2}\right)^2$, $\frac{1}{2}\pi\left(\frac{c}{2}\right)^2$ or at least two of $\frac{1}{2}\pi x^2$, $\frac{1}{2}\pi y^2$, $\frac{1}{2}\pi z^2$ or at least two of $\frac{1}{2}\pi\left(\frac{5}{2}\right)^2$, $\frac{1}{2}\pi\left(\frac{3}{2}\right)^2$, $\frac{1}{2}\pi\left(\frac{4}{2}\right)^2$	Where a, b, c are their diameters Where $2x$, $2y$, $2z$ are their diameters Where 3, 4, 5 are their diameters
		C1	for a fully correct and convincing chain of reasoning, eg showing that eg $\frac{1}{2}\pi\left(\frac{a}{2}\right)^2 = \frac{1}{2}\pi\left(\frac{b}{2}\right)^2 + \frac{1}{2}\pi\left(\frac{c}{2}\right)^2$ can be reduced to $a^2 = b^2 + c^2$ **or** that $(2x)^2 = (2y)^2 + (2z)^2$ is the same as $\frac{1}{2}\pi x^2 = \frac{1}{2}\pi y^2 + \frac{1}{2}\pi z^2$	

Question 13 - Examiner Comments

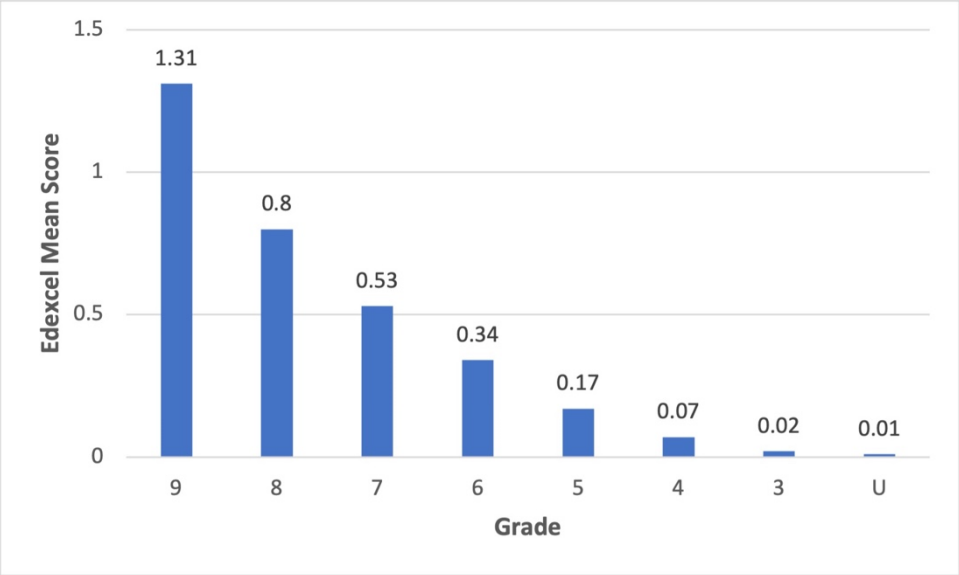
This was an unfamiliar type of question but even so it was not answered as well as might have been expected. Many students recognised that the question required the use of Pythagoras and wrote down Pythagoras' theorem, often as it appears on the formula sheet.

This alone was not sufficient for the first mark – the statement of Pythagoras needed to be linked in some way to the question. Many students did this by labelling the sides of the triangle in the diagram and using these letters in Pythagoras' theorem, some students explained what the letters they used represented. Some students labelled the sides as a^2, b^2 and c^2 and used these incorrectly or used the labels from the diagram to form their Pythagoras equation which was not worthy of any marks unless A, B and C were either clearly linked to the diagram or clearly defined as being the diameters of the semi-circles. It was very disappointing that relatively few students scored the second mark for writing correct expressions for the areas of at least two of the three semicircles. It was very common to see the diameters being used instead of the radii in πr^2 and for expressions to be given for the areas of circles instead of semicircles. Students who labelled the sides $2a$, $2b$ and $2c$ found it easier to write correct expressions for the areas but harder to write a Pythagoras statement. Those who did write correct expressions for the areas were then often not able to complete the

chain of reasoning to give a fully correct answer. Students should be encouraged to use brackets correctly. The omission of brackets was rarely recovered and resulted in a loss of marks. Students who used numerical values for the sides of the triangle were still able to access the first two marks but a surprising number of these students were unable to write correct expressions for the areas and gained the first mark only.

Question 13 - Performance

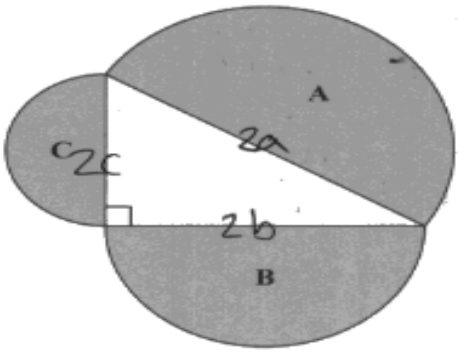
Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
0.48	3	16	0.48	1.31	0.80	0.53	0.34	0.17	0.07	0.02	0.01



Q13
A
B
C

Question 13 - Response A

13 A right-angled triangle is formed by the diameters of three semicircular regions, **A**, **B** and **C** as shown in the diagram.



Show that

area of region **A** = area of region **B** + area of region **C**

$a^2 = b^2 + c^2$

$A = \frac{\pi a^2}{2}$

$B = \frac{\pi b^2}{2}$

$C = \frac{\pi c^2}{2}$

pythag $4a^2 = 4b^2 + 4c^2$

$a^2 = b^2 + c^2 \quad (\times \pi)$

$\pi a^2 = \pi b^2 + \pi c^2 \quad (\div 2)$

$\frac{\pi a^2}{2} = \frac{\pi b^2}{2} + \frac{\pi c^2}{2}$

$A = B + C$

Q13

A
B
C

3 /3

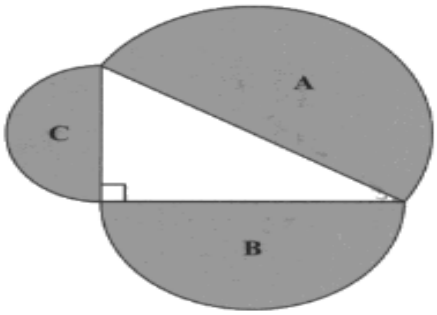
M1 for Pythagoras' theorem used correctly for their labelled diameters.

