Pearson Edexcel

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

Summer 2023 Exemplar
1MA1 1H 2H 3H
Higher Tier

Senior Examiner's feedback on student responses

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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 Summer 2023 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 across papers 1H, 2H and 3H for this booklet.

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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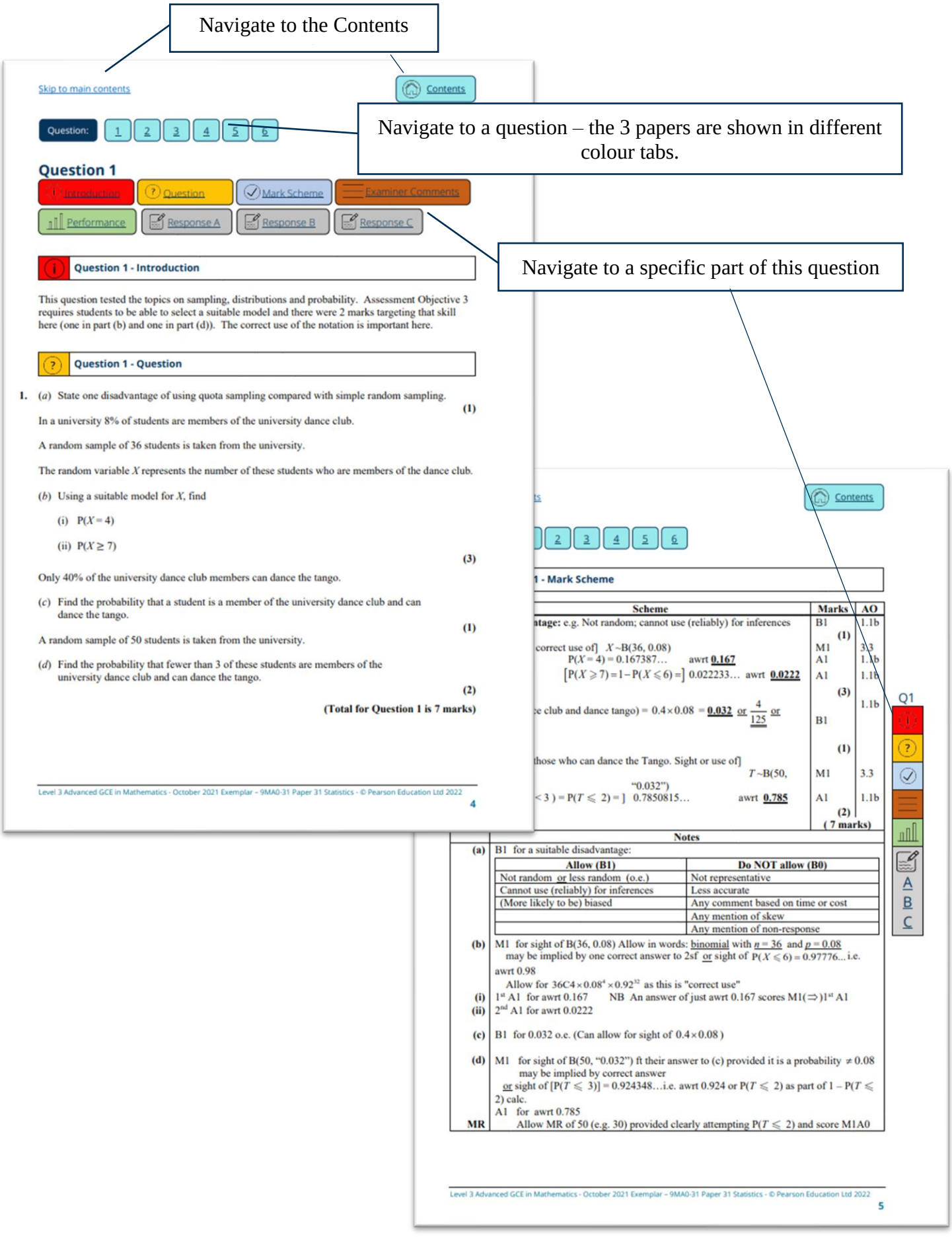
How to use this booklet



General Examiner Feedback

Paper 1H

This paper proved accessible to students with many excellent responses seen to the most challenging questions on the paper. It was pleasing to see that most students attempted most of the questions with few left completely blank.

Students were well-prepared for topics such as subtraction of fractions (Q2), scatter graphs (Q6), direct proportion (Q13) and the product rule for counting (Q19). Students often struggled with a correct method to divide by decimals and with division in general. A large number of students had difficulty interpreting the set notation in Q5b and working consistently in terms of π in Q16. Poor algebraic manipulation in Q15, Q16 and Q17 let students down when rearranging formulae and equations. Simplification of surds was an issue for many students in Q16 and Q23.

It was pleasing that many students presented their working clearly and logically. However, answers to some questions, particularly the ratio problem (Q18), changing the subject of a formula (Q17) and finding an inverse function (Q20a) were not as well presented. Attempts were often quite messy with incomplete methods shown which made them difficult for examiners to follow. Centres should advise students to cross out unnecessary working to avoid leaving a choice of methods.

Carelessness in their working proved costly to some students. This carelessness included errors in simple calculations and imprecise notation when working with algebra, for example brackets missing in Q17 and Q23. Being a non-calculator paper there were frequent instances of arithmetic errors, for example $90 \div 30 = 30$ and $\sqrt{25} = 12.5$, which led to a loss of marks. Often, students did not consider whether or not their answer was reasonable – had they done so, they could have spotted and corrected errors. Once again, there were many cases across many different questions of students miscopying their own figures or misreading the numbers in questions.

Paper 2H

There was evidence of good work across the cohort sitting this Higher paper and as such it appears that candidates had been entered for the appropriate tier. Candidates were well prepared and able to access questions throughout the paper. Weaker candidates found success in the first half of the paper and a number of familiar style questions helped throughout.

There was evidence of calculator use from all candidates and it is pleasing to see that centres are ensuring no one is disadvantaged through lack of equipment. Compared to last year, it seems candidates are getting better at using their calculators, but there is still evidence of many rounding prematurely often leading to answers outside of the given range.

It was also good to see candidates taking on advice from previous series and showing their working. Candidates would benefit however from being clearer in their working and structuring it or annotating, rather than the haphazard working we sometimes see.

Paper 3H

Students entered for this examination generally presented their working in a clear and logical way and found that the time allowed for the examination was sufficient for them to complete the paper. Only a small proportion of students presented very weak scripts, suggesting that most students who sat this paper were entered appropriately for the higher tier.

Nearly all students showed enough working to enable examiners to award partial credit where answers were not correct. However, examiners noticed a significant number of occasions where it was difficult to read the candidate's writing, for example where indices were written or when numbers or algebraic expressions were miscopied. Calculators were usually used efficiently to evaluate numerical expressions with accuracy.

All questions were accessible to some students but, as expected, only the higher attaining students were able to work with confidence on questions towards the end of the paper. Questions 1 (indices and expansion), 2 (multi stage problem), 3 (geometry),
8 (mass, volume and density), 9 (percentages), 11 (box plots) and 12 (product of three linear expressions) were answered well by a large majority of students whereas questions, 4 (inverse proportionality), 13 (algebraic proof), 15(b) (factorisation),
16 (enlargement), 21 (equation with algebraic fractions) and 22 (vectors) proved more of a challenge for students in the target attainment range.

Paper 1H - Question 18

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

Question 18 - Question

18 7 kg of carrots and 5 kg of tomatoes cost a total of 480p

cost of 1 kg of carrots : cost of 1 kg of tomatoes = 5 : 9

Work out the cost of 1 kg of carrots and the cost of 1 kg of tomatoes.

carrots .....p

tomatoes .....p

(Total for Question 18 is 4 marks)

Question 18 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
18	(*c*) 30 (*t*) 54	P1	for setting up an equation, eg $7c + 5t = 480$ **or** $c : t = 5 : 9$ **or** $\frac{c}{t} = \frac{5}{9}$ **or** $9c = 5t$ **or** for starting to work with ratio of total costs, eg 7×5 (= 35) **and** 5×9 (= 45) or $7 \times \frac{5}{14}$ **and** $5 \times \frac{9}{14}$ or 35 : 45 or 7 : 9	

Question 18 - Mark Scheme (cont')

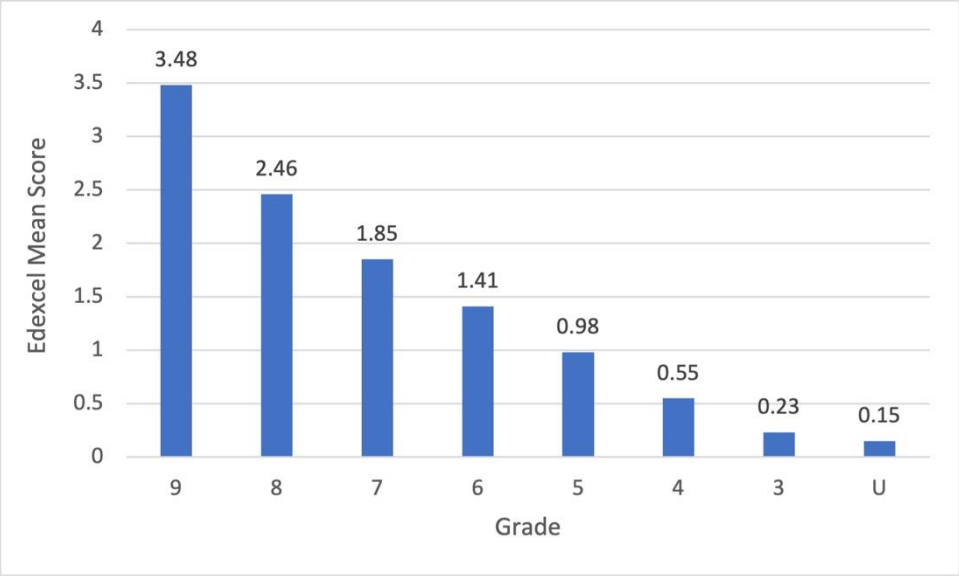
Question	Answer	Mark	Mark scheme	Additional guidance
		P1	for a process to eliminate c or t from correct equations, eg $7c + 9c = 480$ or $7 \times \frac{5t}{9} + 5t = 480$ or $7c + \frac{9c}{5} \times 5 = 480$ **or** for 480 ÷ ("35" + "45") (= 6) **or** for a process to find total cost of carrots or total cost of tomatoes, eg 480 ÷ ("7" + "9") × 7 (= 210) **or** 480 ÷ ("7" + "9") × 9 (= 270)	
		P1	for a process to isolate t or c, eg $16c = 480$ or $80c = 2400$ oe or $80t = 4320$ oe **or** for one value correct eg $c = 30$ or $t = 54$ **or** for a process to find cost of 1 kg of carrots or 1 kg of tomatoes, eg 5 × "6" (= 30) **or** 9 × "6" (= 54) **or** "210" ÷ 7 (= 30) **or** "270" ÷ 5 (= 54)	
		A1	cao	

Question 18 - Examiner Comments

Many students struggled to find a strategy that would enable them to solve this problem and there were many solutions that had calculations dotted around the page making the working very difficult for examiners to follow. Many of the algebraic methods broke down at an early stage. After gaining the first mark for writing an equation such as $7c + 5t = 480$ many students were unable to use the ratio 5 : 9 correctly to write down a second equation. Writing $5c = 9t$ instead of $9c = 5t$ was a common mistake and the incorrect equations $5c + 9t = 14$ and $c + t = 14$ were frequently seen. Nevertheless, it was pleasing to see some successful solutions from students using an algebraic method. The majority of the correct answers came from students adopting a numerical approach. The most efficient of these saw students working with the ratio of total costs, finding 7 × 5 = 35 and 5 × 9 = 45, often as 35 : 45, and then dividing 480 by 80 to get 6. Multiplying 5 by 6 and 9 by 6 completed the solution. Some students worked out the total cost of the tomatoes and the total cost of the carrots and gained the first two marks but did not find the cost of 1 kg of each. Many of the incorrect strategies were based on dividing 480 by 12 or by 14.

Question 18 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
1.56	4	39	1.56	3.48	2.46	1.85	1.41	0.98	0.55	0.23	0.15

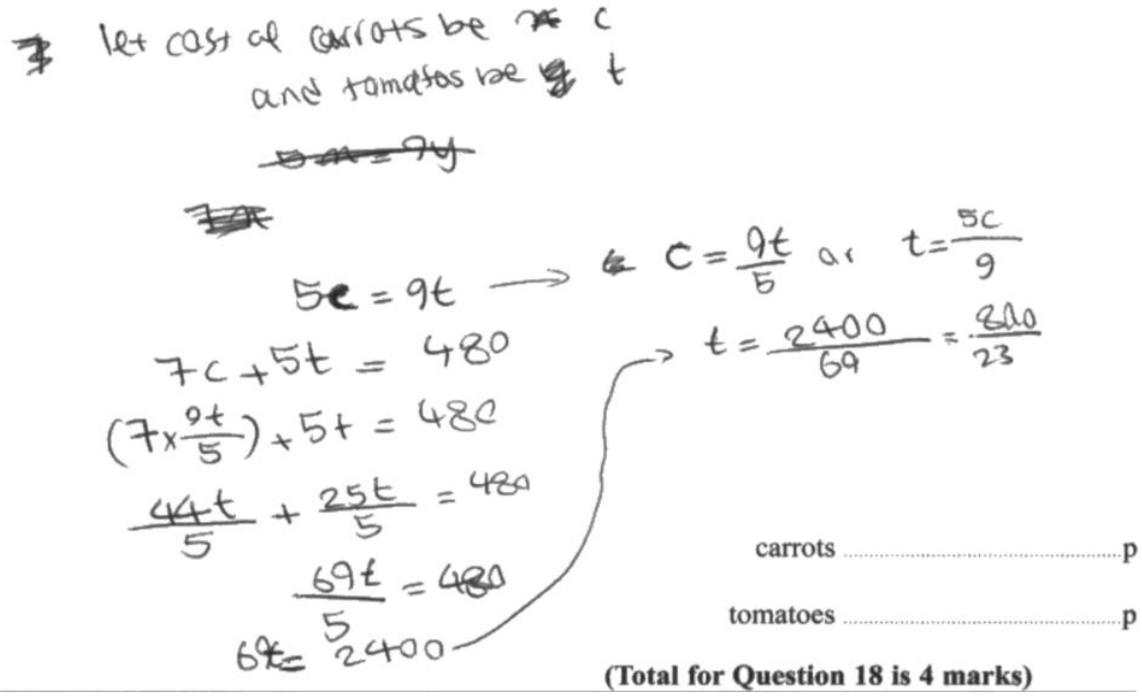


Question 18 - Response A

18 7 kg of carrots and 5 kg of tomatoes cost a total of 480p

cost of 1 kg of carrots : cost of 1 kg of tomatoes = 5 : 9

Work out the cost of 1 kg of carrots and the cost of 1 kg of tomatoes.



(Total for Question 18 is 4 marks)

1 /4

Q18

A B C

P1 for setting up an equation, 7c + 5t = 480.

