National Qualifications 2022

2022 Applications of Mathematics

Paper 1 - (Non-calculator)

National 5

Finalised Marking Instructions

These marking instructions have been prepared by examination teams for use by SQA appointed markers when marking external course assessments.

General marking principles for National 5 Applications of Mathematics

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

For each question, the marking instructions are generally in two sections:

generic scheme — this indicates why each mark is awarded
illustrative scheme — this covers methods which are commonly seen throughout the marking

In general, you should use the illustrative scheme. Only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.

(a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.

(b) If you are uncertain how to assess a specific candidate response because it is not covered by the general marking principles or the detailed marking instructions, you must seek guidance from your team leader.

(c) One mark is available for each ○. There are no half marks.

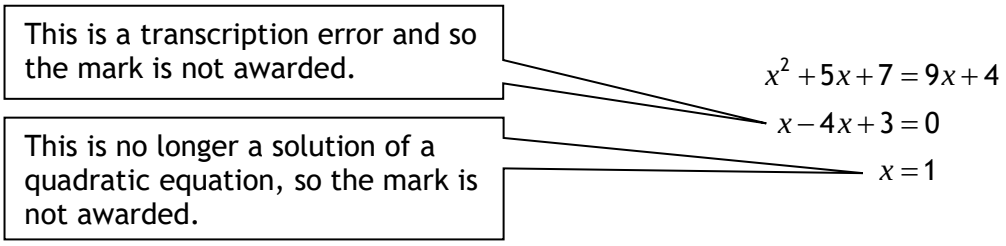
(d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.

(e) Only award full marks where the solution contains appropriate working. A correct answer with no working receives no mark, unless specifically mentioned in the marking instructions.

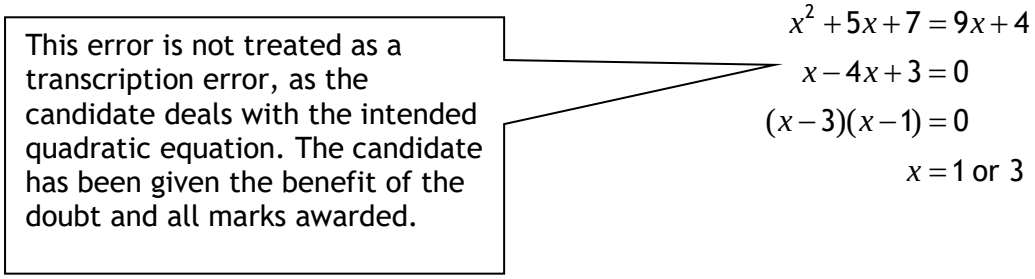
(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(g) If an error is trivial, casual or insignificant, for example 6 x 6 = 12, candidates lose the opportunity to gain a mark, except for instances such as the second example in point (h) below.

(h) If a candidate makes a transcription error (question paper to script or within script), they lose the opportunity to gain the next process mark, for example



The following example is an exception to the above



(i) Horizontal/vertical marking

If a question results in two pairs of solutions, apply the following technique, but only if indicated in the detailed marking instructions for the question.

Example:

	○5	○6
○5	$x=2$	$x=-4$
○6	$y=5$	$y=-7$

Horizontal: ○5 $x=2$ and $x=-4$ ○6 $y=5$ and $y=-7$

Vertical: ○5 $x=2$ and $y=5$ ○6 $x=-4$ and $y=-7$

You must choose whichever method benefits the candidate, **not** a combination of both.

(j) In final answers, candidates should simplify numerical values as far as possible unless specifically mentioned in the detailed marking instruction. For example

$\frac{15}{12}$ must be simplified to $\frac{5}{4}$ or $1\frac{1}{4}$

$\frac{43}{1}$ must be simplified to 43

$\frac{15}{0{\cdot}3}$ must be simplified to 50

$\frac{4/5}{3}$ must be simplified to $\frac{4}{15}$

$\sqrt{64}$ must be simplified to 8*

*The square root of perfect squares up to and including 144 must be known.