M1 as correct expressions are formed for the areas of all 3 semicircles.

C1 because a fully correct chain of reasoning is shown - the substitution of their diameters into Pythagoras' theorem and the various steps that lead to each of the areas of the semicircles defined previously.

Question 13 - Response B

13 A right-angled triangle is formed by the diameters of three semicircular regions, **A**, **B** and **C** as shown in the diagram.



Show that

area of region **A** = area of region **B** + area of region **C**

∵ it's a right-angled triangle.

diameter A^2 = diameter B^2 + diameter C^2

$a^2 = b^2 + c^2$

area = $r^2\pi \times \frac{1}{2}$ $\quad (\frac{b}{2})^2\pi \times \frac{1}{2}$ $\quad (\frac{c}{2})^2\pi \times \frac{1}{2}$

$= (\frac{a}{2})^2\pi \times \frac{1}{2}$ $\quad = \frac{b^2}{4} \times \frac{1}{2}\pi$ $\quad = \frac{c^2}{8}\pi$.

$= \frac{a^2}{4}\pi \times \frac{1}{2}$ $\quad = \frac{b^2}{8}\pi$

$= \frac{a^2}{8}\pi$.

$\frac{a^2}{8}\pi = \frac{b^2}{8}\pi + \frac{c^2}{8}\pi$

$\frac{a^2}{8}\pi = \frac{b^2+c^2}{8}\pi$

$\sqrt{a} = \sqrt{b+c}$

$a = b+c$ //

Q13

A B C

2 /3

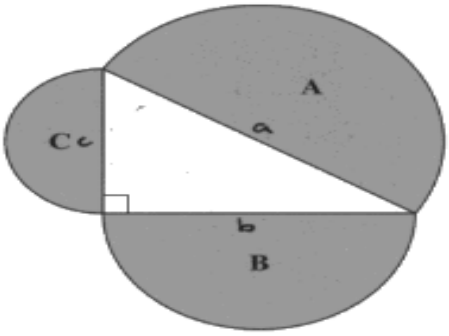
M1 for correct use of Pythagoras' theorem after defining the diameters of the semicircles

M1 for correct expressions for the areas of at least 2 of the 3 semicircles

C0 as the chain of reasoning is not fully correct due to the final two lines of working

Question 13 - Response C

13 A right-angled triangle is formed by the diameters of three semicircular regions, **A**, **B** and **C** as shown in the diagram.



Show that

area of region **A** = area of region **B** + area of region **C**

$a^2 = b^2 + c^2$

AREA B
$\pi \times r^2$
$= \pi \times \frac{1}{2} b^2$

AREA C
$\pi \times \frac{1}{2} c^2$

AREA A
$\pi \times \frac{1}{2} a^2$

$\frac{1}{2}\pi b^2 + \frac{1}{2}\pi c^2 = \frac{1}{2}\pi a^2$

$\Rightarrow b^2 + c^2 = a^2$

∴ as $\frac{1}{2}\pi$ cancels out
$b^2 + c^2 = a^2$

Q13

A
B
C

1 /3

M1 for substitution of their labelled diameters into Pythagoras' theorem

M0 as the expressions for the areas of the semicircles are incorrect.

C0 as there is not a fully correct chain of reasoning.

Question 16

Question | Mark Scheme | Examiner Comments | Performance | Response A | Response B | Response C

Question 16 - Question

16 A first aid test has two parts, a theory test and a practical test.
The probability of passing the theory test is 0.75
The probability of passing only one of the two parts is 0.36

The two events are independent.

Work out the probability of passing the practical test.

.....

(Total for Question 16 is 4 marks)

Question 16 - Mark Scheme

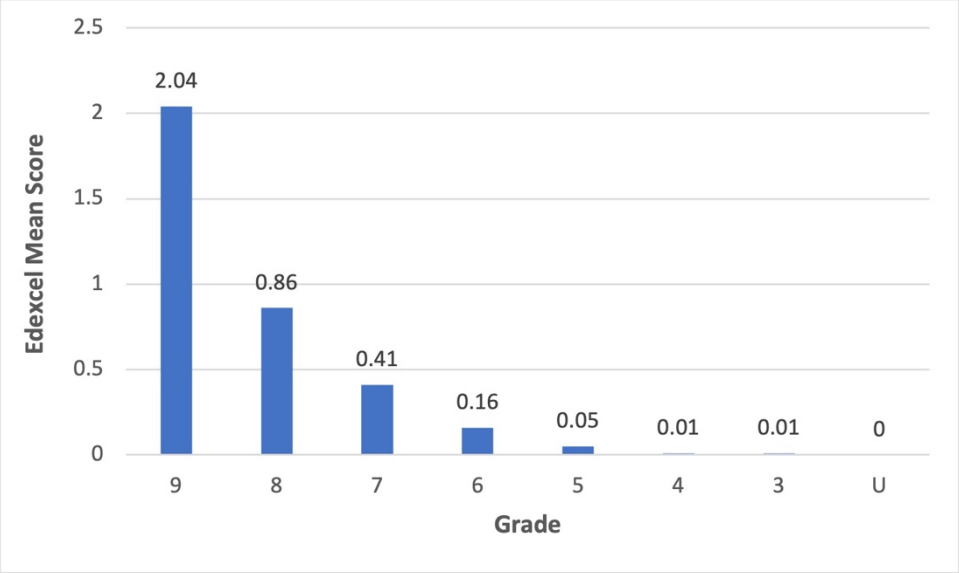
Question	Answer	Mark	Mark scheme	Additional guidance
16	0.78	P1	for using 0.75 or 0.25 in a relevant product, eg $0.75 \times x$ **or** $0.25 \times y$	Allow different letters Could work with fractions
		P1	for using two products to form an equation, eg $0.75x + 0.25y = 0.36$	
		P1	for a correct equation in one variable, eg $0.75(1 - p) + 0.25p = 0.36$ **or** $0.75f + 0.25(1 - f) = 0.36$	Could set up an equation for pass × pass + fail × fail = 0.64
		A1	oe	Accept 78% or any equivalent fraction, eg $\frac{39}{50}, \frac{156}{200}$