P0 does eliminate c but the process is incorrect as 5c = 9t is used instead of 9c = 5t.

P0: no correct process to isolate t since an incorrect substitution for c has been made.

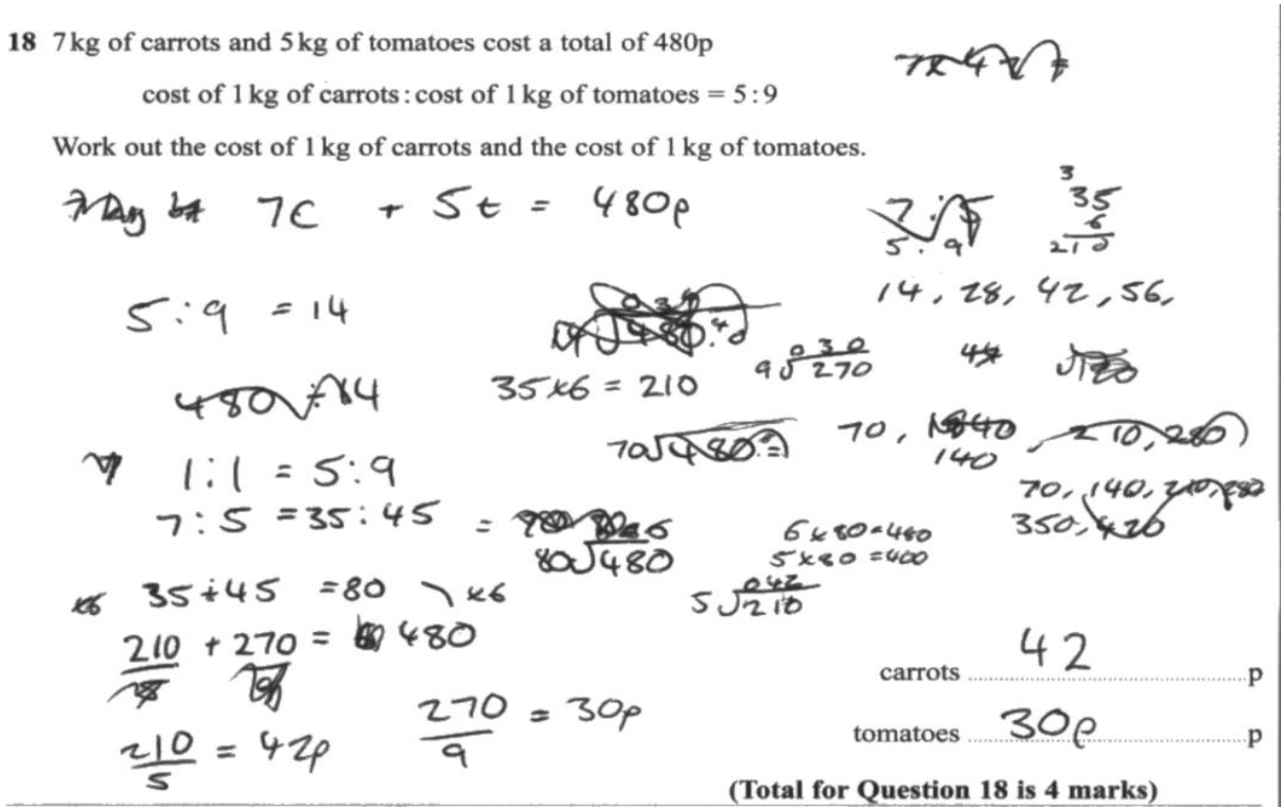
A0: no final correct answer.

Question 18 - Response B

18 7 kg of carrots and 5 kg of tomatoes cost a total of 480p

cost of 1 kg of carrots : cost of 1 kg of tomatoes = 5 : 9

Work out the cost of 1 kg of carrots and the cost of 1 kg of tomatoes.



(Total for Question 18 is 4 marks)

2 /4

Q18

A B C

P1 for 35 : 45

P1 for dividing 480 by (35 + 45) (= 6) or for working out the total cost of the carrots or the tomatoes (210 or 270).

P0 incorrect process to work out cost of 1kg (divides 210 and 270 by 5 and 9 instead of by 7 and 5)

A0 incorrect answer

Note: Although 30 is seen, it comes from 270/9 which is a common error and is clearly linked to tomatoes.

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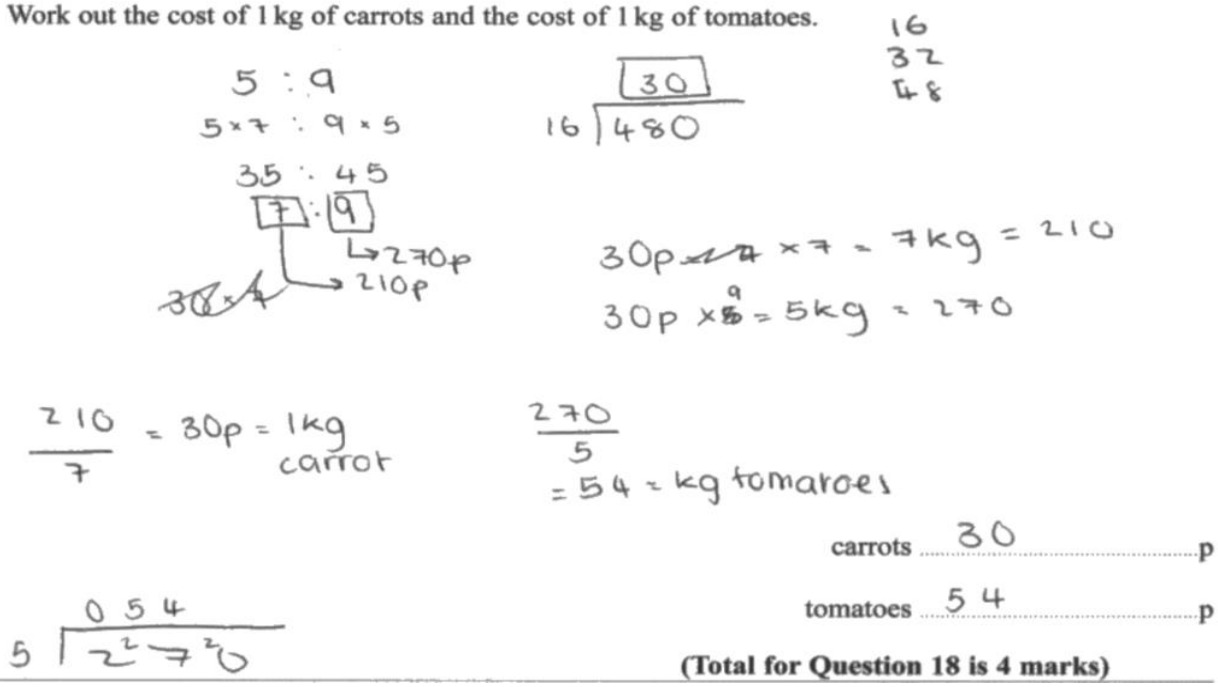
Question 18 - Response C

18 7 kg of carrots and 5 kg of tomatoes cost a total of 480p

cost of 1 kg of carrots : cost of 1 kg of tomatoes = 5 : 9

Work out the cost of 1 kg of carrots and the cost of 1 kg of tomatoes.



carrots 30 p

tomatoes 54 p

(Total for Question 18 is 4 marks)

4 /4

P1 P1 P1 A1
Correct answers from fully correct working

Paper 1H - Question 24

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

Question 24 - Question

24 Find the set of possible values of x for which

$$4x^2 - 25 < 0 \quad \textbf{and} \quad 12 - 5x - 3x^2 > 0$$

You must show all your working.

.....

(Total for Question 24 is 5 marks)

Question 24 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
24	$-2.5 < x < \frac{4}{3}$	M1	for method to find the critical values of $4x^2 - 25 < 0$ eg $(2x + 5)(2x - 5)$ or critical values -2.5 and 2.5 oe	accept use of = or incorrect inequality symbol for 1st and 3rd M marks
		M1	(dep on M1) for $x > -2.5$ **and** $x < 2.5$ or $x > a$ **and** $x < b$ where a and b are their critical values and $a < b$	This may be implied by a suitable diagram

Question 24 - Mark Scheme (cont')

Question	Answer	Mark	Mark scheme	Additional guidance
		M1	for method to find the critical values of $12 - 5x - 3x^2 > 0$ or $3x^2 + 5x - 12 < 0$ eg $(4 - 3x)(x + 3)$ or $(3x - 4)(x + 3)$ $\frac{--5 \pm \sqrt{(-5)^2 - 4\times(-3)\times 12}}{2\times(-3)}$ or $\frac{-5 \pm \sqrt{5^2 - 4\times 3\times(-12)}}{2\times 3}$ $3\left[\left(x+\frac{5}{6}\right)^2 - \left(\frac{5}{6}\right)^2\right] - 12 = 0$ oe or critical values -3 and $\frac{4}{3}$ oe	
		M1	(dep on previous M1) for $x > -3$ **and** $x < \frac{4}{3}$ or $x > c$ **and** $x < d$ where c and d are their critical values and $c < d$	This may be implied by a suitable diagram
		A1	for $-2.5 < x < \frac{4}{3}$ oe eg $x < \frac{4}{3}$, $x > -2.5$	A correct answer with no supportive working gets 0 marks

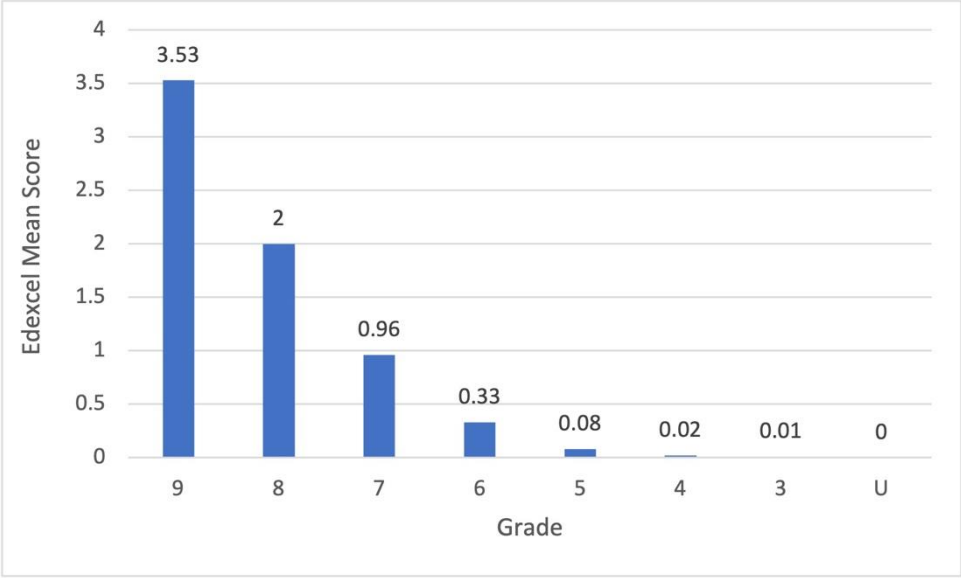
Question 24 - Examiner Comments

It was pleasing to see so many students attempting the final question on the paper. Higher attaining students usually made a good start by showing a correct method to find the critical values for at least one of the inequalities and often for both. Many factorised $4x^2 - 25$ and gained the first mark for $(2x + 5)(2x - 5)$. Those who rearranged it to $x^2 < 25/4$ often failed to complete the method by finding both the positive and negative square root. Inevitably, some errors (mostly sign errors) were made in the factorisation of $12 - 5x - 3x^2$ and those who rearranged the inequality to $3x^2 + 5x - 12 < 0$ tended to make fewer mistakes. After finding the critical values many students were not able to use them correctly to solve the inequalities. It was very common to see $x < -2.5$ and $x < 2.5$ for $4x^2 - 25 < 0$ and $x > -3$ and $x > \frac{4}{3}$ for

$12 - 5x - 3x^2 > 0$ with students using < or > to match the original inequality. Students were more successful in writing the solution to the first inequality, $-2.5 < x < 2.5$, than the solution to the second inequality. The latter was often given as $x < -3$ and $x > \frac{4}{3}$ rather than as $-3 < x < \frac{4}{3}$. Drawing a sketch of the curve helped some students but there were others who drew a correct sketch and were still unable to identify the relevant region. Furthermore, students who drew sketches often drew $y = 12 - 5x - 3x^2$ as if it were a positive quadratic which led them to deduce an incorrect critical region. Students who solved both inequalities correctly were often able to identify the set of possible values as $-2.5 < x < \frac{4}{3}$ and gain full marks. Some students gave the final answer as –2, –1, 0, 1 or used ≤ instead of < and lost the accuracy mark.

Question 24 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
0.81	5	16	0.81	3.53	2.00	0.96	0.33	0.08	0.02	0.01	0.00



Question 24 - Response A

24 Find the set of possible values of x for which

$$4x^2 - 25 < 0 \quad \textbf{and} \quad 12 - 5x - 3x^2 > 0$$

You must show all your working.

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

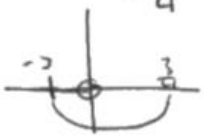
$x = \frac{2}{5}$ $\quad x = -\frac{2}{5}$

$12 - 5x - 3x^2$

$-\frac{2}{5} < 0 < \frac{2}{5}$

$(3x + 4)(x - 3)$

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



$-\frac{3}{4} < 0 < 3$

$-\frac{3}{4} < 0 < 3$

$-\frac{2}{5} < 0 < \frac{2}{5}$

(Total for Question 24 is 5 marks)

Q24

A B C

2 /5

M1 for (2x - 5)(2x + 5)

M1 (dep M1) for identifying correct region for their critical values, condoning use of O instead of x

M0: incorrect factorisation when finding the critical values of $12 - 5x - 3x^2 > 0$

M0: dependent on previous M1

A0: incorrect final answer

Note: when awarding M marks for factorising either quadratic, then the factorisation must be correct.

Question 24 - Response B

24 Find the set of possible values of x for which

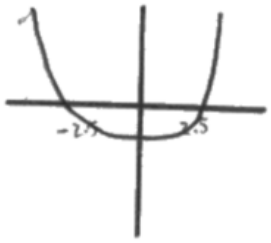
$$4x^2 - 25 < 0 \quad \textbf{and} \quad 12 - 5x - 3x^2 > 0$$

You must show all your working.

$(2x-5)(2x+5) < 0$

$x = \pm\frac{5}{2}$ $\quad x = \frac{5}{2} < 0$

-2.5 $\quad 2.5$



$-2.5 < x < 2.5$

$3x^2 + 5x - 12 < 0$

$3x - 12 = -36$

$(3x+9)(3x-4) < 0$

$(x+3)(3x-4) < 0$

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

$-3 < x < \frac{4}{3}$

$-2, -1, 0, 1$

(Total for Question 24 is 5 marks)

Q24

A B C

4 /5

M1 for method to find the critical values of $4x^2 - 25 < 0$

M1 for $-2.5 < x < 2.5$

M1 for method to find the critical values of $3x^2 + 5x - 12 < 0$

M1 for $-3 < x < 4/3$

A0 incorrect final answer

Question 24 - Response C

24 Find the set of possible values of x for which

$$4x^2 - 25 < 0 \quad \textbf{and} \quad 12 - 5x - 3x^2 > 0$$

You must show all your working.