(k) Commonly Observed Responses (COR) are shown in the marking instructions to help mark common and/or non-routine solutions. CORs may also be used as a guide when marking similar non-routine candidate responses.

(l) Do not penalise candidates for any of the following, unless specifically mentioned in the detailed marking instructions:

- working subsequent to a correct answer
- correct working in the wrong part of a question
- legitimate variations in numerical answers/algebraic expressions, for example angles in degrees rounded to nearest degree
- omission of units
- bad form (bad form only becomes bad form if subsequent working is correct), for example

  $(x^3+2x^2+3x+2)(2x+1)$ written as

  $(x^3+2x^2+3x+2)\times 2x+1$

  $=2x^4+5x^3+8x^2+7x+2$

  gains full credit

- repeated error within a question, but not between questions or papers

(m) In any 'Show that…' question, where candidates have to arrive at a required result, the last mark is not awarded as a follow-through from a previous error, unless specified in the detailed marking instructions.

(n) You must check all working carefully, even where a fundamental misunderstanding is apparent early in a candidate's response. You may still be able to award marks later in the question so you must refer continually to the marking instructions. The appearance of the correct answer does not necessarily indicate that you can award all the available marks to a candidate.

(o) You should mark legible scored-out working that has not been replaced. However, if the scored-out working has been replaced, you must only mark the replacement working.

(p) If candidates make multiple attempts using the same strategy and do not identify their final answer, mark all attempts and award the lowest mark. If candidates try different valid strategies, apply the above rule to attempts within each strategy and then award the highest mark.

For example:

Strategy 1 attempt 1 is worth 3 marks.	Strategy 2 attempt 1 is worth 1 mark.
Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Marking Instructions for each question

Question			Generic scheme	Illustrative scheme	Max mark
1.			•[1] Communication: convert 230 kPa to psi •[2] Communication: state consistent conclusion with comparison	•[1] 33 •[2] no, $33 < 35$	**2**
			Alternative Strategy 1 •[1] Communication: convert 35 psi to kPa •[2] Communication: state consistent conclusion with comparison	•[1] $\square 241$, accept values between 240 and 250 inclusive •[2] no, $241 > 230$	
			Alternative Strategy 2 •[1] Communication: mark pressure in kPa or pressure in psi •[2] Communication: mark other pressure and state consistent conclusion with comparison	•[1] Mark 230 kPa or 35 psi •[2] Mark other pressure, no, because the pressure is outwith the limits	

Notes:

1. Do not penalise candidates who omit, incorrectly convert or incorrectly annotate 45 psi
2. •[2] is only available when •[1] has been attempted
3. For alternative strategy 2 •[2] is only available if both 230 kPa and 35 psi are marked
4. For all strategies, for the award of •[2]
   (a) Accept eg
   - No, it is too low
   - No, it is below 35
   - No, it is below 241
   - No, it is outwith the limits
   - Not safe as pressure is **only** 33

   (b) **Do not** accept eg
   - No
   - Not safe as pressure is 33
   - No, it is not safe
   - The tyres are not at a safe pressure
   - It is below 35

Commonly Observed Responses:
For the following award 1/2 ✓×
1. When only 230 kPa and 40 psi marked on diagram, with or without conclusion

For the following award 0/2 ××
2. No, with no justification

Question			Generic scheme	Illustrative scheme	Max mark
2.			•[1] Strategy: know to calculate percentage John has read •[2] Process/communication: complete calculation **and** state conclusion	•[1] $\frac{210}{350} \times 100\%$ or equivalent •[2] (60) No, since $62 > 60$	**2**
			Alternative Strategy 1 •[1] Strategy: know to calculate number of pages Marie has read •[2] Process/communication: complete calculation **and** state conclusion	•[1] 62% of 350 or equivalent •[2] (217) No, since $217 > 210$	
			Alternative Strategy 2 •[1] Strategy: evidence of common denominator •[2] Process/communication: complete calculation **and** state conclusion	•[1] evidence of 3500 or equivalent •[2] No, since $\frac{2170}{3500} > \frac{2100}{3500}$	