Question 16 - Examiner Comments

Overall, this question was answered very poorly with a large number of students unable to find an appropriate strategy to work out the probability of passing the practical test. Probability tree diagrams were very common but these were of little use to many students as the probability of passing only one of the two parts, 0.36, was often placed incorrectly on branches of the tree diagrams. Some students wrote down a relevant product, often this was $0.75 \times x$, and gained the first mark but many were not able to go on and make any further progress. Statements such as $0.75 \times x = 0.36$ were common because many students did not recognise that there are two ways of passing only one of the two parts. Some of the students who did consider the two ways wrote $0.75 \times x + 0.25 \times x = 0.36$ and gained no more marks. It was also common to see $0.75 \times x + 0.25 \times y = 0.36$ which gained the second mark but this did not necessarily get translated into an equation in one variable and so no further progress was made. Many of those that did show a correct equation such as $0.75(1 - x) + 0.25x = 0.36$ were able to complete the process and give a correct final answer. A small number of students who got as far as forming and solving a correct equation in one variable were confused about what their variable represented and lost the accuracy mark.

Question 16 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
0.47	4	12	0.47	2.04	0.86	0.41	0.16	0.05	0.01	0.01	0.00



Question 16 - Response A

16 A first aid test has two parts, a theory test and a practical test.
The probability of passing the theory test is 0.75
The probability of passing only one of the two parts is 0.36

The two events are independent.

Work out the probability of passing the practical test.

x = probability of failing practical

$(0.75 \times x) + (0.25 \times (1-x)) = 0.36$

$0.75x + 0.25 - 0.25x = 0.36$

$0.5x = 0.11$

$\frac{5}{10}x = \frac{11}{100}$

$x = \frac{11}{100} \div \frac{5}{10}$

$x = \frac{11}{100} \times \frac{2}{1} = \frac{22}{100}$

$= 0.22$

$1 - 0.22 = 0.78$

Q16

A
B
C

4 /4

P1 for a relevant product, either $0.75 \times x$ or $0.25 \times (1 - x)$ is sufficient for this mark

P1 for using two products to form an equation

P1 for a correct equation in one variable $0.75 \times x + 0.25 \times (1 - x) = 0.36$

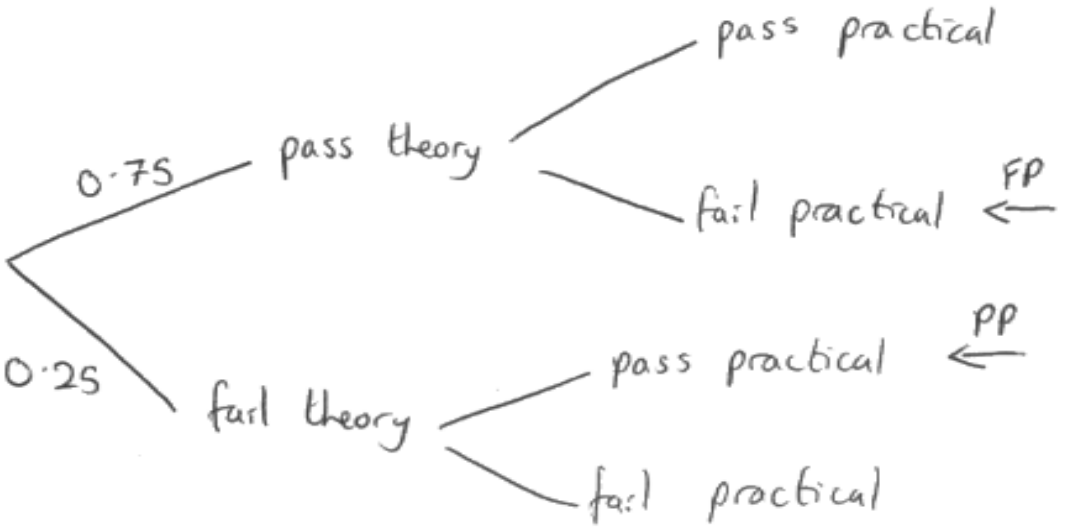
A1 for a correct final answer

Question 16 - Response B

16 A first aid test has two parts, a theory test and a practical test.
The probability of passing the theory test is 0.75
The probability of passing only one of the two parts is 0.36

The two events are independent. one doesn't effect other

Work out the probability of passing the practical test.



$(0·75 \times FP) + (0·25 \times PP) = 0·36$

~~0·36 = (0·75 + 0·25) = PP~~

~~0·36 = FP + PP~~ $FP + PP = 1$

$0·25 \times 0·8 = 0·2$

$0·75 \times 0·2 = 0·16$

0·8

2 /4

Q16

A B C

P1 for a relevant product, either 0.75 × FP or 0.25 × PP is sufficient for this mark

P1 for using two products to form an equation, 0.75 × FP + 0.25 × PP = 0.36

P0 because no equation in one variable is formed

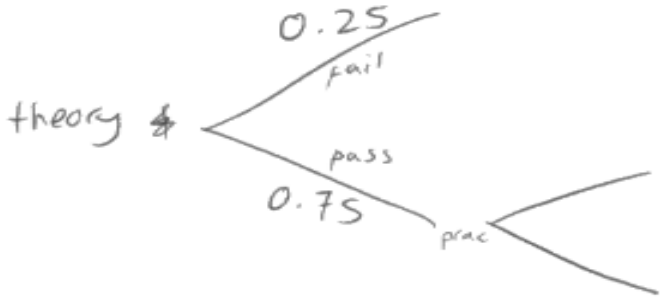
A0 as the final answer is incorrect

Question 16 - Response C

16 A first aid test has two parts, a theory test and a practical test.
The probability of passing the theory test is 0.75
The probability of passing only one of the two parts is 0.36

The two events are independent.

Work out the probability of passing the practical test.