$4x^2 - 25$ $(2x+5)(2x-5)$

$4x^2 + 10x - 10x - 25$

$-3x^2 - 5x + 12$

-36

6 6 4 9

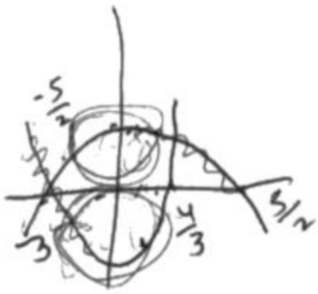
$-3x^2 - 9x + 4x + 12$

$-3x(x+3)\ 4(x+3)$ $x = \frac{-5}{2}$

$(x+3)(-3x+4)$ $x = \frac{5}{2}$ 2.5

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

1. -2.5



$-2.5 < x < \frac{4}{3}$

$3 \overline{)40}$ 1.39

$-2.5 < x < 1.3$

$-\frac{5}{2} < x < \frac{4}{3}$

(Total for Question 24 is 5 marks)

Q24 ? A B C

5 /5

M1 for method to find the critical values of $4x^2 - 25 < 0$

M1 for $-2.5 < x < 2.5$ implied by diagram (and by final answer)

M1 for method to find the critical values of $3x^2 + 5x - 12 < 0$

M1 for $-3 < x < 4/3$ implied by diagram (and by final answer)

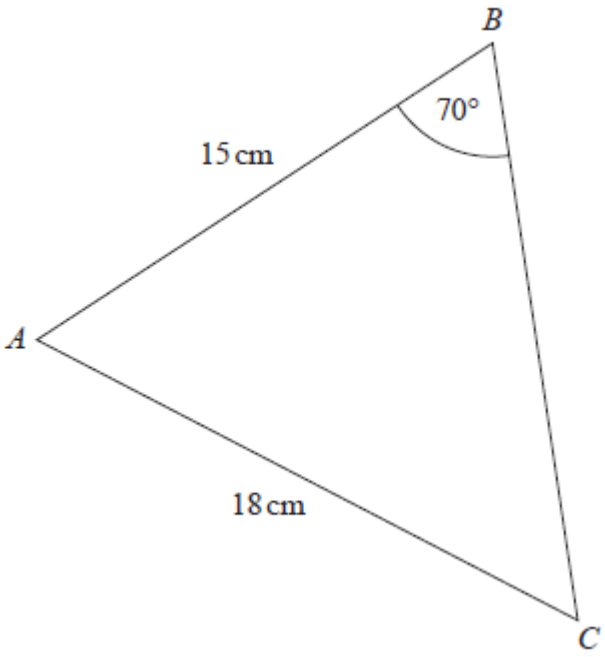
A1: correct final answer

Paper 2H - Question 13

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

Question 13- Question

13 *ABC* is a triangle.



Calculate the size of angle *BAC*.
Give your answer correct to 1 decimal place.

.....°

(Total for Question 13 is 4 marks)

Question 13- Mark Scheme

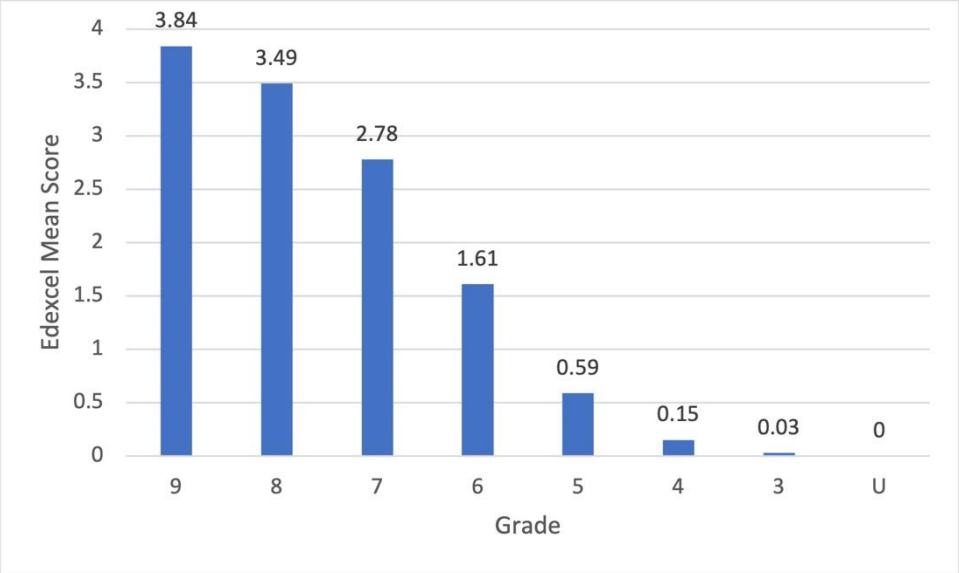
Question	Answer	Mark	Mark scheme	Additional guidance
13	58.5	P1	for start of process to find angle BCA, eg $\frac{18}{\sin 70} = \frac{15}{\sin BCA}$ or $\frac{\sin 70}{18} = \frac{\sin BCA}{15}$	Angle BCA must be correctly identified to gain marks $\sin 70 = 0.939\ldots$ $\sin 70 \div 18 = 0.052\ldots$ $18 \div \sin 70 = 19.1\ldots$
		P1	for rearrangement, eg $(\sin BCA =)\frac{15\sin 70}{18}$ $(= 0.783\ldots)$ oe **or** $BCA = 51.5...$	
		P1	for complete process to find angle BAC, eg $180 - 70 - \sin^{-1}\left(\frac{15\sin 70}{18}\right)$	
		A1	for answer in the range 58.4 to 58.5	If an answer is given in the range in working and then rounded incorrectly award full marks.

Question 13 - Examiner Comments

This trigonometry question proved to be a challenge for many as they either attempted to use the cosine rule to find the length *BC*, but substituted incorrectly, or they attempted the sine rule but incorrectly linked the side *AB* with the angle *BAC* rather than *ACB*. In all these cases candidates typically scored zero marks. We did see candidates though who were able to correctly use the sine rule to find *ACB* and those that did normally then gained the last 2 marks for a process to find *BAC* and a correct answer.
Greater care in labelling the sides and angles of the triangle prior to substitution into one of the formulae would have helped many to not make the mistakes they did. Some assumed the triangle was right angled and tried Pythagoras' theorem to find the missing side. Most candidates who used the correct method gained full marks - in these cases the working out tended to be neater and more logical than those who did not gain full marks.

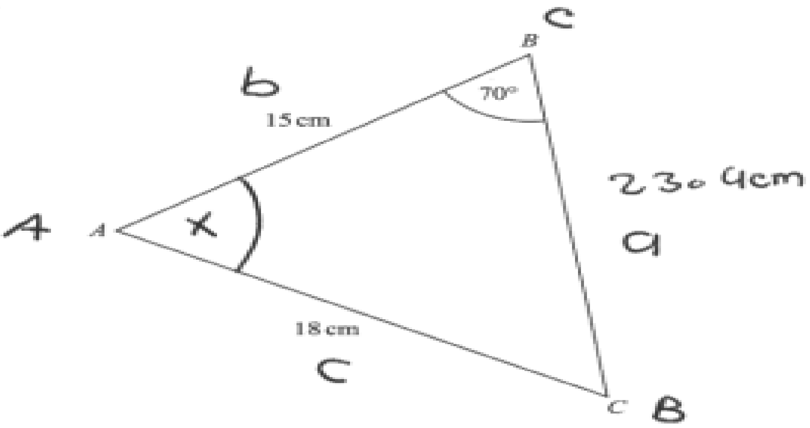
Question 13 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
1.79	4	45	1.79	3.84	3.49	2.78	1.61	0.59	0.15	0.03	0.00



Question 13- Response A

13 *ABC* is a triangle.



Calculate the size of angle *BAC*.
Give your answer correct to 1 decimal place.

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

$15^2 + 18^2 = c^2$

$225 + 324 = c^2$

$c^2 = 549$

$c = \sqrt{549} = 23.43$

$\frac{23.4}{\sin(23.4)} = 58.9201....$

$\frac{15}{\sin(15)} = 57.95554958$

$\frac{18}{\sin(18)} = 58.24922359$

Sine rule $= \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$\frac{18}{\sin(70)} = 19.1551999$

58.2

(Total for Question 13 is 4 marks)

0 /4

P0: there is no attempt to find angle BCA. 18/sin70 on its own is not enough working for the first process mark.

P0: no equation is given that can be rearranged.

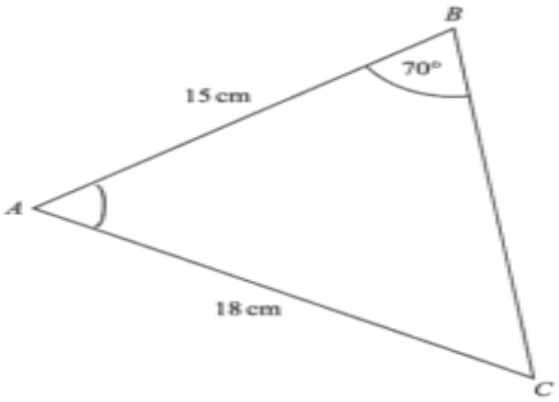
P0: no complete process to find the required angle.

A0: the answer is not in the given range.

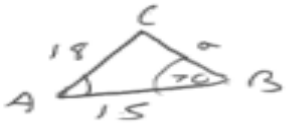
Note: Be careful of answers that are close to the correct one, the answer must come from correct working.

Question 13 - Response B

3 *ABC* is a triangle.



Calculate the size of angle *BAC*.
Give your answer correct to 1 decimal place.



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

$\frac{18}{\sin(70)} = 19.1551999$

$\frac{15}{\sin C} = 19.1551999$

$\frac{15}{19.1551999} = \sin C = 0.783077184$

2 /4

Q13

P1 for a correct start to find angle BCA. Accept if given as angle C.

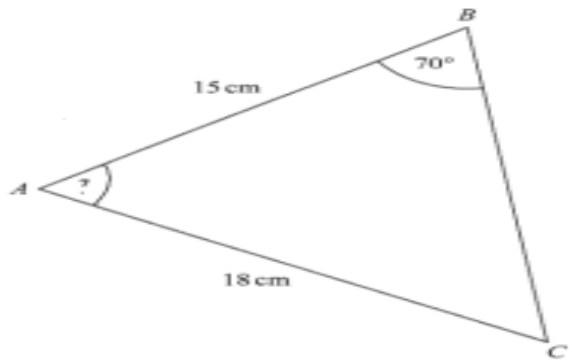
P1 for a correct rearrangement, (sin C) = 0.783.

P0: no attempt is made to find angle BAC.

A0: no final answer for angle BAC is given.

Question 13 - Response C

13 ABC is a triangle.



Calculate the size of angle BAC.
Give your answer correct to 1 decimal place.

$$\frac{18}{\sin(70)} = \frac{15}{\sin(?)}$$

$$18\sin(?) = 15\sin(70)$$

$$\sin(?) = \frac{15\sin(70)}{18}$$

$$\sin^{-1}\left(\frac{15\sin(70)}{18}\right) = \angle BCA \;/\; 51.543184\ldots$$

$$180 - 70 - \left(\sin^{-1}\left(\frac{15\sin(70)}{18}\right)\right)$$

$$= 58.956810\ldots$$

58.4 °

(Total for Question 13 is 4 marks)

4 /4

Q13

A
B
C

P1 P1 P1 for a complete process to find angle BAC.

A1: Although the answer is rounded incorrectly it is within the given range.
Note: The accuracy mark is awarded if the answer is given in the range in working and then rounded incorrectly or, as in this case, if the correct answer is given on the answer line which clearly comes from a correct expression but may not follow directly from the figures in their working.

'?' is used for angle BCA in working, which contradicts the labelling on the diagram - this would be 0 marks. However, student recovers this in later working by writing '...angle BCA', also seen by correct answer.

Paper 2H - Question 22

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

Question 22 - Question

22 There are only blue pens and red pens in a box.

The number of blue pens is four times the number of red pens.

Rita takes at random one pen from the box.
She records the colour of the pen and then replaces it in the box.
Rita does this n times, where $n \geq 2$

Write down an expression, in terms of n, for the probability that Rita gets a blue pen at least once and a red pen at least once.

.....

(Total for Question 22 is 2 marks)

Question 22 - Mark Scheme

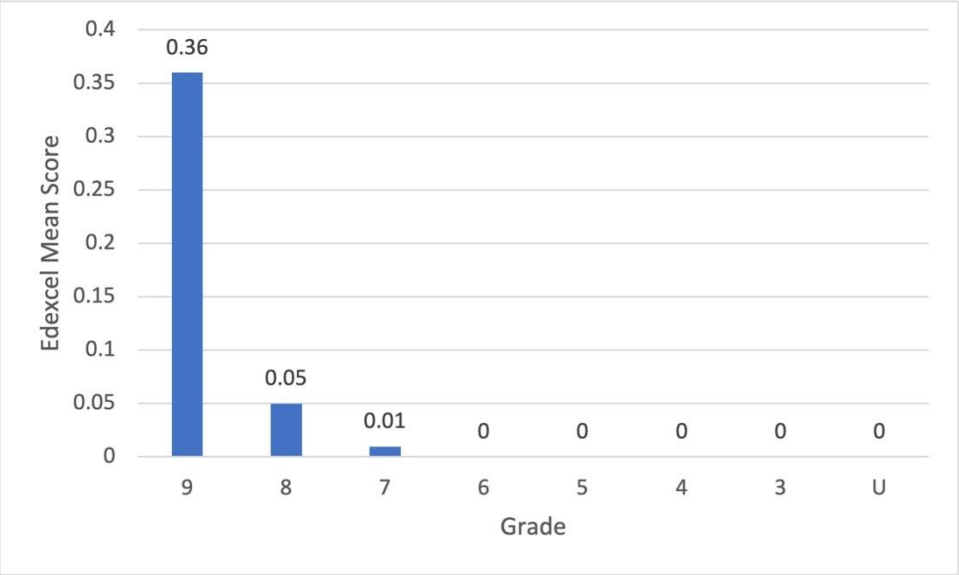
Question	Answer	Mark	Mark scheme	Additional guidance
22	$1-\left(\frac{4}{5}\right)^n-\left(\frac{1}{5}\right)^n$	P1	for start to the process, eg P(at least one blue and at least one red) = 1 – P(all blue) – P(all red) oe **or** P(all blue) = $\left(\frac{4}{5}\right)^n$ oe **or** P(all red) = $\left(\frac{1}{5}\right)^n$	
		A1	for $1-\left(\frac{4}{5}\right)^n-\left(\frac{1}{5}\right)^n$ oe	

Question 22 - Examiner Comments

Whilst only being 2 marks, this probability problem was probably found to be the hardest on the paper for students. Very few were able to gain any credit. To gain a single mark they had to either write an expression for getting all blue, or all red for *n* trials. It was this element that challenged students, with many giving examples for 2 or possibly 3 years, but not the generalisation that the mark scheme demanded, we did on occasion see elements such as $\frac{4}{5}^{n}$ but without the brackets, no credit could be given. A fully correct expression was needed for both marks, typically given as $1-\left(\frac{4}{5}\right)^{n}-\left(\frac{1}{5}\right)^{n}$ but also seen as $1-\frac{4^{n}+1}{5^{n}}$ which is a correct simplified form.