Question	Generic scheme	Illustrative scheme	Max mark
Question (2) (continued)			
Notes: 1. $\bullet^1$ can be implied by $\bullet^2$ 2. For $\bullet^1$, in original strategy, multiplying by 100% can be implied by subsequent working 3. $\bullet^1$ and $\bullet^2$ are available to candidates who compare 140 pages and 38% 4. $\bullet^2$ is only available for a comparison accompanied by a statement including 'no', 'incorrect', 'wrong' or equivalent 5. For the award of $\bullet^2$ (a) Accept eg • No, as Marie has read more pages • No, as John has only read 60% • John is incorrect because he has read less (b) **Do not** accept eg • No • Marie has read more • John is not correct			
Commonly Observed Responses: For the following, award 1/2 ×✓ 1. 62% of 210 $\rightarrow$ 130.2, yes, since $130.2 < 210$ 2. 62% of 210 $\rightarrow$ 130, yes, since $130 < 210$ 3. 62% of 210 $\rightarrow$ 131, yes, since $131 < 210$ 4. $\frac{350}{210} \times 100\% \rightarrow$ 166.6%, yes, since $166.6 > 62$ For the following, award 0/2 ×× 5. No 6. $\frac{140}{560} \times 100 = 25\%$ with any conclusion 7. $\frac{420}{560} \times 100 = 75\%$ with any conclusion			

Question			Generic scheme	Illustrative scheme	Max mark
3.	(a)		$\bullet^1$ Process: determine the median $\bullet^2$ Process: find the lower quartile and upper quartile	$\bullet^1$ 3.4 $\bullet^2$ 3.2, 3.9	**2**

Notes:

1. If the numbers are unordered, only $\bullet^2$ is available
2. If **one** number is missed from or added to an **ordered** list, only $\bullet^2$ is available
3. If **more than one** number is missed from or added to an ordered list, $\bullet^1$ and $\bullet^2$ are not available
4. The answers for part (a) can be inferred from the boxplot if not stated

Commonly Observed Responses:

For the following, award 1/2 ✓×

1. Median = 3.4 and quartiles of 2.9 and 4.2

For the following, award 1/2 ×✓

2. Median = 4.2 and quartiles of 3.4 and 3.45

	(b)		$\bullet^3$ Communication: any two points correctly annotated $\bullet^4$ Communication: remaining points annotated and box plot drawn	$\bullet^3$ any 2 from 2.9, Q_1, Q_2, Q_3 and 4.2 $\bullet^4$ complete box plot	**2**

Notes:

1. The answers for part (a) can be inferred from the boxplot if not stated
2. If the candidate constructs a dot plot award 0/2
3. $\bullet^3$ and $\bullet^4$ cannot be awarded if more than 5 values are annotated
4. $\bullet^4$ is not available for candidates who only annotate the five figure summary using dots or crosses
5. Do not accept 2.9 and 3.9 drawn on a grid line

Commonly Observed Responses:

Special case

For follow through from COR 1 in part (a), only $\bullet^3$ is available

Question			Generic scheme	Illustrative scheme	Max mark
3.	(c)		$\bullet^5$ Process: calculate interquartile range	$\bullet^5$ 0.7	**1**

Notes:

1. $\bullet^5$ must be consistent with quartiles from $\bullet^2$

Commonly Observed Responses:

For the following, award 0/1 ×

1. $(3.9-3.2=)0.7 \rightarrow 0.35$

	(d)		$\bullet^6$ Communication: valid comment	$\bullet^6$ eg the temperatures of the café fridge were less consistent	**1**

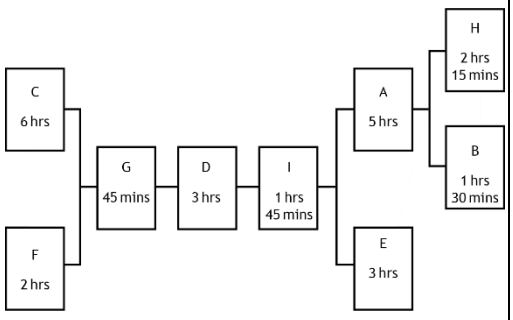
Notes:

1. Answer must be consistent with answer to part (c)
2. Comments **must** refer to temperature as well as café and/or restaurant
3. For the award of $\bullet^6$
   (a) Accept eg
   - The spread of temperatures is more in the café
   - The temperatures in the restaurant are less varied
   - There is less variation in degrees in the restaurant

   (b) **Do not** accept eg
   - Café's IQR is more
   - The range of restaurant temperatures is less
   - On average the temperatures in the café are more varied
   - The IQR of café's temperatures is less consistent
   - The temperature in the café fridge is higher
   - The temperatures are less varied
   - The café's fridge is more varied

4. If in part (c) the calculated interquartile range is 0.9 then award $\bullet^6$ for 'the spread of temperatures was the same in both fridges' or equivalent

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
4.	(a)		•[1] Strategy/communication: any 4 tasks and times in the correct boxes •[2] Strategy/communication: complete diagram	•[1] •[2]  	**2**

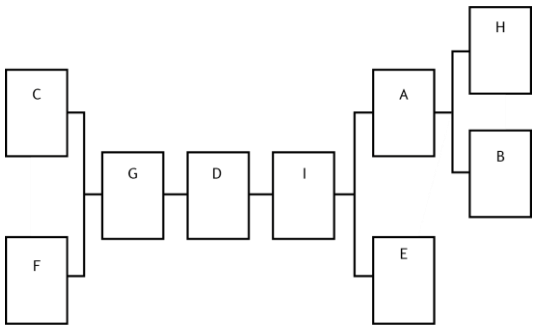
Notes:

1. If the candidate uses decimal time incorrectly eg 0.45, 1.3, 1.45 or 2.15 award a maximum of 1/2
2. For times in inconsistent units
   a) **Accept**
      eg 1 hour 30 minutes, 1h 30, 1.5 h, 1h 30m, 90m, 1h 30 mins
   b) **Do not accept**
      eg 130, 1 30, 1.30, 1:30
3. If the candidate omits hours/hrs/h with whole number of hours the candidate must state minutes, or equivalent, for 15, 30 and 45 minutes
4. In COR 1 and COR 2 all tasks/times must be in the correct boxes for the mark to be awarded
5. C and F are interchangeable
6. H and B are interchangeable

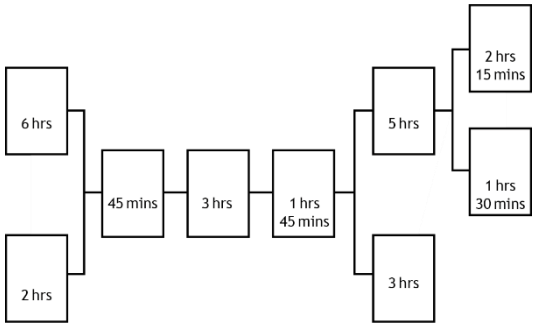
Commonly Observed Responses:

For the following, award 1/2 ×✓

1.



2.



Question			Generic scheme	Illustrative scheme	Max mark
	(b)		•[3] Strategy: select critical path •[4] Process/communication: calculate time consistent with path chosen	•[3] 6h + 45m + 3h + 1h45m + 5h + 2h15m or equivalent •[4] 18hours and 45minutes	**2**

Notes:

1. Correct answer with no working — award 2/2
2. 18 hours 45 minutes $\rightarrow$ 18.75 hours — award 2/2

Commonly Observed Responses:

For the following, award 2/2 ✓✓

1. $6+0.45+3+1.45+5+2.15$, $\rightarrow$ 18 hours 45 minutes, see also COR 2

For the following, award 1/2 ✓×

2. $6+0.45+3+1.45+5+2.15$, $\rightarrow$ 18.45, see also COR 1
3. 18.75 hours
4. 1125 minutes