10 = 5 × 2
10 ÷ 5 = 2

75
150
225
300
375
450
525
600

0.36 = 0.75 × x

$$75 \overline{)360} \quad 0.48$$
300
600

0.48

Q16

1 /4

P1 for a relevant product, 0.75*x*. For this mark we can ignore equating it with 0.36

P0 as two products are not used to form an equation

P0 because there is not a correct equation in one variable

A0 as the final answer is incorrect

Question 19

Question | Mark Scheme | Examiner Comments | Performance | Response A | Response B | Response C

Question 19 - Question

19 Solve $\frac{1}{2x-1}+\frac{3}{x-1}=1$

Give your answer in the form $\frac{p\pm\sqrt{q}}{2}$ where p and q are integers.

.....

(Total for Question 19 is 4 marks)

Question 19 - Mark Scheme

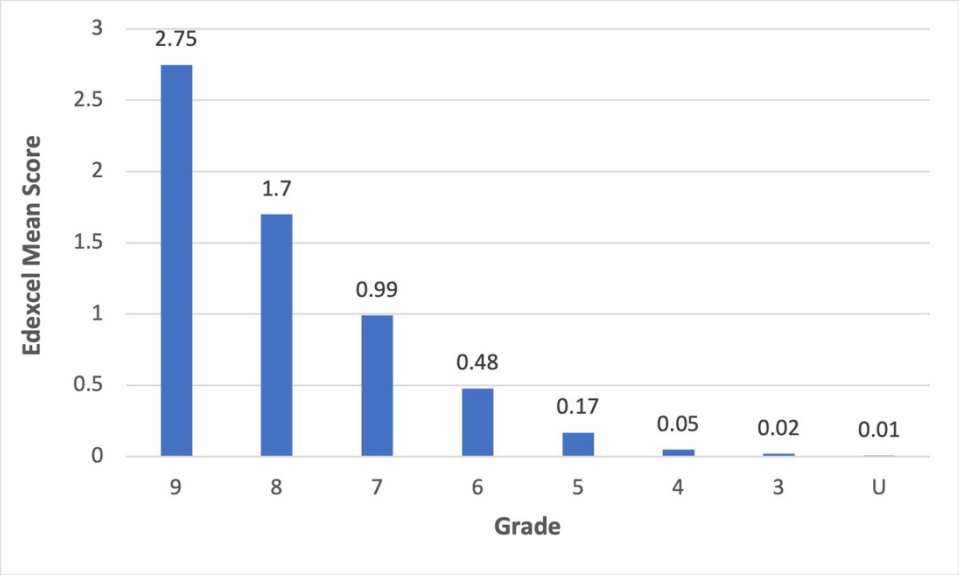
Question	Answer	Mark	Mark scheme	Additional guidance
19	$\frac{5\pm\sqrt{15}}{2}$	M1	for using a common denominator eg $\frac{x-1}{(2x-1)(x-1)}+\frac{3(2x-1)}{(2x-1)(x-1)}$ (= 1) **or** $(x-1)+3(2x-1)=(2x-1)(x-1)$	
		M1	for expanding and rearranging to get $2x^2-10x+5$ (= 0)	Note we don't need to see "= 0"; just the LHS is sufficient Accept other forms of the 3 term quadratic, eg $2x^2-10x=-5$
		M1	(dep M1) ft for a method to solve their 3 term quadratic equation eg $\frac{10\pm\sqrt{(-10)^2-4\times2\times5}}{2\times2}$ or $\frac{10\pm\sqrt{60}}{4}$ **or** $2\left[\left(x-\frac{5}{2}\right)^2-\left(\frac{5}{2}\right)^2\right]+5=0$ oe	Correct use of formula or completing the square
		A1	cao	

Question 19 - Examiner Comments

Relatively few students could demonstrate the necessary skills of algebraic manipulation to solve the equation and give the answer in the required form. Many students were able to correctly write the two fractions with a common denominator and gain the first mark but a significant number were then unable to carry the algebraic solution any further. Those that did reduce the equation to a 3 term quadratic often made errors when rearranging and did not get the second mark. Substitution into the quadratic equation formula was generally done well but some students attempted to use completing the square and this was done less well due to not dealing with the coefficient of 2 correctly. Some students who did not get a correct quadratic equation were still able to gain the third mark for dealing correctly with their 3 term quadratic equation. The final step to write $\frac{10 \pm \sqrt{60}}{4}$ in the required form proved difficult with $\frac{5 \pm \sqrt{30}}{2}$ a common incorrect answer.

Question 19 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
0.89	4	22	0.89	2.75	1.70	0.99	0.48	0.17	0.05	0.02	0.01



Question 19 - Response A

19 Solve $\frac{1}{2x-1}+\frac{3}{x-1}=1$

Give your answer in the form $\frac{p\pm\sqrt{q}}{2}$ where p and q are integers.

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

$\frac{x-1+6x-3}{(2x-1)(x-1)}=1$

$\frac{7x-4}{2x^2-3x+1}=1$

$7x-4=2x^2-3x+1$

$2x^2-10x+5=0$

$x=\frac{10\pm\sqrt{100-40}}{4}$

$x=\frac{10\pm\sqrt{60}}{4}$

$x=\frac{10\pm2\sqrt{15}}{4}$

$x=\frac{5\pm\sqrt{15}}{2}$

Q19

A B C

4 /4

M1 for using a common denominator - (second line)

M1 for rearranging to get the correct quadratic $2x^2 - 10x + 5$

M1(dep M1) for a full method to solve the quadratic - in this case using the quadratic formula. The mark is awarded at the unsimplified stage.

A1 as the solution is given in the form required by the question

Question 19 - Response B

19 Solve $\frac{1}{2x-1}+\frac{3}{x-1}=1$

Give your answer in the form $\frac{p\pm\sqrt{q}}{2}$ where p and q are integers.