Question 22 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
0.04	2	2	0.04	0.36	0.05	0.01	0.00	0.00	0.00	0.00	0.00



Question 22 - Response A

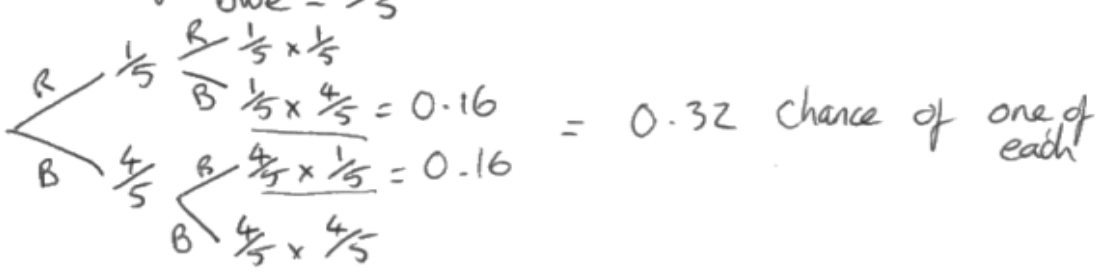
22 There are only blue pens and red pens in a box.

The number of blue pens is four times the number of red pens. 4 : 1

Rita takes at random one pen from the box.
She records the colour of the pen and then replaces it in the box.
Rita does this n times, where $n \geqslant 2$

Write down an expression, in terms of n, for the probability that Rita gets a blue pen at least once and a red pen at least once.

Probability of red = $\frac{1}{5}$
blue = $\frac{4}{5}$



= 0.32 chance of one of each

(Total for Question 22 is 2 marks)

0 /2

P0: no sight of $(4/5)^n$ or $(1/5)^n$

A0: incorrect answer

Note: We must see a general form, with n included, to award any marks.

Q22
A
B
C

Question 22 - Response B

22 There are only blue pens and red pens in a box.

The number of blue pens is four times the number of red pens.

Rita takes at random one pen from the box.
She records the colour of the pen and then replaces it in the box.
Rita does this n times, where $n \geqslant 2$

Write down an expression, in terms of n, for the probability that Rita gets a blue pen at least once and a red pen at least once.

$\frac{4}{5}b$ $\frac{1}{5}R$

$b = 4R$

$\frac{8}{10}b$ $\frac{2}{10}R$

$n = \left(\frac{4}{5}\right)^n + \left(\frac{1}{5}\right)^n$

$n = \left(\frac{4}{5}\right)^n + \left(\frac{1}{5}\right)^n$

(Total for Question 22 is 2 marks)

1 /2

P1 for $(4/5)^n$ or $(1/5)^n$

A0 incorrect answer

Q22

A
B
C

Question 22 - Response C

22 There are only blue pens and red pens in a box.

The number of blue pens is four times the number of red pens.

Rita takes at random one pen from the box.
She records the colour of the pen and then replaces it in the box.
Rita does this n times, where $n \geqslant 2$

Write down an expression, in terms of n, for the probability that Rita gets a blue pen at least once and a red pen at least once.

$b = 4r$ $\quad n = 2$

$b + r = 5r \quad 2 \times \frac{4}{5} \times \frac{1}{5} = \frac{8}{25}$

$n = 3$

$1 - \frac{4}{5}^3 - \frac{1}{5}^3$

$1-\left(\frac{4}{5}\right)^n-\left(\frac{1}{5}\right)^n$

$1-\left(\frac{4}{5}\right)^n-\left(\frac{1}{5}\right)^n$

(Total for Question 22 is 2 marks)

2 /2

Q22

A
B
C

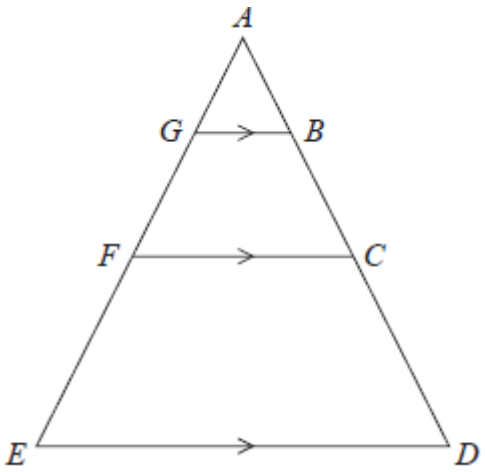
P1 for $(4/5)^n$ or $(1/5)^n$.
Note: 'P(all blue)' or 'P(all red)' does not need to be stated for this mark to be awarded.

A1 correct answer
Note: Incorrect further simplification can be ignored (isw) once the correct answer seen.

Paper 2H - Question 23

Question 23 - Question

23 Here are three similar triangles, *ABG*, *ACF* and *ADE*.



ABCD and *AGFE* are straight lines.

AB : *BC* : *CD* = 1 : 2 : 3

Show that

area of *ABG* : area of *BCFG* : area of *CDEF* = 1 : 8 : 27

(Total for Question 23 is 3 marks)

Question 23 - Mark Scheme

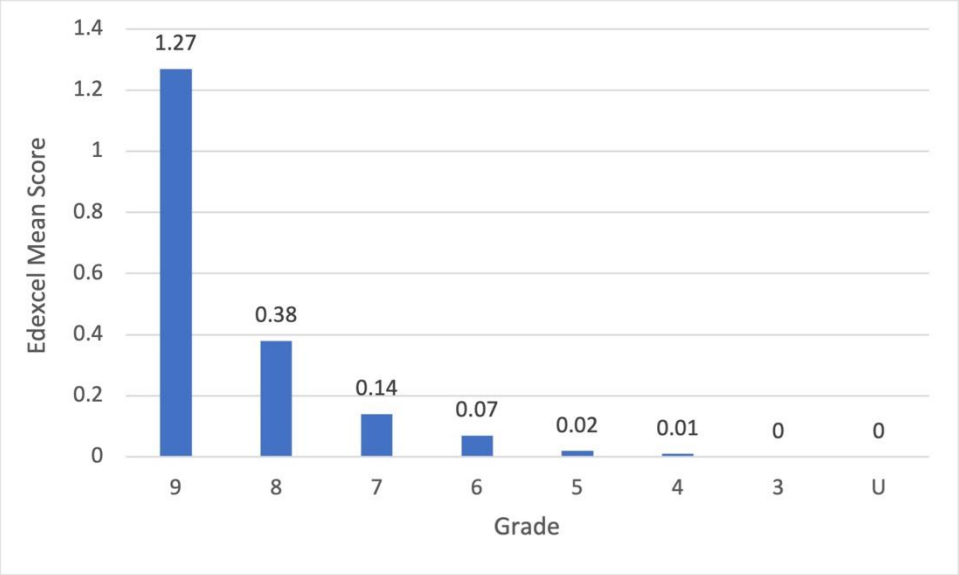
Question	Answer	Mark	Mark scheme	Additional guidance
23	Shown	M1	for start to process using ratio, eg 1 : 1 + 2 : 1 + 2 + 3 (= 1 : 3 : 6)	Values may not be seen in a ratio, can still award M marks May be seen combined with algebra
		M1	for process to write down ratio of areas of triangles eg $1^2 : 3^2 : 6^2$ (= 1 : 9 : 36)	
		C1	for correct working leading to answer, eg 1 : 9 – 1 : 36 – 9 = 1 : 8 : 27	

Question 23 - Examiner Comments

Many candidates were caught out but the relatively familiar figures of 1, 8 and 27, and thought they had to work with cubing numbers. However, candidates had to find the length scale factor of the 3 triangles from the given ratio as 1:3:6 to gain the first mark, whereas many worked with the 1:2:3. Once they had the correct ratio of lengths they could then work out the correct ratio of areas for the 3 triangles to get 1:9:36. From here they had to work out the ratio of the areas of the 3 shapes, 2 of which were trapezia not triangles. There were a number of excellent responses, some working as above and others working nicely with algebra. There were also a number of candidates that gave lengths to the parallel sides and perpendicular height and worked correctly with areas.

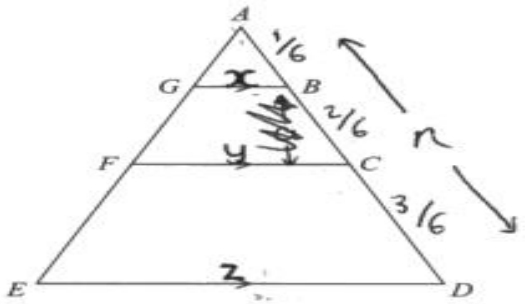
Question 23- Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
0.19	3	6	0.19	1.27	0.38	0.14	0.07	0.02	0.01	0.00	0.00



Question 23 - Response A

23 Here are three similar triangles, *ABG*, *ACF* and *ADE*.



ABCD and *AGFE* are straight lines.

AB : *BC* : *CD* = 1 : 2 : 3

Show that

area of *ABG* : area of *BCFG* : area of *CDEF* = 1 : 8 : 27

~~area ABG = 1/6 AD × ED × 1/2 = 1/12 (n × 2)~~

~~area BCFG = 1/2 (AB + x + y) × a~~

AB = 1/6 AD

BC = 2/6 AD

CD = 3/6 AD

~~(1/6)³~~ 1/6 : 2/6 : 3/6

$1^3 : 2^3 : 3^3$

= 1 : 8 : 27

Q23

0 /3

M0: 1, 3, 6 not seen.

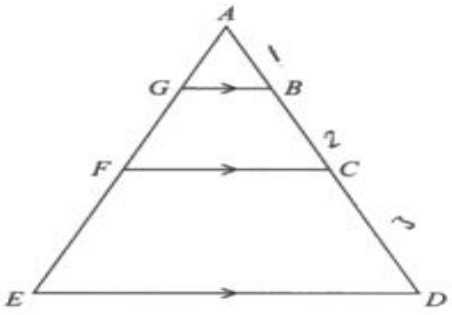
M0: No attempt to write down ratio of areas.

A0: no further work

NB: It is not enough for the first M1 to simply show fractions 1/6, 2/6 and 3/6 or a ratio 1:2:3
A common incorrect method is cubing the given ratio 1:2:3 to reach the correct answer 1:8:27. This gains no marks.

Question 23 - Response B

23 Here are three similar triangles, *ABG*, *ACF* and *ADE*.



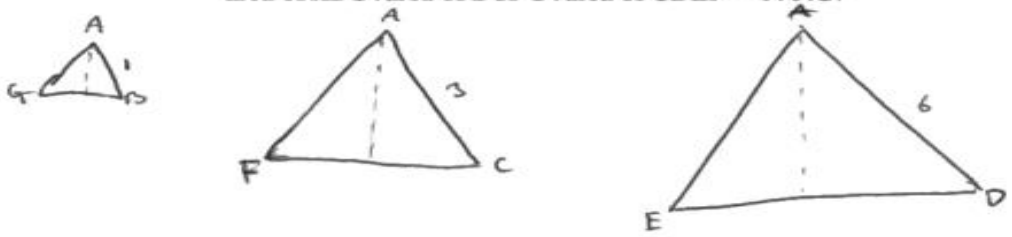
ABCD and *AGFE* are straight lines.

area = b×h / 2

AB : *BC* : *CD* = 1 : 2 : 3

Show that

area of *ABG* : area of *BCFG* : area of *CDEF* = 1 : 8 : 27



1 /3

M1: 1, 3, 6 seen

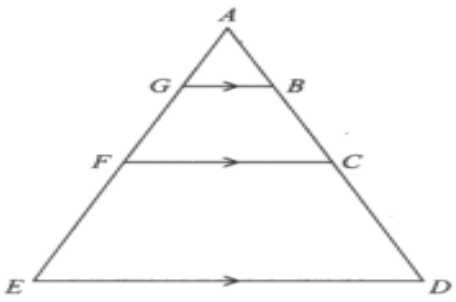
M0 : No method used to find areas.

C0: Correct answer not seen.

Note: 1x, 3x, 6x or 1, 3, 6 seen in a calculation would also get M1. If correct algebraic method seen, this can gain full marks.

Question 23- Response C

23 Here are three similar triangles, ABG, ACF and ADE.



$ABCD$ and $AGFE$ are straight lines.

$AB : BC : CD = 1 : 2 : 3$

Show that

area of ABG : area of $BCFG$: area of $CDEF = 1 : 8 : 27$

AB = 1 arbitrary unit

AC = 1 + 2 au = 3 au

AD = 1 + 2 + 3 = 6 au

area of ABG = 1 unit²

area of BCFG = area of ACF − area of ABG

9 unit² − 1 unit² = 8 unit²

area of CDEF = area of AED − area of AFC

= 36 unit² − 9 unit²

= 27 unit²

∴ ABG : BCFG : CDEF = 1 : 8 : 27

(Total for Question 23 is 3 marks)

Q23

A
B
C

3 /3

M1: 1, 3, 6 seen in reference to lengths.

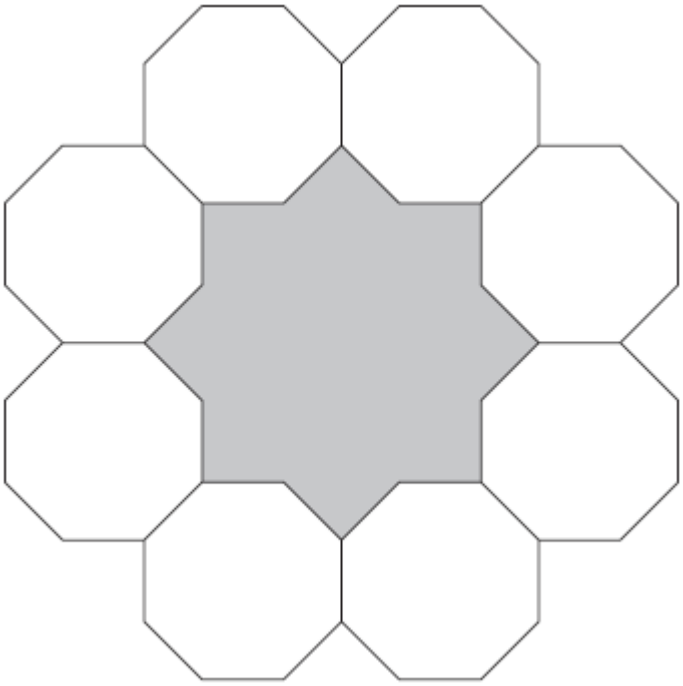
M1: 1, 9, 36 seen in reference to areas.
Note: values do not need to be seen in a ratio, or explicitly identified as lengths or areas for M marks.