For the following, award 1/2 ×✓

5. 10 hours 30 minutes
6. 14 hours
7. 14 hours 30 minutes
8. 14 hours 45 minutes
9. 18 hours
10. 25 hours 15 minutes

For the following, award 0/2 ××

11. 12 hours
12. 24 hours 35 minutes
13. 25.15
14. 24.35

Question			Generic scheme	Illustrative scheme	Max mark
5.			$\bullet^1$ Strategy/process: know to find total number of combinations $\bullet^2$ Process: find the number of combinations greater than 30 $\bullet^3$ Communication: state probability	$\bullet^1$ evidence of 35 combinations $\bullet^2$ 11 or evidence of 11 $\bullet^3$ $\frac{11}{35}$	**3**

Notes:

1. Correct answer with no working award 3/3
2. The combinations need not be listed for award of $\bullet^1$ and $\bullet^2$
3. $\bullet^3$ is only available when the denominator is the number of combinations identified
4. Where the answer is incorrect, $\bullet^3$ can only be awarded if the numerator **and** denominator are consistent with working
5. The final answer **does not** need to be in its simplest form
6. Do not award $\bullet^3$ for an answer written as a ratio
7. For $\bullet^3$
   a) Accept
      - 11 out of 35
      - 11 in 35

   b) Do not accept
      - 11:35
      - 11 to 35
8. For subsequent incorrect working $\bullet^3$ is not available

eg $\frac{11}{35} \rightarrow$ 11:35 award 2/3 ✓✓×

$\frac{11}{35} = \frac{1}{3}$ award 2/3 ✓✓×

Commonly Observed Responses:

For the following, award 3/3 ✓✓✓

1. $0.31(428\ldots)$

For the following, award 2/3 ✓✓×

2. $\frac{35}{11}$ with or without working

For the following, award 2/3 ×✓✓

3. $\frac{11}{30}$ with or without working

For the following, award 2/3 ✓×✓

4. $\frac{13}{35}$ with or without working

Question			Generic Scheme	Illustrative scheme	Max Mark
6.			$\bullet^1$ Process: calculate gross pay $\bullet^2$ Process: calculate net pay	$\bullet^1$ 1218 $\bullet^2$ $(1218-120.62=)\ 1097.38$	**2**

Notes:
1. Correct answer with no working - award 2/2
2. When the final answer is not a whole number $\bullet^2$ is only available where the final answer is rounded or truncated to 2 decimal places

Commonly Observed Responses:
For the following, award 1/2 ×✓
1. $1092-120.62\rightarrow 971.38$
2. $840-120.62\rightarrow 719.38$
3. $1344-120.62\rightarrow 1223.38$

For the following, award 1/2 ✓×
4. $1218+120.62\rightarrow 1338.62$

Question	Generic scheme	Illustrative scheme	Max mark
7.	•[1] Process: calculate the correct vertical distance •[2] Process/communication: state gradient •[3] Process/communication: express gradient as a fraction in its simplest from	•[1] 399 (m) or 0.399 (km) •[2] $\frac{399}{3000}$ or $\frac{0.399}{3}$ •[3] $\frac{133}{1000}$	**3**

Notes:

1. Correct answer with no working award 3/3
2. •[2] is only available for a denominator of 3 or 3000 where the units are consistent with the numerator
3. •[3] is not available when an attempt is made to further simplify a fraction already in its simplest form

   eg $\frac{133}{1000} = \frac{66.5}{500}$

Commonly Observed Responses:

For the following, award 2/3 ×✓✓

1. $\frac{420}{3000} \rightarrow \frac{7}{50}$

2. $\frac{21}{3000} \rightarrow \frac{7}{1000}$
3. $\frac{441}{3000} \rightarrow \frac{147}{1000}$

For the following, award 2/3 ✓×✓

4. $\frac{399}{3} \rightarrow 133$
5. $\frac{3000}{\square ABC} \rightarrow \frac{1000}{133}$