$\frac{1(x-1)}{(2x-1)(x-1)} + \frac{3(2x-1)}{(2x-1)(x-1)} = 1$ $2x^2-2x-x+1$

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

$\frac{7x-4}{2x^2-3x+1} = 1$

$\frac{7x-4}{2x^2-3x+1} = \frac{1}{1}$

$7x-4 = 2x^2-3x+1$

$7x = 2x^2-3x+5$

$0 = 2x^2-10x+5$ 100 -40

$\frac{10\pm\sqrt{(-10)^2-(4\times2\times5)}}{2(2)}$

$\frac{10\pm\sqrt{60}}{4}$

$x = \frac{5\pm\sqrt{30}}{2}$

Q19

A B C

3 /4

M1 for use of a common denominator

M1 for expanding and rearranging into the required form

M1 (dep M1) for a full method to solve their equation (scored at the unsimplified stage)

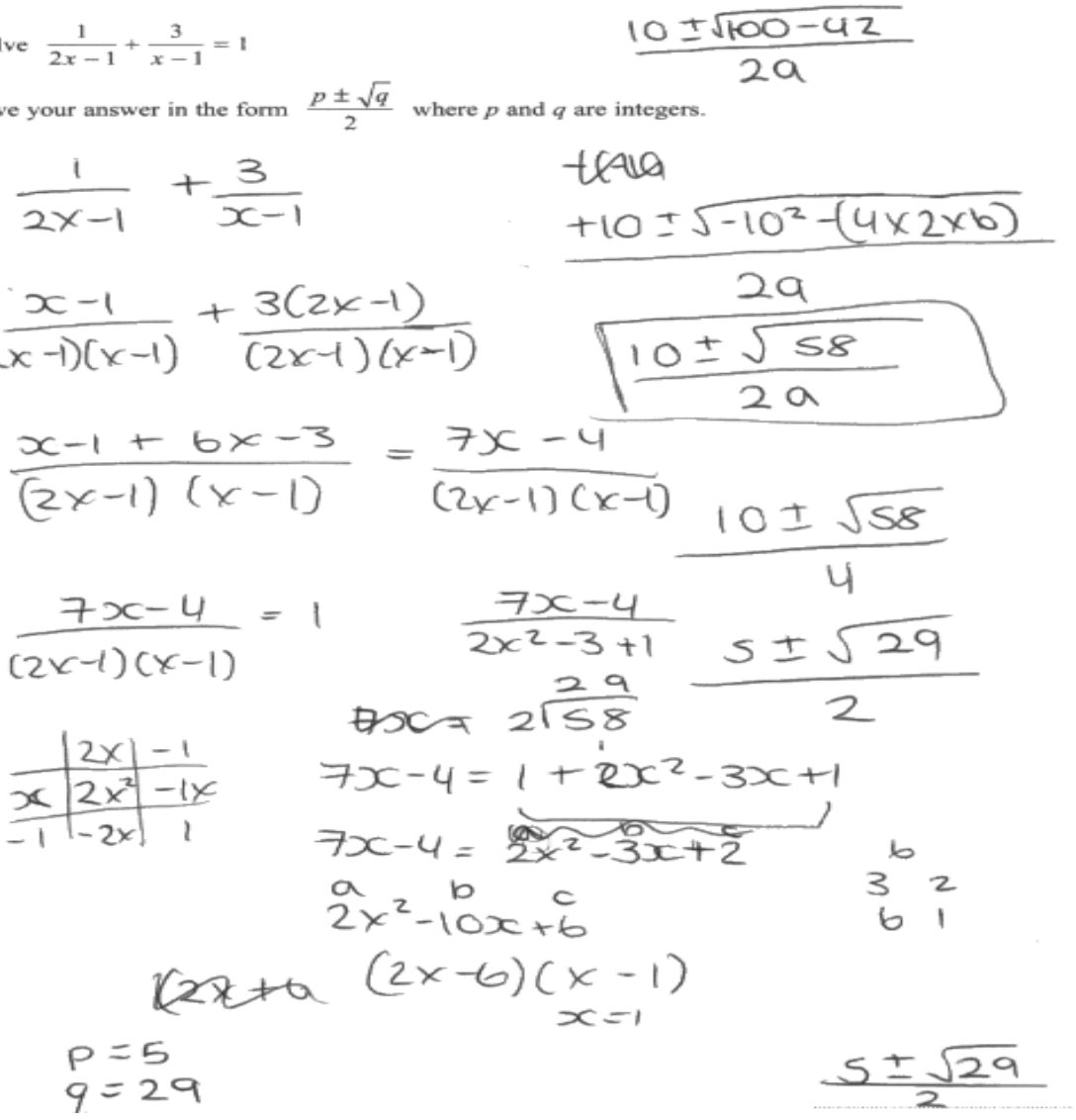
A0 for a nearly correct answer ($\sqrt{60}$ is not $2\sqrt{30}$)

Note that the error in simplifying $\sqrt{60}$ was quite common

Question 19 - Response C

19 Solve $\frac{1}{2x-1}+\frac{3}{x-1}=1$

Give your answer in the form $\frac{p\pm\sqrt{q}}{2}$ where p and q are integers.



2 /4

M1 for use of a common denominator

M0 because the correct quadratic is not reached

M1 (dep M1) for a full substitution to solve their 3 term quadratic equation. The full method is seen in stages and the arithmetic error is condoned (100 – 48 is not 58)

A0 as the answer is incorrect

Question 20

Question | Mark Scheme | Examiner Comments | Performance | Response A | Response B | Response C

Question 20 - Question

20 The centre of a circle is the point with coordinates (−1, 3)

The point A with coordinates (6, 8) lies on the circle.

Find an equation of the tangent to the circle at A.
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

.....

(Total for Question 20 is 4 marks)