C1: correct manipulation to show correct answer as a ratio.

Paper 2H - Question 24

Question 24 - Question

24 The diagram shows 8 identical regular octagons joined to enclose a shaded shape.



Each octagon has sides of length a.

Find, in terms of a, an expression for the area of the shaded shape.

Give your answer in the form $p\left(2+\sqrt{2}\right)a^2$ where p is an integer.

You must show all your working.

.....

(Total for Question 24 is 5 marks)

Question 24 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
24	$4\left(2+\sqrt{2}\right)a^2$	P1	for process to find area required and identifying 135° or 45° or 90° angle(s), eg splitting shape into square and 4 triangles and an angle relevant to the triangle clearly identified.	90° must be in a triangle to gain credit. May be seen on diagram.
		P1	for process to find the area of a relevant triangle using 45°, eg $\frac{1}{2}\times a\times\left(2\times\frac{a}{\sqrt{2}}\right)\times\frac{1}{\sqrt{2}}$ $\left(=\frac{a^2}{2}\right)$ or using 90°, eg $\frac{1}{2}\times a\times a$ $\left(=\frac{a^2}{2}\right)$ or process to find the area of a square made from 2 small triangles, eg $a\times a\ (=a^2)$	Accept $0.49\ldots a^2$ May be seen as the area of 2 squares (from 4 small triangles)
		P1	for process to find the length of the square, eg $a+a+\sqrt{a^2+a^2}\ (=2a+a\sqrt{2})$	Accept $3.41a$
		P1	for process to find the total area, eg $(\text{"}2a+a\sqrt{2}\text{"})^2+4\times\text{"}\frac{a^2}{2}\text{"}$	Accept $(11.655+4\times0.49)\,a^2$
		A1	(dep on P3) for $4\left(2+\sqrt{2}\right)a^2$	Answer only award no marks. If working in decimals accept $\frac{13.656}{2+\sqrt{2}}$ leading to 4 Accept $p = 4$ if supported by correct working

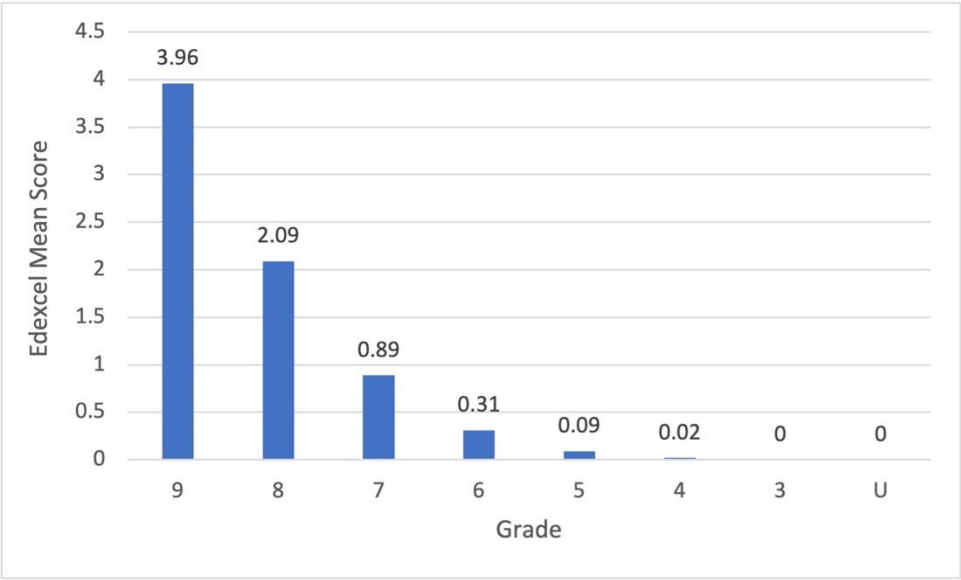
Q24
A
B
C

Question 24 - Examiner Comments

The final question on the paper was a challenging shape problem requiring candidates to find an expression for the area of an unfamiliar shape. The most common approach was to split the shape into a square and 4 identical triangles. By doing this and correctly identifying an angle inside or outside of the triangle, candidates were able to gain the first mark. To gain the second and third they needed an expression for the area of one of the triangles, or the length of the side of the square. The former was awarded more regularly, as many spotted that the triangles were right-angles and isosceles. The length of the square proved more challenging as it involved using Pythagoras and surds. The final process mark was to put it altogether to form an expression for the total area, before simplifying it to the given form. Although there were some excellent responses, some candidates were let down by the accuracy of their algebra, and we also saw candidates guessing the value of *p*, but without supporting algebra, this gained no credit. A successful method seen, other than the square and four triangles split, was to split the shape into 8 triangles, 2 trapezia and 1 rectangle. Several responses started with finding the hypotenuse of the small triangle or the area but did not get beyond this. There was evidence that candidates were not very confident at manipulating numbers inside a square root. Some had trouble with simplifying $\sqrt{2a^2}$ to $a\sqrt{2}$ after using Pythagoras theorem to find the length of the hypotenuse of the small triangle.
If candidates did correctly expand the expression for the area of the square and added on the triangle areas, they were usually able to work backwards from the final answer to rearrange their expression correctly.

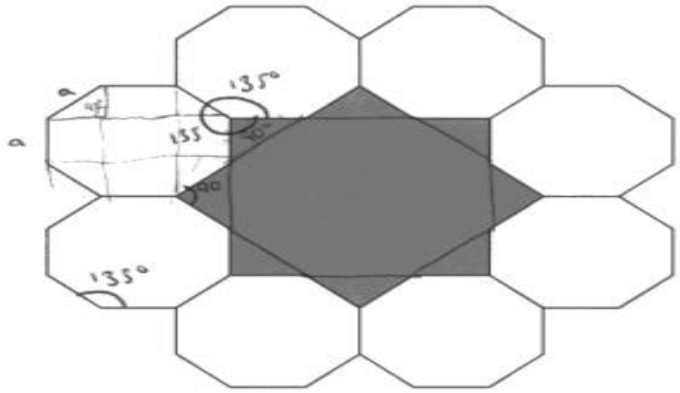
Question 24 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
0.84	5	17	0.84	3.96	2.09	0.89	0.31	0.09	0.02	0.00	0.00



Question 24 - Response A

24 The diagram shows 8 identical regular octagons joined to enclose a shaded shape.



Each octagon has sides of length a.

Find, in terms of a, an expression for the area of the shaded shape.
Give your answer in the form $p(2+\sqrt{2})a^2$ where p is an integer.
You must show all your working.

Sum of angle = $8-2=6\times180=1080$

1 angle = 135°

$135+135=270°$

$360-270=90°$

~~area of triangle = $\frac{1}{2}ab\sin C$~~

$180-90=90\div2=45$ area of triangle

length a = 1080 -

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

$\sqrt{c}=$

Q24

A B C

1 /5

P1 for splitting shape into square and triangles with angles identified.
NB: check diagram for any working and angles.

P0: no attempt to find area of triangle.

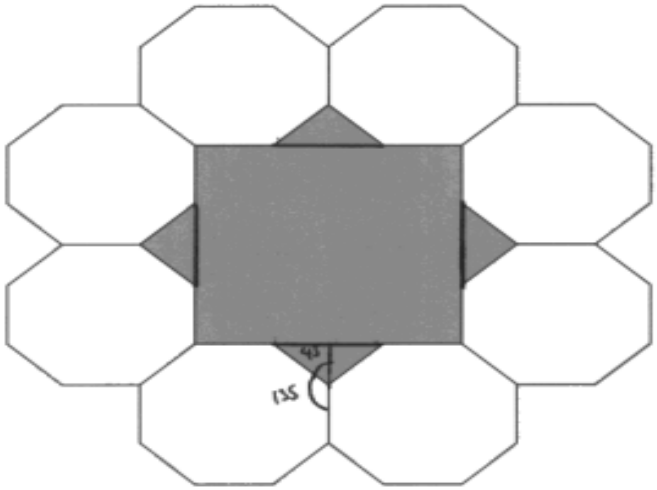
P0: no attempt to find length of square.

P0: no attempt to find total area.

A0: incorrect answer

Question 24 - Response B

24 The diagram shows 8 identical regular octagons joined to enclose a shaded shape.



Each octagon has sides of length a.

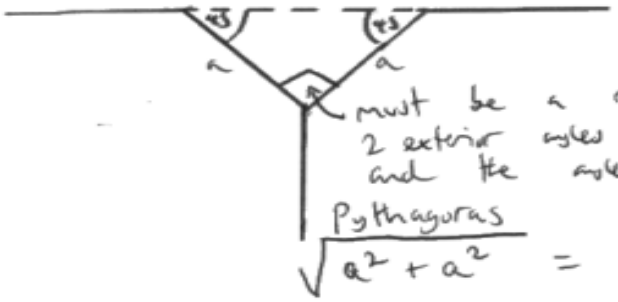
Find, in terms of a, an expression for the area of the shaded shape.
Give your answer in the form $p(2+\sqrt{2})a^2$ where p is an integer.
You must show all your working.

Sum of Interior angle of octagon $= (n-2) \times 180° = 1080°$

~~Exterior angle~~ Interior angle $= \frac{1080}{8} = 135°$

Sum of exterior angles $= 360°$

Exterior angle $= \frac{360°}{8} = 45°$



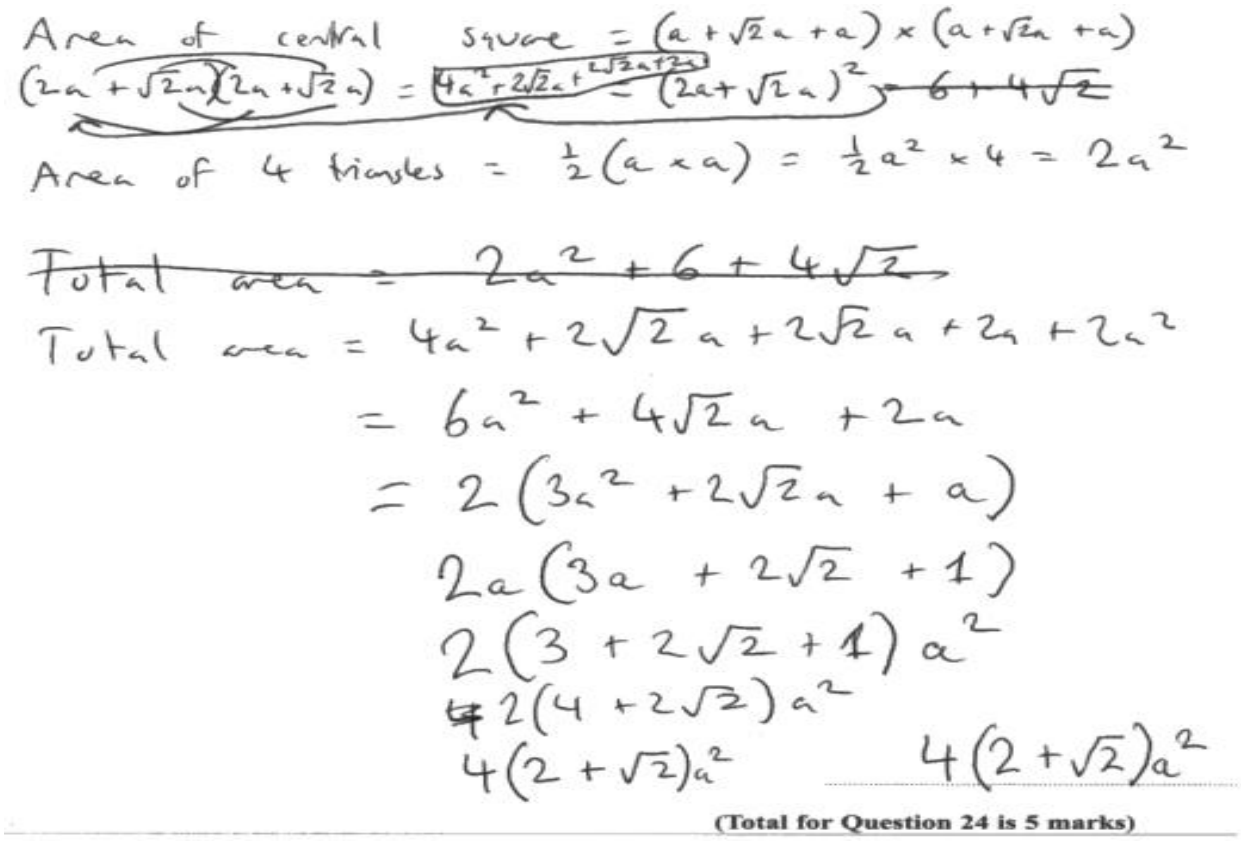
must be a right angle due to 2 exterior angles adding up to 90° and the angles of a triangle adding up to 180°

Pythagoras

$\sqrt{a^2 + a^2} = \sqrt{2}\,a$

Q24

A
B
C



(Total for Question 24 is 5 marks)

4 /5

Q24

P1 to split into square and triangles with angles given.

P1 for process to find area of triangle.

P1 for finding the correct length of square.

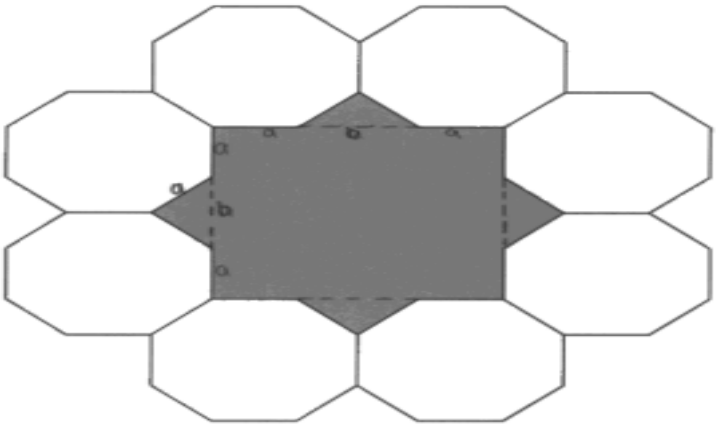
P1 for process to find the total area.

A0: correct answer but from incorrect working for the area of the square

NB: correct answer on answer line does not mean full marks, method must be checked carefully. All algebra must be correct to award the accuracy mark.

Question 24 - Response C

24 The diagram shows 8 identical regular octagons joined to enclose a shaded shape.



Each octagon has sides of length a.