For the following, award 1/3 ✓××

6. $\frac{399}{3} \rightarrow \frac{133}{1}$

For the following, award 1/3 ××✓

7. $\frac{3000}{420} \rightarrow \frac{50}{7}$

8. $\frac{21}{420} \rightarrow \frac{1}{20}$

Question	Generic scheme	Illustrative scheme	Max mark
8.	$\bullet^1$ Strategy: evidence of common denominator $\bullet^2$ Process: add fractions $\bullet^3$ Process: calculate the fraction that Jessica ate.	$\bullet^1$ evidence of 21 or equivalent $\bullet^2$ $\frac{29}{21}$ $\bullet^3$ $\left(\frac{42}{21}-\frac{29}{21}=\right)\frac{13}{21}$	**3**
	Alternative Strategy $\bullet^1$ Process: calculate the remaining fraction of each pizza $\bullet^2$ Strategy: evidence of common denominator $\bullet^3$ Process: calculate the fraction that Jessica ate.	$\bullet^1$ $\frac{2}{7}$ and $\frac{1}{3}$ $\bullet^2$ evidence of 21 or equivalent $\bullet^3$ $\frac{13}{21}$	

Notes:

1. Correct answer with no working award 3/3
2. In original strategy, $\bullet^3$ is only available when the numerator is calculated by subtracting from 42
3. In the alternative strategy, $\bullet^3$ is only available for adding the 2 fractions from $\bullet^1$
3. The final answer does not need to be in its simplest form
4. Do not penalise incorrect simplification of final answer
5. Candidates working in decimals must work to at least 3 decimal places for $\bullet^2$ to be awarded in original strategy or $\bullet^3$ in alternative strategy
5. Candidates working in percentages must work to at least 1 decimal place for $\bullet^2$ to be awarded in original strategy or $\bullet^3$ in alternative strategy

Commonly Observed Responses:

For the following, award 2/3 ✓✗✓

1. $\frac{5}{21}+\frac{2}{21}=\frac{7}{21}\rightarrow\frac{35}{21}$

2. $\frac{15}{21}+\frac{14}{21}=\frac{29}{42}\rightarrow\frac{13}{42}$

For the following, award 2/3 ✓✓✗

3. $\frac{15}{21}+\frac{14}{21}=\frac{29}{21}\rightarrow\frac{13}{42}$

For the following, award 1/3 ✓✗✗

4. $\frac{5}{21}+\frac{2}{21}=\frac{7}{21}\rightarrow\frac{14}{21}$

5. $\frac{14}{21}+\frac{15}{21}=\frac{19}{21}\rightarrow\frac{2}{21}$

Question			Generic scheme	Illustrative scheme	Max mark
9.			•[1] Process: calculate length of semi-circle •[2] Process: calculate perimeter	•[1] $\left(\frac{1}{2}\times 3.14\times 10=\right)15.7$ •[2] $\left(10+15+15+15.7=\right)55.7$	**2**

Notes:
1. Correct answer with no working award 2/2
2. •[2] is only available for adding 40 (10 + 15 + 15) to a previously **calculated** value
3. Ignore incorrect or omitted units

Commonly Observed Responses:

For the following, award 2/2 ✓✓

1. $3.14\times 5=15.7\rightarrow 55.7$, refer also to COR 4

For the following, award 1/2 ✓×

2. $\left(\frac{1}{2}\times 3.14\times 10+50=\right)65.7$

For the following, award 1/2 ×✓

3. $\left(3.14\times 10+40=\right)71.4$

4. $C=3.14\times 5=15.7\rightarrow 55.7$, refer also to COR 1

5. $\left(\frac{1}{2}\times 3.14\times 5+40=\right)47.85$

6. $\left(\frac{1}{2}\times 3.14\times 5^2+40=\right)79.25$

For the following, award 0/2 ××

7. $\left(3.14\times 10+50=\right)81.4$

8. $\left(\frac{1}{2}\times 3.14\times 5^2+15\times 10=\right)189.25$

Question			Generic scheme	Illustrative scheme	Max mark
10.			•[1] Strategy/process: calculate cost plus profit •[2] Process: calculate minimum ticket price	•[1] 3200 •[2] 16	**2**