Question 20 - Mark Scheme

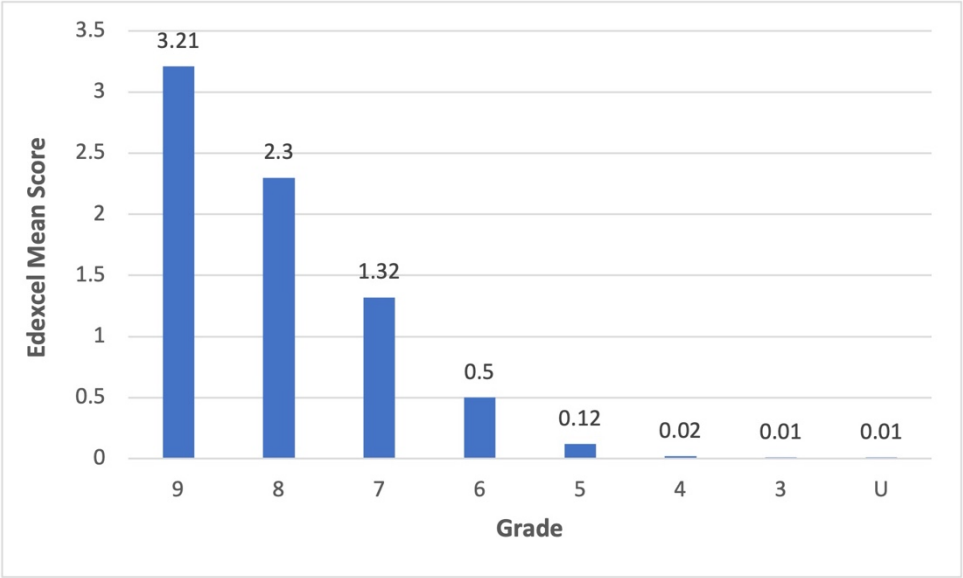
Question	Answer	Mark	Mark scheme	Additional guidance
20	$7x + 5y - 82 = 0$	P1	for process to work out the gradient of the line from the centre of the circle to the point (6,8) eg $\frac{8-3}{6--1}$ $(=\frac{5}{7})$	
		P1	(dep P1) for using $mn = -1$ eg $-1 \div \text{“}\frac{5}{7}\text{”}$ $(=-\frac{7}{5})$	
		P1	for substituting (6, 8) into $y = \text{“}-\frac{7}{5}\text{”}x + c$ **or** for $(y-8) = \text{“}-\frac{7}{5}\text{”}(x-6)$ **or** for $y = -\frac{7}{5}x + \frac{82}{5}$ oe	
		A1	$7x + 5y - 82 = 0$ oe SC B2 for answer of $5x + 7y - 86 = 0$ oe in any form	Must be in form $ax + by + c = 0$ with integer coefficients, eg $82 - 7x - 5y = 0$

Question 20 - Examiner Comments

It was pleasing to see many students attempting to draw diagrams to help them structure their response. Those who did often then started by finding the gradient of the line from the centre of the circle to the point A and gained the first mark. A good number were then able to find the gradient of the tangent and use $y = mx + c$ to find an equation of the tangent. Those who got this far and gained the first three marks often failed to gain the accuracy mark. Sometimes this was due to an error when finding the value of c but more commonly it was because the final equation was not given in the form $ax + by + c = 0$ that was required by the question. A common error at the first stage was for students to attempt to work out a gradient without using both (–1, 3) and (6, 8) and give gradients such $\frac{8}{6}$ or $\frac{1}{3}$. These students gained no marks as did students who changed the circle centre to the origin. A minority of students found an incorrect gradient from using change in x divided by change in y but they could still get two marks if their final equation was $5x + 7y – 86 = 0$.

Question 20 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
1.08	4	27	1.08	3.21	2.30	1.32	0.50	0.12	0.02	0.01	0.01

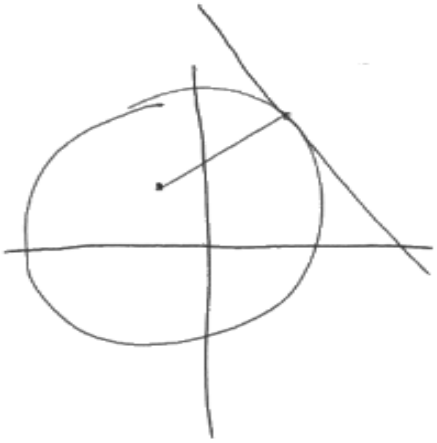


Question 20 - Response A

20 The centre of a circle is the point with coordinates $(-1, 3)$

The point A with coordinates $(6, 8)$ lies on the circle.

Find an equation of the tangent to the circle at A.
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.



$\frac{8-3}{6--1} = \frac{5}{7}$

$y = y = -\frac{7}{5}x + c$

$5y = -7x + c$

$40 = -42 + c$

$82 = c$

$5y = -7x + 82$

$0 = -7x - 5y + 82$

4 /4

Q20

A
B
C

P1 for process to find the gradient of the line from the centre to the point (6, 8)

P1 for a correct gradient of the tangent

P1 for substituting (6, 8) into $5y = -7x + c$

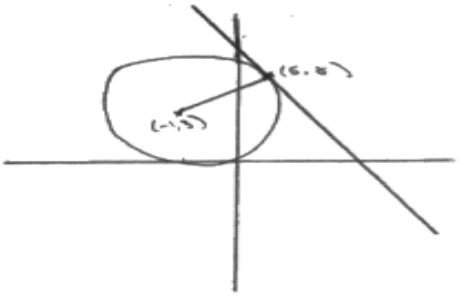
A1 because a correct equivalent of $7x + 5y - 82 = 0$ is shown on the answer line
Note that equivalent equations in the form $ax + by + c = 0$ are acceptable but a, b and c must be integers.

Question 20 - Response B

20 The centre of a circle is the point with coordinates $(-1, 3)$

The point A with coordinates $(6, 8)$ lies on the circle.

Find an equation of the tangent to the circle at A.
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.



(6, 8)

(-1, 3)

$\frac{\Delta y}{\Delta x} = \frac{5}{7}$

tangent $m = -\frac{7}{5}$

$8 = -\frac{7}{5} \times 6 + c$

$\frac{8}{1} = \frac{40}{5}$

$8 = -\frac{42}{5} + c$

$\frac{40}{5} + \frac{42}{5} = c$

$\frac{82}{5} = c$

$y = -\frac{7}{5}x + \frac{82}{5}$

Q20

3 /4

P1 for a correct gradient of 5/7

P1 for a correct gradient of the tangent

P1 for substitution of (6, 8) into $y = -\frac{7}{5}x + c$

A0 because the equation of the straight line is not in the required form
Note that substitution of (6, 8) without evaluation to find c is sufficient for the 3rd mark.

Question 20 - Response C

20 The centre of a circle is the point with coordinates $(-1, 3)$ point O

The point A with coordinates $(6, 8)$ lies on the circle.

Find an equation of the tangent to the circle at A.
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

$\frac{8-3}{6-(-1)} = \frac{5}{7}$ = grad of OA

grad of tangent = $\frac{7}{5}$

$8 = \frac{7}{5} \times 6 + c$

$8 = \frac{42}{5} + c$

$8 - \frac{42}{5} = c$

$\frac{40}{5} - \frac{42}{5} = c$

$-\frac{2}{5} = c$

$y = \frac{7}{5}x - \frac{2}{5}$

$-\frac{7}{5}x + y + \frac{2}{5} = 0$

$-7x + 5y + 2 = 0$

$-7x + 5y + 2 = 0$

Q20

A B C

1 /4

P1 for finding the gradient of the line from the centre to the point (6, 8)

P0 as the gradient of the tangent is incorrect.