Find, in terms of a, an expression for the area of the shaded shape.
Give your answer in the form $p(2+\sqrt{2})a^2$ where p is an integer.
You must show all your working.

triangle $= \frac{a \times a}{2} = \frac{1}{2}a^2$

4 triangles $= \frac{1}{2}a^2 \times 4 = 2a^2$

Square

~~rectangle 3a~~

~~Area B 3a~~

$2a + b$

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

$b = \sqrt{2a^2} = \sqrt{2} \times a$

$= a\sqrt{2}$

area $= (2a + a\sqrt{2})^2$

Q24

A
B
C

$(2a + a\sqrt{2})^2$

$(2a + a\sqrt{2}) \times (2a + a\sqrt{2})$

$4a^2 + 2a^2\sqrt{2} + 2a^2\sqrt{2} + 2a^2$

$6a^2 + 4a^2\sqrt{2}$ = area of square

shape area

$6a^2 + 4a^2\sqrt{2} + 2a^2$

$= 8a^2 + 4a^2\sqrt{2}$

$= (8 + 4\sqrt{2})a^2$

$= 4(2 + \sqrt{2})a^2$

$4(2+\sqrt{2})a^2$

(Total for Question 24 is 5 marks)

Q24

5 /5

P1 for splitting shape into square and triangles
NB although angles are not indicated, sight of a correct length or area indicates correct angles used.

P1 for process to find area of triangles.

P1 for process to find length of square.

P1 for process to find total area.

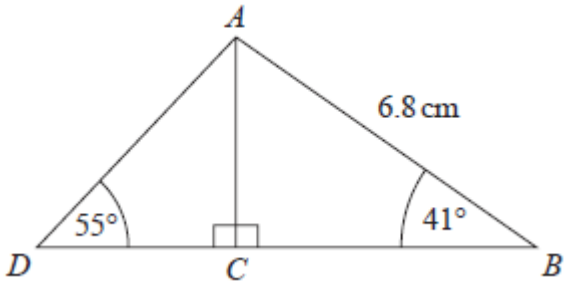
A1 for correct answer

Paper 3H - Question 10

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

Question 10 - Question

10 *ABD* is a triangle.
C is a point on *BD*.



Work out the length of *DC*.
Give your answer correct to 1 decimal place.

..... cm

(Total for Question 10 is 3 marks)

Question 10 - Mark Scheme

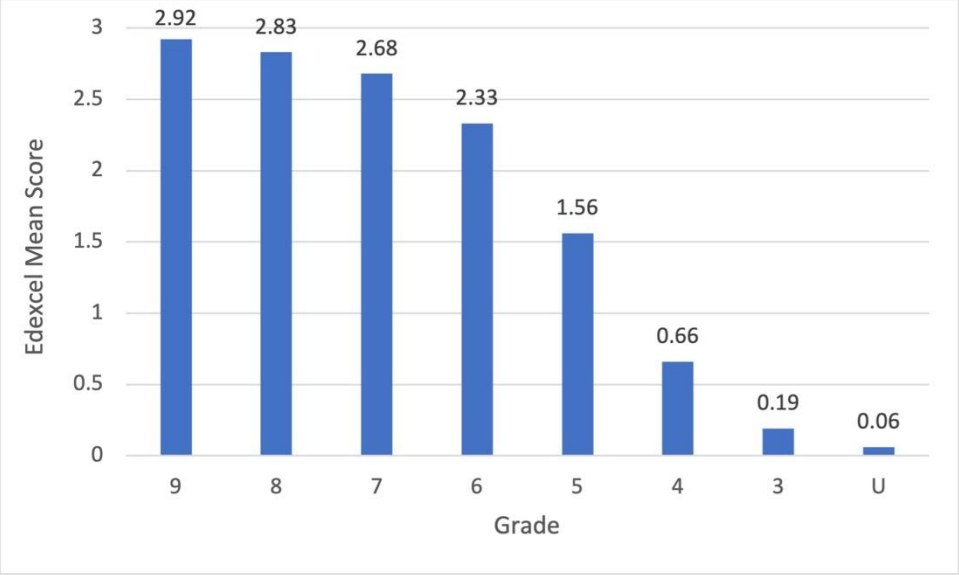
Question	Answer	Mark	Mark scheme	Additional guidance
10	3.1	P1	for using sin to find length of *AC*, eg 6.8 × sin 41 **or** a full process to find *AC* or (*AC* =) 4.46... **or** a full process to find *AD* or (*AD* =) 5.44…	Accept rounded or truncated figures.
		P1	for a complete process to find a relationship involving *DC* eg tan 55 = $\frac{\text{"4.46..."}}{DC}$ or (*DC* =) $\frac{\text{"4.46..."}}{\tan 55}$ **or** cos 55 = $\frac{DC}{\text{"5.44..."}}$	
		A1	answer in the range 3.1 to 3.2	If a correct answer within the range is shown in working but is incorrectly rounded, award full marks.

Question 10 - Examiner Comments

A good discriminator, this question tested trigonometry within the context of right-angled triangles. Higher attaining students found the question to be routine but it also gave most students the opportunity to apply their knowledge and skills to show a process or processes to find the length of *AC* as an intermediate stage. A high proportion of students got this far. Many students were also able to progress to find a relationship involving *DC*, for example tan 55 = $\frac{4.46}{DC}$ so scored the second mark. Fewer students could rearrange the relationship to get "*DC* =" so could not obtain the final accuracy mark. A common sense check that the length of *DC*, often calculated as 6.4, should be less than the length of *AC* may have alerted some students to the error made at this stage. A small minority of students used the sine rule as an alternative approach, sometimes, finding the length of *AD* as a first step. This was, of course acceptable for the award of the first mark. These students sometimes then progressed to get a correct answer by using right-angled triangle trigonometry and/or Pythagoras' rule. A significant number of students lost the final accuracy mark because they rounded too much earlier in their working.

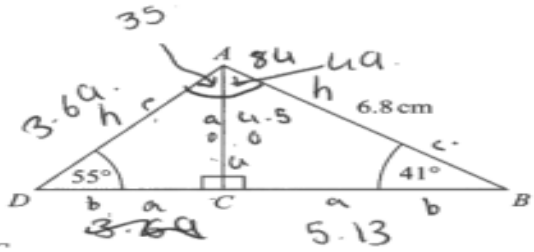
Question 10 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
2.08	3	69	2.08	2.92	2.83	2.68	2.33	1.56	0.66	0.19	0.06



Question 10 - Response A

10 *ABD* is a triangle.
C is a point on *BD*.



Work out the length of *DC*.
Give your answer correct to 1 decimal place.

Start

$\cos 41 = 0.75$
$4 \times 6.8 = 5.13$

$a^2 + b^2 = c^2$
$5.13^2 + x^2 = 6.8^2$
$x^2 = 6.8^2 - 5.13^2$
$x^2 = 19.9231$
$x = 4.5$

$\sin(55) = 0.8$
$4 \times 4.5 = 3.69$

$a^2 + b^2 = c^2$
$4.5^2 + x^2 = 3.64^2$
$x^2 = 8.69^2 - 4.5^2$
$x^2 = -4.5684$
$x = 2.1$

2.1 cm

4.463524aa93

(Total for Question 10 is 3 marks)

1 /3

P1 awarded for a full and correct process (though not a direct method) to find the length of AC. The student has found BC first then used Pythagoras' rule to find AC. Alternative methods may be seen and would be duly credited.

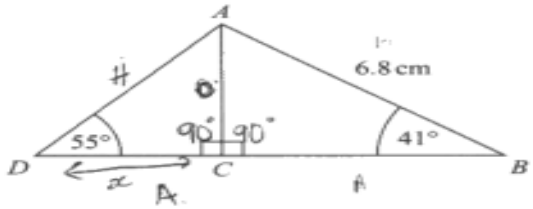
P0 awarded for an incorrect process to find DC. 4.5 x sin 55 is not a correct method to find AD.

A0: incorrect final answer.

s

Question 10 - Response B

10 *ABD* is a triangle.
C is a point on *BD*.



Work out the length of *DC*.
Give your answer correct to 1 decimal place.

$S = \frac{O}{H}$

$\sin = \frac{x}{6.8}$

$6.8 \sin(41)^\circ = x$

$AC = 4.4612$

$\tan = \frac{O}{A}$

$\tan(55) = \frac{4.4612}{x}$

$4.4612 \tan(55)$

6.37125

6.4 cm

(Total for Question 10 is 3 marks)

2 /3

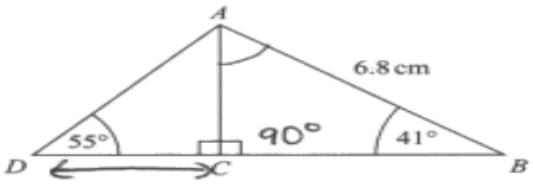
P1 awarded for using sin to correctly find AC.

P1 awarded for a correct relationship involving DC. This student has used *x* in their working for both *AC* and *DC* but they replaced the first one with *AC* = … and the diagram unambiguously shows that *x* is used for *DC*.

A0 awarded for an incorrect answer.

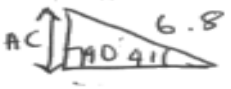
Question 10 - Response C

10 *ABD* is a triangle.
C is a point on *BD*.



Work out the length of *DC*.
Give your answer correct to 1 decimal place.

$\frac{6.8}{\sin(90)} = \frac{AC}{\sin(41)}$

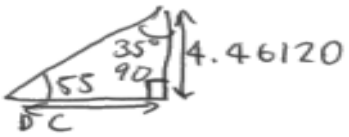


$\frac{6.8\sin(41)}{\sin(90)} = AC$

$4.46120139\frac{7}{5} = AC$

$55 + 90 = 145$

$180 - 145 = 35°$



$\frac{DC}{\sin(35)} = \frac{4.46120139\frac{7}{5}}{\sin(55)}$

$DC = \frac{4.46\sin(35)}{\sin(55)}$

$DC = 3.123766848$

3.1 (1dp)

3.1 cm

(Total for Question 10 is 3 marks)

3 /3

P1 awarded for a full process using the sine rule to find the length of AC. Sight of 4.46....would be enough to award the first process mark.

P1 awarded for a complete process using the sine rule to find a relationship involving DC in line 6, "DC/sin(35) = ..."

A1 awarded for an answer in the range 3.1 to 3.2.

Q10
A
B
C

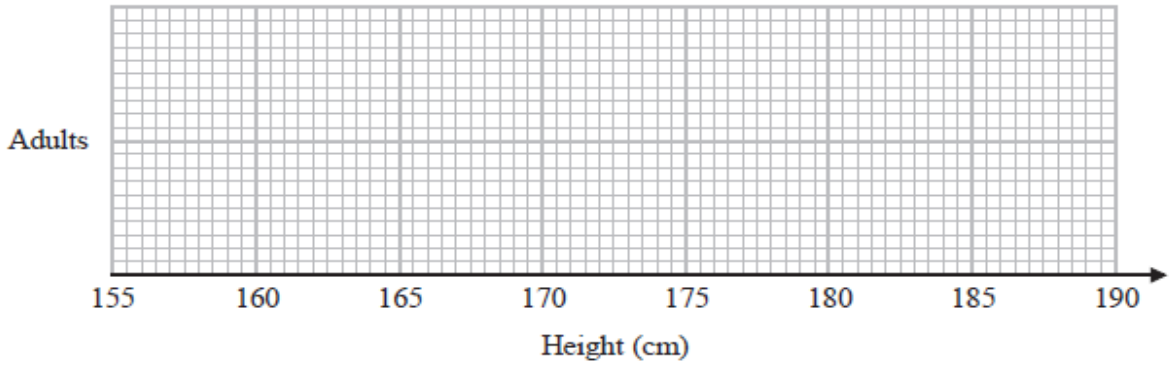
Paper 3H - Question 11

Question 11 - Question

11 The table shows some information about the heights of a group of adults.

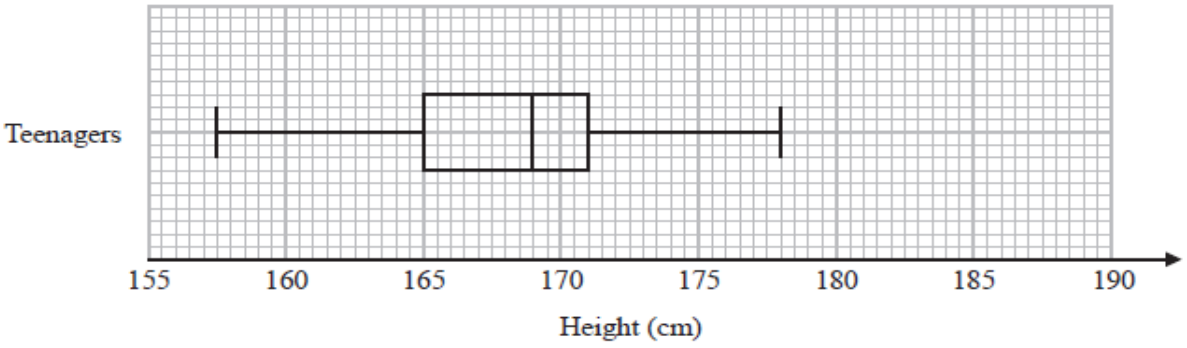
least height	169 cm
greatest height	186 cm
median	177 cm
lower quartile	174 cm
upper quartile	180 cm

(a) On the grid, draw a box plot for the information in the table.



(3)

The box plot below shows the distribution of the heights of a group of teenagers.



(*b*) Compare the distribution of the heights of the adults with the distribution of the heights of the teenagers.

(2)

(Total for Question 11 is 5 marks)

Question 11 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
11 (a)	Box plot	B3	for fully correct box plot	Box can be of any height. Accept ends that are marked (eg line, cross, dot) or defined by the end of the whiskers if clear
		(B2	for box plot showing a box and whiskers and at least 3 correctly plotted values from 169, 174, 177, 180, 186)	
		(B1	for at least 2 correctly plotted values including a box or whiskers)	
11 (b)	Comparisons	C1	(ft) for a correct comparison of medians, eg the median for Adults is greater than the median for Teenagers or the Teenagers heights are lower in general as the median is lower	For 2 marks, at least one comparison must be in context (eg refers to heights or cm). Simply quoting values for median and range and IQR is insufficient, they must be compared
		C1	(ft) for a correct comparison of a measure of spread, eg the interquartile (range) of the Adults is the same as (similar to) the IQR of the Teenagers, the range of the Teenagers is greater than the range of the Adults Comparisons for this mark can relate to the range or the IQR.	Median Range IQR Adults 177 17 6 Teenagers 169 20.5 6 Figures need not be seen but if given they must be correct.