Notes:

1. Correct answer with no working award 2/2
2. •[2] is only available when all four expenses have been included in the calculation
3. When the final answer is not a whole number •[2] is only available where the final answer is rounded or truncated to 2 decimal places

Commonly Observed Responses:
For the following, award 1/2 ×✓

1. $1200 \div 200 = 6$
2. $(2000 - 1200) \div 200 = 4$

For the following, award 0/2 ××

3. $2000 \div 200 = 10$

Question			Generic scheme	Illustrative scheme	Max mark
11.			$\bullet^1$ Strategy: correct substitution into Pythagoras' Theorem $\bullet^2$ Process: calculate height of triangle $\bullet^3$ Process: calculate area of triangle $\bullet^4$ Process: calculate area of rectangle and add to area of triangle and state correct units	$\bullet^1$ $13^2 - 5^2$ $\bullet^2$ 12 $\bullet^3$ $(0.5\times10\times12=)60$ $\bullet^4$ $(10\times4+60=)$ 100 cm^2	**4**

Notes:

1. Correct answer with no working award 0/4
2. For $\bullet^4$ correct units must be stated in final answer
3. 12 with no working $\bullet^1$ and $\bullet^2$ can be awarded
4. With the exceptions of COR 5 and COR 7, $\bullet^3$ is only available for using a height
5. $\bullet^4$ is only available for adding 40 (10×4) to a previously **calculated** area

Commonly Observed Responses:

For the following, award 3/4 ✓✓✓×

1. $0.5\times10\times12=60$

For the following, award 3/4 ×✓✓✓

2. $13^2+5^2\rightarrow\sqrt{194}\rightarrow5\sqrt{194}\rightarrow5\sqrt{194}+40$ cm^2

For the following, award 3/4 ✓✓×✓

3. $0.5\times5\times12+10\times4=70\,\text{cm}^2$
4. $12\times10+10\times4=160\,\text{cm}^2$

For the following, award 2/4 ××✓✓

5. $0.5\times10\times13+10\times4=105\,\text{cm}^2$

For the following, award 2/4 ✓✓××

6. $12\times10+10\times4=160$

For the following, award 1/4 ××✓×

7. $0.5\times10\times13=65$

For the following, award 1/4 ×××✓

8. $13\times10+10\times4=170\,\text{cm}^2$
9. $0.5\times5\times13+10\times4=72.5\,\text{cm}^2$

For the following, award 0/4 ××××

10. $13\times10+10\times4=170$
11. $10\times4+13+13=66\,\text{cm}^2$
12. $10\times4=40\,\text{cm}^2$

Question	Generic scheme	Illustrative scheme	Max mark
12.	$\bullet^1$ Process: calculate expected frequency $\bullet^2$ Communication: conclusion consistent with working	$\bullet^1$ $(700 \times 0.023 =) 16.1$ $\bullet^2$ less	**2**
	Alternative Strategy $\bullet^1$ Process: calculate probability $\bullet^2$ Communication: conclusion consistent with working	 $\bullet^1$ $(15 \div 700 =)\ 0.021(4285714...)$ $\bullet^2$ less	

Notes:
1. $\bullet^2$ is only available when the calculation in $\bullet^1$ includes $\times$ or $\div$ and 700
2. In the alternative strategy, the probability must be between 0 and 1 for $\bullet^2$ to be available
3. In the alternative strategy, if the probability is calculated to more than 3 decimal places all working must be correct for $\bullet^1$ to be awarded

Commonly Observed Responses:
For the following, award 0/2 **××**

1. 'Less' with no working
2. $700 \div 15 = 46.6...$ with or without a conclusion
3. $\frac{15}{700} \rightarrow 700 \div 15$
4. 685 with or without a conclusion

[END OF MARKING INSTRUCTIONS]