P0 as this mark is dependent on P2 due to the use of quotation marks.

A0 as the final answer is incorrect.

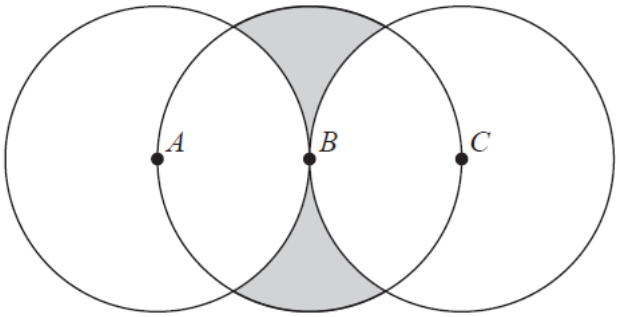
Question 21

Question | Mark Scheme | Examiner Comments | Performance | Response A | Response B | Response C

Question 21 - Question

21 The diagram shows three circles, each of radius 4 cm.

The centres of the circles are A, B and C such that ABC is a straight line and $AB = BC = 4$ cm.



Work out the total area of the two shaded regions.
Give your answer in terms of π

..... cm^2

(Total for Question 21 is 5 marks)

Question 21 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
21	$16\sqrt{3}-\frac{16\pi}{3}$	P1	for identifying an angle of 60 or 120	
		P1	for process to find the area of a sector of angle 60 or 120 eg $\pi 4^2\times\frac{60}{360}\left(=\frac{8\pi}{3}\right)$ or $\pi 4^2\times\frac{120}{360}\left(=\frac{16\pi}{3}\right)$	
		P1	for process to find the area of an equilateral triangle eg $\frac{1}{2}\times 4\times 4\times\sin 60\ (=4\sqrt{3})$ **or** $\frac{4\times\sqrt{4^2-2^2}}{2}$ $(=2\sqrt{12}$ or $4\sqrt{3})$ **or** the area of an isosceles triangle **or** area of a right-angled triangle eg $\frac{1}{2}\times 4\times 4\times\sin 120\ (=4\sqrt{3})$ **or** $\frac{2\times\sqrt{4^2-2^2}}{2}$ $(=\sqrt{12}$ or $2\sqrt{3})$	
		P1	for using area of sector – area of triangle to find area of a segment eg $\pi 4^2\times\frac{60}{360}-\frac{1}{2}\times 4\times 4\times\sin 60\ \left(=\frac{8\pi}{3}-4\sqrt{3}\right)$ **or** $\pi 4^2\times\frac{120}{360}-\frac{1}{2}\times 4\times 4\times\sin 120\ \left(=\frac{16\pi}{3}-4\sqrt{3}\right)$	
		A1	for $16\pi-4\left(\frac{16\pi}{6}-4\sqrt{3}+\frac{16\pi}{6}\right)$ or $16\sqrt{3}-\frac{16\pi}{3}$ oe	Does not need to be in simplest form

Q21

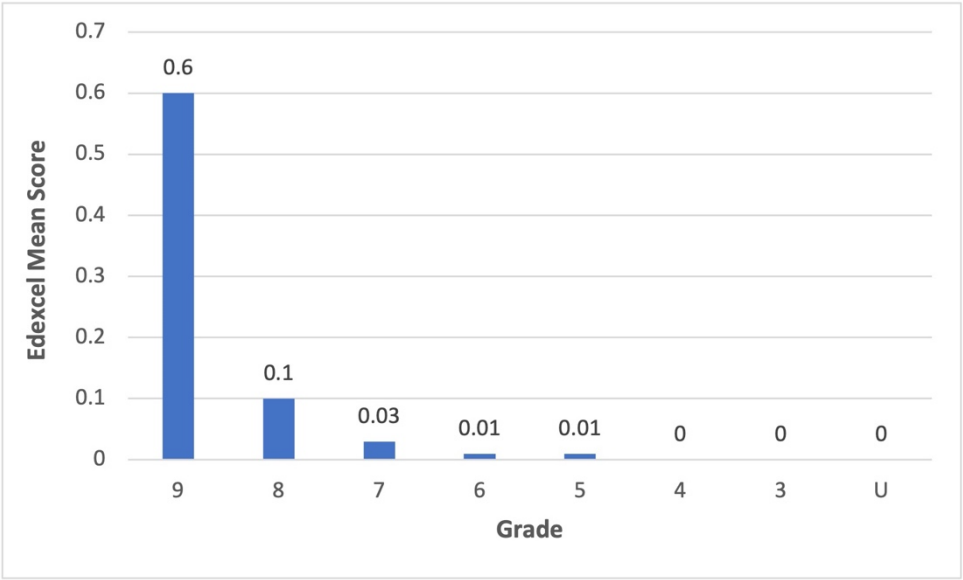
A B C

Question 21 - Examiner Comments

This proved to be a challenging question with very few students showing any understanding of what was required to find the total area of the two shaded regions. Most students failed to find a successful strategy and working out was often messy and difficult for examiners to follow. Fully correct answers were seen only rarely but nevertheless it was pleasing to see some excellent solutions from the most able students taking this paper. The students who scored marks had generally drawn appropriate triangles on the diagram to help formulate their approach. Those who used $\frac{1}{2}ab\sin C$ to find the area of a triangle were usually able to recall the exact value of $\sin 60^o$ or $\sin 120^o$. Some students made a good start and gained the first two marks by finding either the area of a triangle or the area of a sector but often they did not find both and were unable to make any further progress. It was pleasing to see many students attempting this question but often they simply found the area of one circle as 16π or the area of three circles and then made incorrect assumptions about the proportion shaded in searching for a solution.