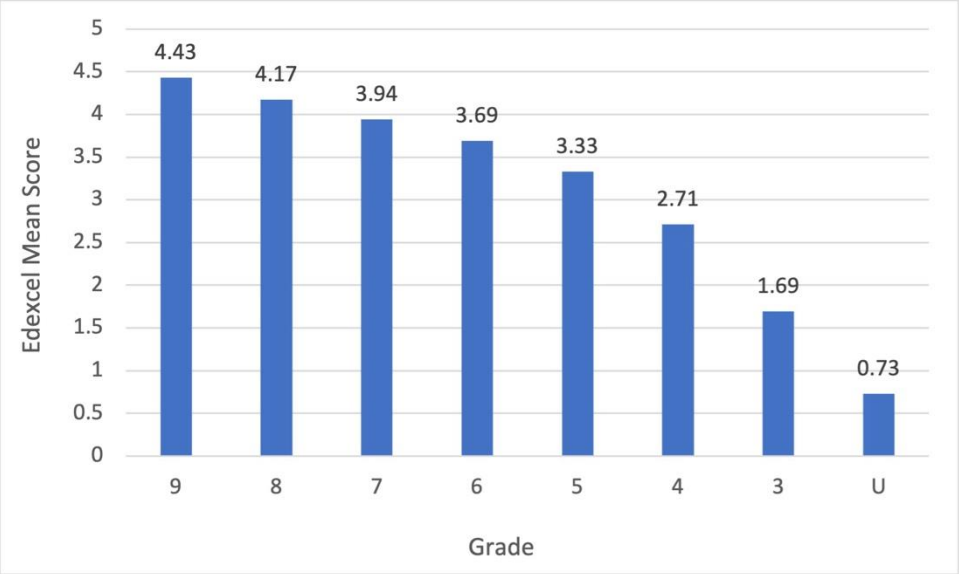
Question 11 - Examiner Comments

This question was generally well answered with most students scoring 3 marks for a correctly drawn box plot and at least 1 mark for a correct comparison of the two distributions. The main error seen by examiners in part (a) was a misinterpretation of the scale. Unfortunately, these usually led to students drawing a diagram with only one correct measure plotted and so no marks could be awarded. In part (b), examiners expected to see a comparison of the medians and either the ranges or the interquartile ranges with specific reference to the measure used. A comparison of, for example, the greatest heights was not acceptable. This is a topic that would benefit from more emphasis at centres. Some students merely stated values without comparing them. For example, "the median for adults = 177 whereas the median for teenagers = 169" cannot be given any credit but "the median for adults is greater than the median for teenagers" can be. It should also be noted that there is no need to give values in the comparisons but, if they are given, they must be correct. Students

quite often failed to refer to the context of the question and so restricted themselves to the award of only one of the two marks available.

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
3.62	5	72	3.62	4.43	4.17	3.94	3.69	3.33	2.71	1.69	0.73

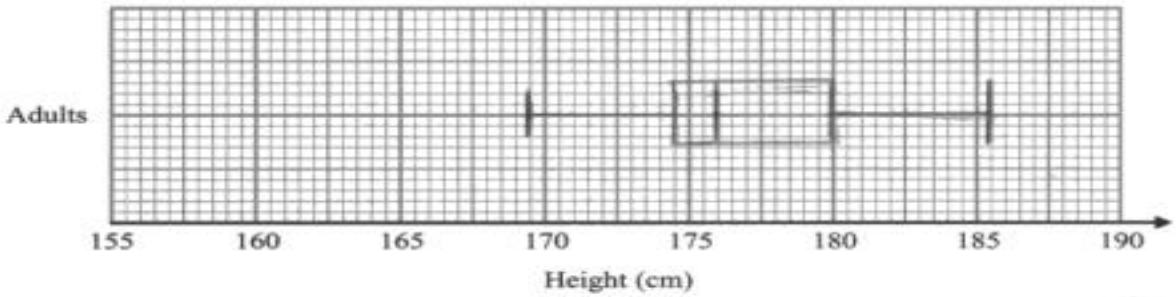


Question 11 - Response A

11 The table shows some information about the heights of a group of adults.

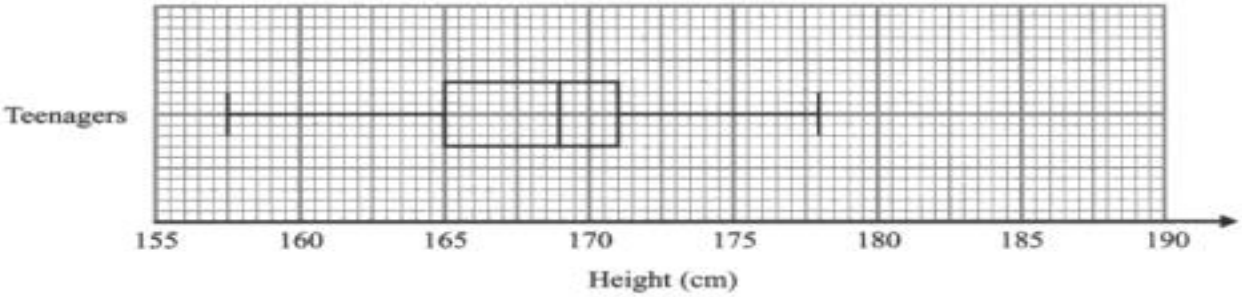
least height	169 cm
greatest height	186 cm
median	177 cm
lower quartile	174 cm
upper quartile	180 cm

(a) On the grid, draw a box plot for the information in the table.



(3)

The box plot below shows the distribution of the heights of a group of teenagers.



(b) Compare the distribution of the heights of the adults with the distribution of the heights of the teenagers.

the adults have a higher maximum and minimum point than the teenagers which means they have a lower median

(2)

(Total for Question 11 is 5 marks)

0 /5

Part (a)
B0 as there is only 1 value (180) plotted correctly. The student has not interpreted the scale correctly.

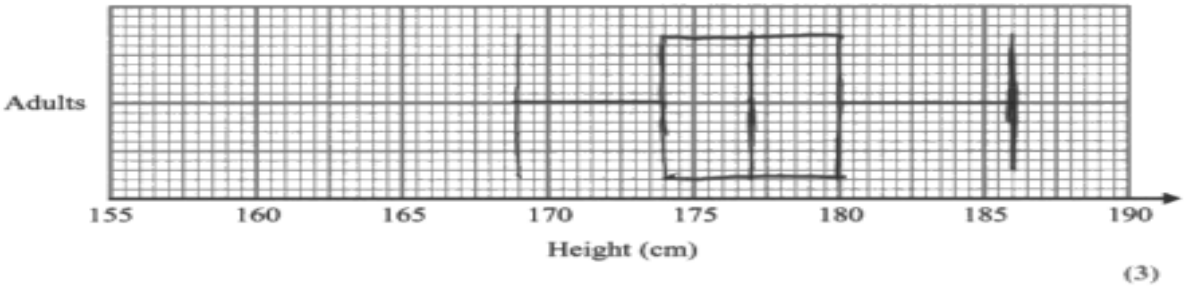
Part (b)
C0 C0 as the statement is ambiguous/unclear and the reasoning incorrect.

Question 11 - Response B

11 The table shows some information about the heights of a group of adults.

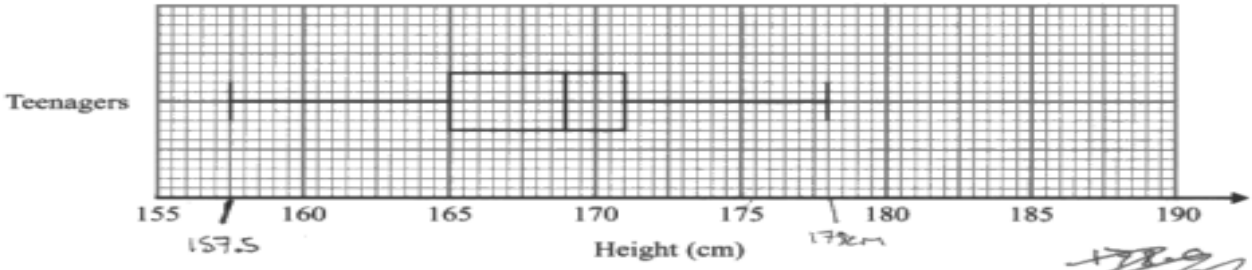
least height	169 cm
greatest height	186 cm
median	177 cm
lower quartile	174 cm
upper quartile	180 cm

(a) On the grid, draw a box plot for the information in the table.



(3)

The box plot below shows the distribution of the heights of a group of teenagers.



(b) Compare the distribution of the heights of the adults with the distribution of the heights of the teenagers.

The Difference between the smallest adult and tallest adult is 17 cm, whereas the difference between the smallest teenager and tallest teenager is 20.5 cm.

3 /5

Part (a)
B3 for a fully correct box and whisker diagram.

Part (b)
C0 C0 because there are no comparisons made by using words/phrases such as "is greater than", "is less than" or "is the same as". The statement made is correct but not enough.

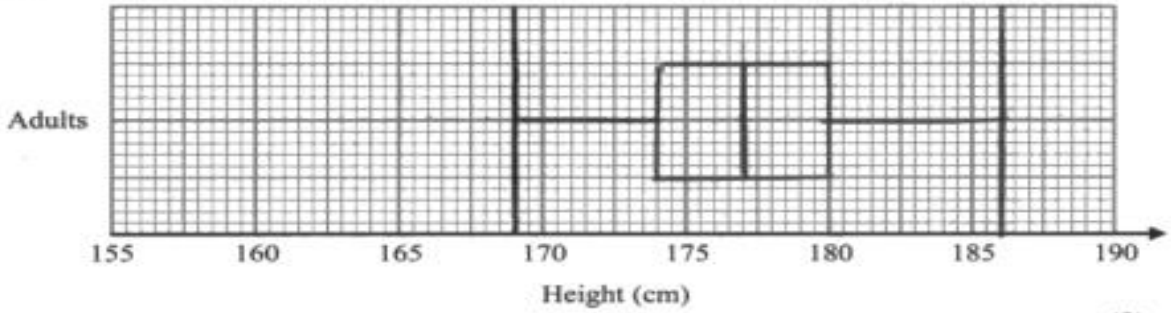
Please note that this comment is in context because it uses words such as smallest, tallest and gives the cm units but doesn't have the "comparison" words required.

Question 11 - Response C

11 The table shows some information about the heights of a group of adults.

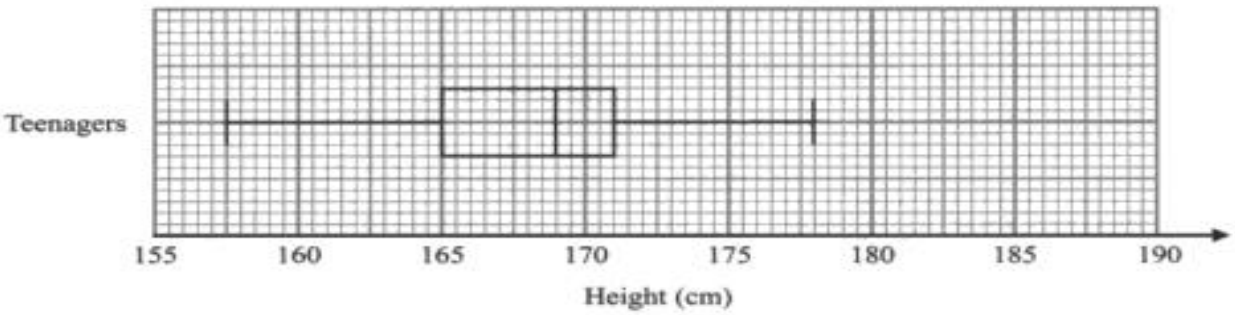
least height	169 cm
greatest height	186 cm
median	177 cm
lower quartile	174 cm
upper quartile	180 cm

(a) On the grid, draw a box plot for the information in the table.



(3)

The box plot below shows the distribution of the heights of a group of teenagers.



(b) Compare the distribution of the heights of the adults with the distribution of the heights of the teenagers.

- The teenagers have a larger range
- The median and general heights are distributed more evenly in the adults
- The teenagers have a larger interquartile range but their median is less than adults

(2)

(Total for Question 11 is 5 marks)

4 /5

Question:	18	24	13	22	23	24	10	11	22	23

Part (a)
B3 for a fully correct box and whisker diagram.

Part (b)
C1 for " the teenagers have a larger range." No context included (no reference to heights or cm) but not needed for 1 mark.

C0 as the second comment does not use a comparison of the medians and spread has already been credited.

The third comment re the medians could have earned a second mark if it had been written in context (e.g. “their median height is less than adults”)
Note that neither comment 1 nor comment 3 were in context as neither mentioned height or cm.

Paper 3H - Question 22

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

Question 22 - Question

22 Given that the vector $a\begin{pmatrix}2\\6\end{pmatrix}+b\begin{pmatrix}8\\2\end{pmatrix}$ is parallel to the vector $\begin{pmatrix}13\\6\end{pmatrix}$

find an expression for b in terms of a.

.....

(Total for Question 22 is 3 marks)

Question 22 - Mark Scheme

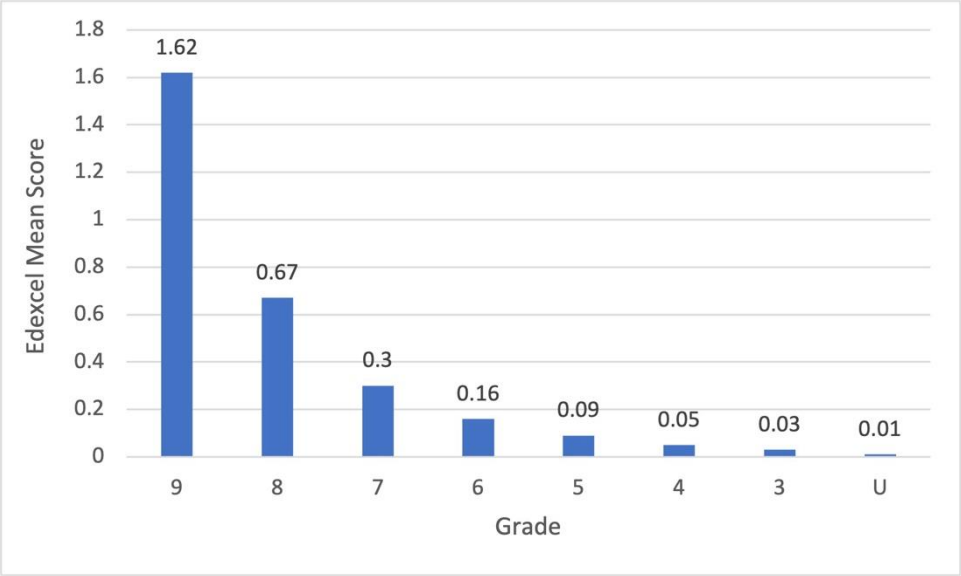
Question	Answer	Mark	Mark scheme	Additional guidance
22	$b = 3a$	P1	for $a\binom{2}{6} + b\binom{8}{2} = k\binom{13}{6}$ oe or for setting up a linear equation in a or b eg $2a + 8b = 13k$ or $6a + 2b = 6k$, $k \neq 0, 1$ **or** for $2a + 8b = 13$ and $6a + 2b = 6$ **or** for $\frac{2a+8b}{6a+2b} = \frac{13}{6}$ oe	Accept any non zero value substituted for k
		P1	for process to solve the simultaneous equations to get $b = \frac{3k}{2}$ and $a = \frac{k}{2}$ or $b = \frac{3}{2}$ and $a = \frac{1}{2}$ **or** both $2a + 8b = 13k$ and $6a + 2b = 6k$ with process to eliminate k	
		A1	for $b = 3a$ oe	

Question 22 - Examiner Comments

Fully correct answers to this question were seen infrequently and there were many students who made no attempt to answer the question. However, a significant proportion of students were able to score at least one mark for writing down a correct vector equation and/or two simultaneous linear equations from the information given. The most success was achieved by students who wrote down and solved the equations $2a + 8b = 13$ and $6a + 2b = 6$ to get $b = \frac{3}{2}$ and $a = \frac{1}{2}$ then used this to write down a correct expression for b in terms of a. Some students formed simultaneous equations but then used only one equation to find a relationship between a and b. Of those students who did solve the equations to get the value of a and the value of b, some failed to complete the question to get b in terms of a. Approaches using $a\binom{2}{6} + b\binom{8}{2} = k\binom{13}{6}$ where k was treated as a general constant or using $\frac{2a+8b}{6a+2b} = \frac{13}{6}$ as a start were rarely seen.