Question 21 - Performance

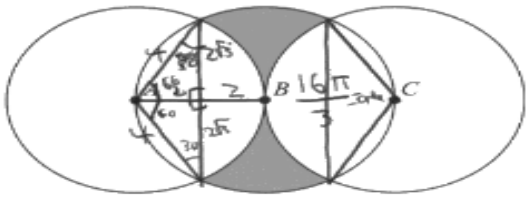
Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
0.09	5	2	0.09	0.60	0.10	0.03	0.01	0.01	0.00	0.00	0.00



Question 21 - Response A

21 The diagram shows three circles, each of radius 4 cm.

The centres of the circles are A, B and C such that ABC is a straight line and $AB = BC = 4$ cm.



$\cos 60 = \frac{1}{2}$

Work out the total area of the two shaded regions.
Give your answer in terms of π

SOH CAH TOA

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

$\cos^{-1}\left(\frac{1}{2}\right) = 60°$

πr^2

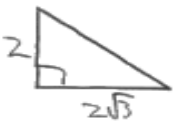
$A = C = B$

$\pi 4^2 = 16\pi$

$16\pi \times 2 = 32\pi$

$4^2 - 2^2 = 16 - 4 = \sqrt{12}$

$\sqrt{12} = \sqrt{4 \times 3} = 2\sqrt{3}$



$2 \times 2\sqrt{3} = 4\sqrt{3}$

~~64 − 49~~ ~~64~~

$\frac{360}{120} = \frac{36}{12} = \frac{3}{1}$

$\frac{\pi r^2}{3} = \frac{16\pi}{3}$

$16\pi = \frac{48\pi}{3}$

$\frac{48\pi}{3} - \frac{64\pi}{3} = -\frac{16\pi}{3}$

$48 = 16$

$\frac{16\pi}{3} - 4\sqrt{3}$

$16\pi - 4\left(\frac{16\pi}{3} - 4\sqrt{3}\right)$

$16\pi + 16\sqrt{3} - \frac{64\pi}{3}$

$16\sqrt{3} - \frac{16\pi}{3}$ cm²

5 /5

P1 for identifying an angle of 60°

P1 for process to find the area of a sector of angle 120°

P1 for process to find the area of a right-angled triangle. This is then doubled to give the area of an isosceles triangle.

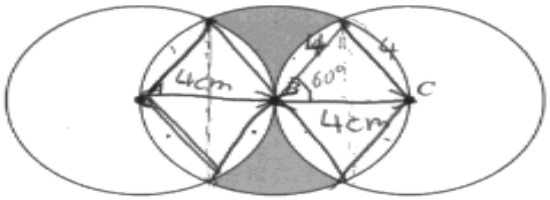
P1 for using area of sector – area of triangle to find the area of a segment

A1 for a correct final answer which comes from area of circle – area of 4 segments
Note that the final answer does not have to be in its simplest form.
There is an additional page at the end of the mark scheme showing three possible approaches to solving this problem; this is not an exhaustive list

Question 21 - Response B

21 The diagram shows three circles, each of radius 4 cm.

The centres of the circles are A, B and C such that ABC is a straight line and $AB = BC = 4$ cm.



Work out the total area of the two shaded regions.
Give your answer in terms of π

AC Middle circle : 16π.

$\frac{1}{2} \times 4 \times 4 \times \sin(60)$

$\frac{1}{2} \times 16 \times \frac{\sqrt{3}}{2}$

$\frac{8}{1} \times \frac{\sqrt{3}}{2} = \frac{8\sqrt{3}}{2}$

$4\sqrt{3}$

$\frac{1}{6} \times \pi \times 4^2$

$= \frac{1}{6} \times 16\pi$

$= \frac{16}{6}\pi$

$8\left(\frac{16}{6}\pi - 4\sqrt{3}\right)$

$\frac{128}{6}\pi - 32\sqrt{3}$

$\frac{16}{3}\pi - 32\sqrt{3}$

$\frac{16}{3}\pi - 32\sqrt{3}\ \text{cm}^2$

$\frac{16}{1} - \frac{64}{3}$

$\frac{48}{3} - \frac{64}{3}$

16π

(Total for Question 21 is 5 marks)

Q21

A B C

4 /5

P1 for identifying an angle of 60°

P1 for process to find the area of a sector of angle 60°

P1 for process to find area of an equilateral triangle, using $1/2ab\text{Sin}C$

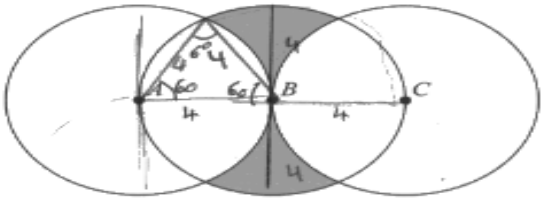
P1 for using area of sector – area of triangle to find the area of a segment; this is seen inside the brackets with '8' in front.

A0 as the expression for the total area is incorrect.

Question 21 - Response C

21 The diagram shows three circles, each of radius 4 cm.

The centres of the circles are A, B and C such that ABC is a straight line and $AB = BC = 4$ cm.



16×6 = 96

Work out the total area of the two shaded regions.
Give your answer in terms of π

Area of whole shaded circle = 16π

~~area of $\frac{1}{3}$ of circle = $\frac{16}{3}\pi$~~

area triangle = $\frac{1}{2} 4 \times 4 = 8$ cm

area of triangles = 32 cm^2

$4^2 \pi \times \frac{60}{360}$

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

$16\pi \times \frac{1}{6} = \frac{16}{6}\pi$ 2

$\frac{16}{6}$

$\frac{16}{6}\pi - 8$ = segment

$6\overline{)128.20}$ 21.3

$16\pi - 32 - 2$

$\frac{16}{6}\pi \times \frac{2}{1} = \frac{32}{6}\pi - 16$

$\frac{32}{6}\pi \times \frac{1}{6} = \frac{128}{6}\pi - 64$

$16\pi - 32 - \frac{128}{6}\pi$

$16\pi - 96 - \frac{128}{6}\pi$ cm^2

$-32 - 64$

2 /5

P1 for identifying an angle of 60°

P1 for process to find the area of a sector

P0 because the process to find the area of an equilateral triangle is incorrect, assumes height of triangle to be 4 cm.

P0 because the area of the triangle comes from an incorrect process; therefore this mark for using area of sector – area of triangle cannot be awarded.

A0 as the expression for the total area is incorrect.

Q21
A
B
C