Question 22 - Performance

Mean score	Max score	Mean %	Edexcel averages: mean scored by candidates achieving grade:								
			ALL	9	8	7	6	5	4	3	U
0.33	3	11	0.33	1.62	0.67	0.30	0.16	0.09	0.05	0.03	0.01



Question 22 - Response A

22 Given that the vector $a\begin{pmatrix}2\\6\end{pmatrix} + b\begin{pmatrix}8\\2\end{pmatrix}$ is parallel to the vector $\begin{pmatrix}13\\6\end{pmatrix}$

find an expression for b in terms of a.

$\begin{pmatrix}2a\\6a\end{pmatrix} + \begin{pmatrix}8b\\2b\end{pmatrix}$ parallel to $\begin{pmatrix}13\\6\end{pmatrix}$

$2a + 8b = 13$ · $a + 4b = 13$ ·

$6a + 2b = 6$ $a = 13 - 4b$ ·

~~$6(13-4b) + 2b = 6$~~ · $2a + 24 - 2ba = 13$ ·

~~$2a = 13 - 8b$~~ ·

$2b = 6 - 6a$

$b = 3 - 3a$

~~$2a + t$~~ $b = 3 - 3a$ ·

(Total for Question 22 is 3 marks)

1 /3

Q22

A B C

The expression for b in terms of a is incorrect so we consider the working.
P1 for the two simultaneous equations 2a + 8b = 13 and 6a + 2b = 6.
Both must be given in the case k = 1.

Note: that if they had set up an equation involving the variable k, only one equation is needed for this mark,
eg 2a + 8b = 13k OR 6a + 2b = 6k

P0 as there is no correct method to find a and b.

A0 for an incorrect expression

Question 22 - Response B

22 Given that the vector $a\begin{pmatrix}2\\6\end{pmatrix}+b\begin{pmatrix}8\\2\end{pmatrix}$ is parallel to the vector $\begin{pmatrix}13\\6\end{pmatrix}$ find an expression for b in terms of a.

$\frac{2a}{6a} + \frac{8b}{2b} = \frac{13}{6}$

$2a + 8b = 13$

$6a + 2b = 6$

$a = \frac{1}{2}$

$b = \frac{3}{2}$

(Total for Question 22 is 3 marks)

2 /3

Q22

There is no correct expression shown for b in terms of a so we consider the working.
Sight of a = 1/2 and b = 3/2 leads to the award of the first 2 marks

P1 for the two equations, 2a + 8b = 13 and 6a + 2b = 6.

P1 for a = 1/2 and b = 3/2

A0 no expression given.

Question 22 - Response C

22 Given that the vector $a\begin{pmatrix}2\\6\end{pmatrix} + b\begin{pmatrix}8\\2\end{pmatrix}$ is parallel to the vector $\begin{pmatrix}13\\6\end{pmatrix}$

find an expression for b in terms of a.

$a\begin{pmatrix}2\\6\end{pmatrix} + b\begin{pmatrix}8\\2\end{pmatrix} = \begin{pmatrix}13\\6\end{pmatrix}$

$2a + 8b = 13$

$6a + 2b = 6 \quad \times 4$

$24a + 8b = 24$

$2a - 8b = 13$

$22a = 11$

$a = 0.5$

$0.5 \times 2 = 1$

$1a + 8b = 13$

$8b = 12$

$b = 1.5$

$b = 3a$

(Total for Question 22 is 3 marks)

3 /3

P1 P1 A1 for the correct expression b = 3a from a correct method writing down and solving the two equations 2a + 8b = 13 and 6a + 2b = 6.

Paper 3H - Question 23

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

Question 23 - Question

23 A circle has equation $x^2 + y^2 = 25$

The point P with coordinates (–3, 4) lies on the circle.

Alex says that the tangent to the circle at P crosses the x-axis at the point (–8, 0)

Is Alex correct?
You must show how you get your answer.

(Total for Question 23 is 4 marks)

Question 23 - Mark Scheme

Question	Answer	Mark	Mark scheme	Additional guidance
23	No (supported)	P1	for a first step, eg to find the gradient of the line (normal) joining (0, 0) to (–3, 4), eg $\frac{4-0}{-3-0}$ $(= -\frac{4}{3})$ **OR** finds the length^2 for one side of triangle, eg $(-3--8)^2+(4-0)^2$ $(=41)$ or $(-3-0)^2+(4-0)^2$ $(=25)$ or 64	Alternative processes may be seen and should be duly credited.
		P1	for a second step, eg to find the gradient of the tangent, eg $-1 \div$ "$\frac{-4}{3}$" $(=\frac{3}{4})$ **OR** finds the length^2 for two sides of triangle, two of 25, 41 and 64	

Question 23 - Mark Scheme (Cont.)

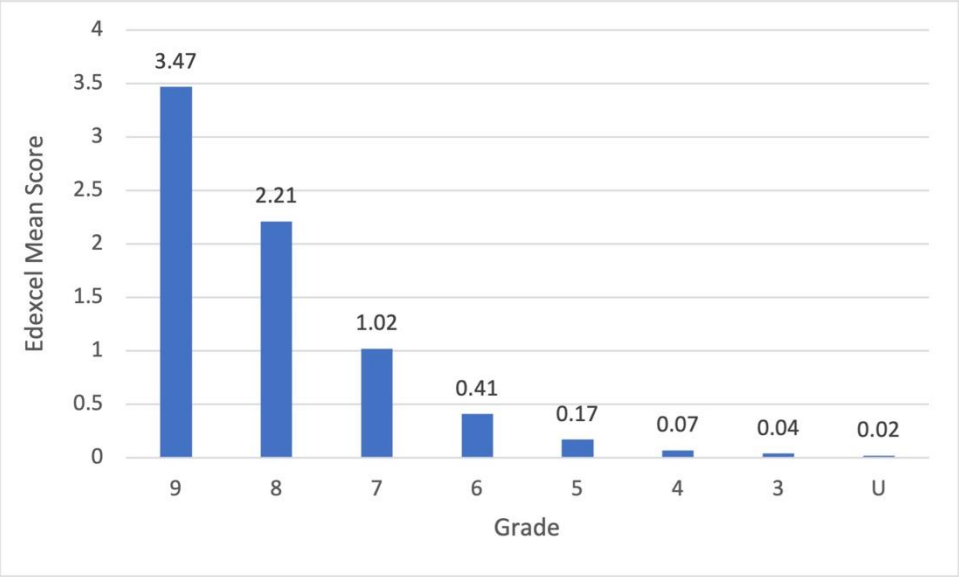
Question	Answer	Mark	Mark scheme	Additional guidance
		P1	for a third step, eg to find the gradient of the line joining (–8, 0) to (–3, 4), $\frac{4-0}{-3--8}$ (= $\frac{4}{5}$) or finds the equation of the tangent, eg $y = \frac{3}{4}x + \frac{25}{4}$ or $y - 4 = \frac{3}{4}(x - -3)$ **OR** for process to use Pythagoras' rule, eg 41 + 25 (= 66) or 64 – 25 (= 39) or 64 – 41 (= 23)	
		C1	for No from correct figures and a complete process from comparison of gradients, eg $\frac{3}{4}$ and $\frac{4}{5}$ or showing the equation of the tangent does not pass through (–8, 0), eg when $x = -8$, $y = \frac{1}{4}$ (not 0) or when $y = 0$, $x = -\frac{25}{3}$ (not –8) **OR** correct figures from Pythagoras' rule, eg 41 + 25 (= 66) ≠ 64 or 64 – 41 ≠ 25 or 64 – 25 ≠ 41 oe	Award 0 marks for No without complete and correct supportive working

Question 23 - Examiner Comments

This question was accessible to and discriminated well between the highest attaining students sitting this paper. There were a number of routes through the question available to students. The most concise route was for students to find the gradient of the tangent at the point (−3, 4) on the circle and compare it with the gradient of the line joining the point (−8, 0) to the point (−3, 4). Few students chose this route, instead opting to find the equation of the tangent at the point (−3, 4), then show that the tangent would not pass through the point with coordinates (−8, 0) but through one of the points $(-\frac{25}{3}, 0)$ or $(-8, \frac{1}{4})$. Though this was the most frequently seen route, a significant number of students did not get as far as a correct conclusion supported by correct reasoning and necessary values. A number of students opted to approach the problem by using Pythagoras' rule to show the triangle with vertices (−8, 0),(−3, 4) and (0, 0) was not right-angled. It was rare to find a complete solution from students using this strategy.

Question 23 - 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	3.47	2.21	1.02	0.41	0.17	0.07	0.04	0.02



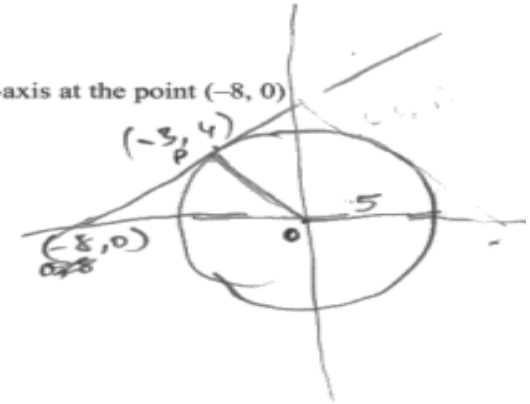
Question 23 - Response A

23 A circle has equation $x^2 + y^2 = 25$

The point P with coordinates $(-3, 4)$ lies on the circle.

Alex says that the tangent to the circle at P crosses the x-axis at the point $(-8, 0)$

Is Alex correct?
You must show how you get your answer.



line PO

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 + 3}{0 - 4}$$

$$m = -\frac{3}{4}$$

line ⊥

$y = mx + c$

$4 = \frac{4}{3}(-3) + c$

$4 + 4 = +c$

$8 = c$

$y = \frac{4}{3}x + 8$

$0 = \frac{4}{3}(-8) + 8$

$0 = -10.667 + 8$

$0 = -2.66$

∴ Alex is incorrect

Q23

A
B
C

0 /4

P0: The process to find the gradient of the line joining (0, 0) to (-3, 4) is incorrect.

P0: Although the candidate has used the relationship for gradients of perpendicular lines this needs to be applied to a gradient for the radius that comes from a correct process, hence the use of inverted commas on " -4/3 ". This mark cannot be awarded because a correct process to find the radius of PO had not been used.

P0: The candidate has not found a correct equation for the tangent because their gradient is incorrect. Nor have they found the gradient of the line joining (-8, 0) to (-3, 4) which would have been another way to score this mark.

C0: no correct figures for comparison

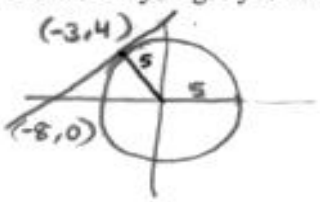
Question 23 - Response B

23 A circle has equation $x^2 + y^2 = 25$

The point P with coordinates $(-3, 4)$ lies on the circle.

Alex says that the tangent to the circle at P crosses the x-axis at the point $(-8, 0)$

Is Alex correct?
You must show how you get your answer.



-3,4
0 0

$\frac{4-0}{-3-0} = \frac{4}{-3} = -\frac{4}{3}$ (gradient of radius)

tangent gradient = $\frac{3}{4}$

$y = mx + c$

$4 = \frac{3}{4}(-3) + c$

$4 = -\frac{9}{4} + c$

$c = 6.25$

y intercept = 6.25
gradient = $\frac{3}{4}$

~~y intercept~~ $= \frac{6.25}{-8} = -0.78125$

$\neq \frac{3}{4}$ (gradient)

$\frac{\text{change in } y}{\text{change in } x}$ should $= \frac{3}{4}$

but using the point $-8, 0$ it does not

Alex is wrong

3 /4

P1 for a first step to find the gradient of the line joining (0, 0) to (-3, 4)

P1 for a second step to find the gradient of the tangent using the relationship mn = - 1

P1 the candidate has not found the equation of the tangent. They have found the value of c and have attempted to use it for an alternative approach. They have attempted to use the (correct) intercept along with the given point (– 8 , 0) to find the gradient and compare it with the correct gradient of the tangent. This is a correct process, however they have used – 8 rather than 8 on the denominator of their gradient and this has led to an incorrect value. Since the process is correct and the only error is an accuracy slip we can award the 3rd P mark.

Note that this alternative approach is not explicitly set out in the mark scheme, but we will always accept correct, alternative processes.

C0 as the solution was not correctly completed. It should have been 6.25/8 = 0.78... compared to 0.75 and this mark requires a comment that Alex is incorrect supported by correct figures.

Question 23 - Response C

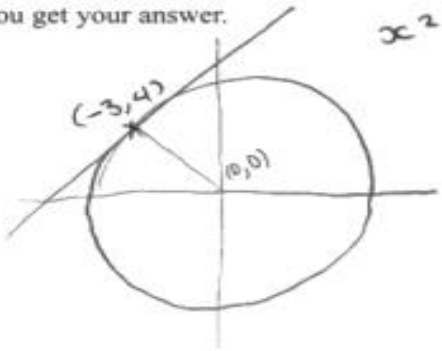
23 A circle has equation $x^2 + y^2 = 25$

The point P with coordinates $(-3, 4)$ lies on the circle.

Alex says that the tangent to the circle at P crosses the x-axis at the point $(-8, 0)$

Is Alex correct?
You must show how you get your answer.

$x^2+y^2=25$



gradient of radius $= \frac{4-0}{-3-0} = -\frac{4}{3}$

gradient of tangent $= \frac{3}{4}$

$(-3, 4)$

$y = \frac{3}{4}x + c$

$4 = \frac{3}{4}(-3) + c$

$4 = -\frac{9}{4} + c$

$\frac{25}{4} = c$

$y = \frac{3}{4}x + \frac{25}{4}$

$0 = \frac{3}{4}x + \frac{25}{4}$

$-\frac{25}{4} = \frac{3}{4}x$

$-\frac{25}{4} \div \frac{3}{4} = x$

$x = -\frac{25}{3} = -8.\dot{3}$

so P crosses x axis at $(-8.\dot{3}, 0)$ not $(-8, 0)$

so Alex is wrong because $-8.\dot{3} \neq -8$

(Total for Question 23 is 4 marks)

4 /4

P1 for finding the gradient of the radius as -4/3

P1 for a second step to find the gradient of the tangent as 3/4

P1 for finding a correct equation for the tangent

C1 for a correct conclusion with the figure of -25/3 to compare with -8. We do not need to see the -8 rewritten as it appears in the question (though this candidate has stated it again).