National
Qualifications
2018

2018 Mathematics

National 5 - Paper 1

Finalised Marking Instructions

General marking principles for National 5 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.

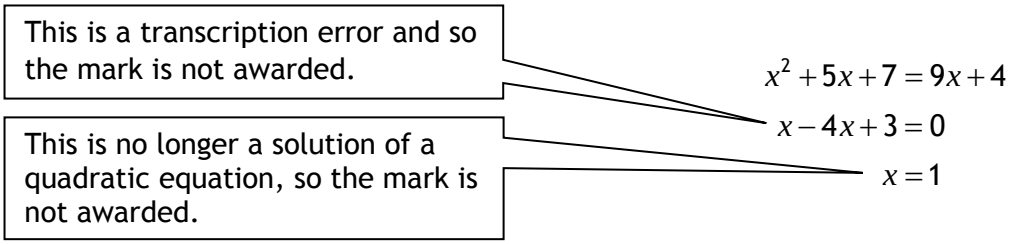
(d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.

(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.

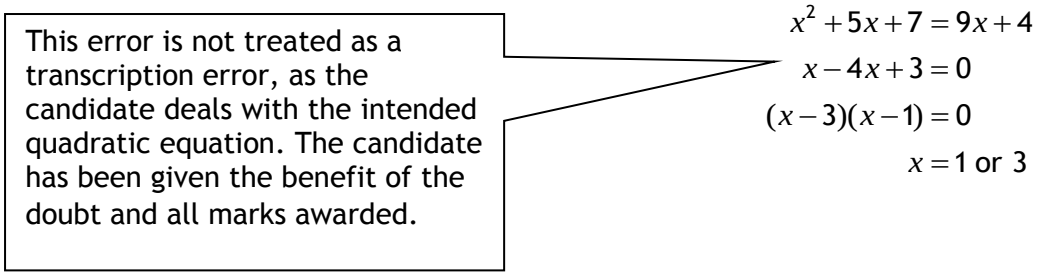
(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(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:

	$\bullet^5$	$\bullet^6$
$\bullet^5$	$x=2$	$x=-4$
$\bullet^6$	$y=5$	$y=-7$

Horizontal: $\bullet^5$ $x=2$ and $x=-4$ Vertical: $\bullet^5$ $x=2$ and $y=5$

$\bullet^6$ $y=5$ and $y=-7$ $\bullet^6$ $x=-4$ 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 100 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.

Detailed marking instructions for each question

Question	Generic scheme	Illustrative scheme	Max mark
1.	•[1] identify common denominator	•[1] $2\frac{\cdots}{15}+\frac{\cdots}{15}$ **or** $\frac{\cdots}{15}+\frac{\cdots}{15}$	**2**
	•[2] answer	•[2] $3\frac{2}{15}$ or $\frac{47}{15}$	

Notes:

1. Correct answer without working award 0/2
2. Do not penalise incorrect conversion of $\frac{47}{15}$ to a mixed number

Commonly Observed Responses:

Question	Generic scheme	Illustrative scheme	Max mark
2.	•[1] start expansion	•[1] $3x^2-3x+x-1$ **or** $2x^2-10$	**3**
	•[2] complete expansion	•[2] $3x^2-3x+x-1+2x^2-10$	
	•[3] collect like terms (see Note 2)	•[3] $5x^2-2x-11$	

Notes:

1. Correct answer without working award 3/3
2. Terms in the expression to be simplified must include a constant and two different powers of x eg
   (a) $3x^3-3x+x-1+2x^2-10=3x^3+2x^2-2x-11$ award 2/3 ✓×✓
   (b) $3(x-1)+1(x-1)+2(x^2-5)=3x-3+x-1+2x^2-10=2x^2+4x-14$ award 2/3 ✓×✓
   (c) $3x^2+1-1+2x^2-10=5x^2-10$ award 1/3 ✓××
3. For subsequent incorrect working, the final mark is not available

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
3.			•[1] evidence of scaling (match x or y coefficients) •[2] follow a valid strategy through to produce values for x and y •[3] calculate correct values for x and y	•[1] eg $8x+10y=-6$, $30x-10y=25$ •[2] values for x and y •[3] $x=0\cdot5,\ y=-1$	**3**

Notes:

1. Correct answer without working award 0/3
2. Answer obtained by guess and check award 0/3

Commonly Observed Responses:

Question	Generic scheme	Illustrative scheme	Max mark
4.	$\bullet^1$ evidence of subtraction	$\bullet^1$ eg $\begin{pmatrix}6\\-4\\3\end{pmatrix}-\begin{pmatrix}1\\5\\1\end{pmatrix}$	**2**
	$\bullet^2$ all components correct	$\bullet^2$ $\begin{pmatrix}5\\-9\\2\end{pmatrix}$	

Notes:

1. Correct answer without working award 2/2

2. The maximum mark available is 1/2 where
   (a) brackets are omitted from the final answer
   (b) final answer is given in coordinate form

2. Accept one correct component for evidence of subtraction
   eg $\begin{pmatrix}5\\ \\ \end{pmatrix}$ or $\begin{pmatrix}\\-9\\ \end{pmatrix}$ or $\begin{pmatrix}\\ \\2\end{pmatrix}$ award 1/2 ✓×

Commonly Observed Responses:

1. (a) $\begin{pmatrix}1\\5\\1\end{pmatrix}+\begin{pmatrix}5\\-9\\2\end{pmatrix}=\begin{pmatrix}6\\-4\\3\end{pmatrix}$ award 2/2

   (b) $\begin{pmatrix}1\\5\\1\end{pmatrix}+\begin{pmatrix}5\\-9\\2\end{pmatrix}=\begin{pmatrix}6\\-4\\3\end{pmatrix}\rightarrow \mathbf{v}=\begin{pmatrix}6\\-4\\3\end{pmatrix}$ award 1/2

2. $\begin{pmatrix}-5\\9\\-2\end{pmatrix}$ $[\mathbf{u}-(\mathbf{u}+\mathbf{v})]$ no working necessary award 1/2 ×✓

3. $\begin{pmatrix}7\\1\\4\end{pmatrix}$ $[\mathbf{u}+(\mathbf{u}+\mathbf{v})]$ no working necessary award 1/2 ×✓

4. $(5,-9,2)$ or $5,-9,2$ award 1/2 ✓×

Question			Generic scheme	Illustrative scheme	Max mark
5.			$\bullet^1$ correct factorisation $\bullet^2$ solve for x	$\bullet^1$ $(x-3)(x-8)$ $\bullet^2$ $(x=)3,(x=)8$	**2**

Notes:

1. Correct answer without working award 0/2
2. For an answer obtained by guess and check award 0/2
3. **BEWARE**
   $\bullet^2$ is only available if 3,8 are clearly stated as solutions to $(x-3)(x-8)[=0]$ and not as factors of 24
4. Where quadratic formula is used award marks as follows
   $\bullet^1 \frac{11\pm\sqrt{25}}{2}$
   $\bullet^2$ 3,8

Commonly Observed Responses:

1. $(x+3)(x+8)\rightarrow 3,8$ award 0/2
2. $(x+4)(x-6)\rightarrow -4,6$ award 1/2 ×✓

Question			Generic scheme	Illustrative scheme	Max mark
6.			•[1] state the value of a •[2] state the value of b	•[1] $a = 5$ •[2] $b = 4$	**2**
Notes:					
Commonly Observed Responses: 1. (a) $y = 5\cos 4x$ award 2/2 (b) 5, 4 award 1/2 2. (a) $a = 4, b = 5$ or $y = 4\cos 5x$ award 1/2 (b) 4, 5 award 0/2 3. (a) $y = 5\cos 2x$ award 1/2 (b) 5, 2 award 0/2					

Question			Generic scheme	Illustrative scheme	Max mark
7.	(a)		**Method 1:** $y-b=m(x-a)$ •1 calculate gradient •2 substitute gradient and a point into $y-b=m(x-a)$ •3 state equation in simplest form in terms of P and d **Method 2:** $y=mx+c$ •1 calculate gradient •2 substitute gradient and a point into $y=mx+c$ •3 state equation in simplest form in terms of P and d	**Method 1** •1 $\frac{6}{4}$ or equivalent •2 eg $y-20=\frac{6}{4}(x-12)$ •3 $P=\frac{3}{2}d+2$ or equivalent **Method 2** •1 $\frac{6}{4}$ or equivalent •2 eg $20=\frac{6}{4}\times 12+c$ •3 $P=\frac{3}{2}d+2$ or equivalent	**3**

Question	Generic scheme	Illustrative scheme	Max mark

Notes:

1. Correct answer without working award 0/3
2. Gradient need not be simplified for the award of $\bullet^2$
3. Where $\frac{6}{4}$ is simplified incorrectly $\bullet^2$ is still available

   eg $m=\frac{6}{4}=\frac{2}{3} \rightarrow y-20=\frac{2}{3}(x-12) \rightarrow P=\frac{2}{3}d+12$ award 2/3 ✓✓×
4. $\bullet^3$ is not available where the calculated gradient is an integer
5. $\bullet^3$ is not available where a decimal **approximation** is used for the gradient

   eg $m=\frac{4}{6}=0\cdot67 \rightarrow y-20=0\cdot67(x-12) \rightarrow P=0\cdot67d+11\cdot96$ award 1/3 ×✓×
6. $\bullet^3$ is not available for invalid subsequent working

   eg $P=\frac{3}{2}d+2 \rightarrow 2P=3d+2$ award 2/3 ✓✓×

Commonly Observed Responses:
Working must be shown.

1. $y=\frac{3}{2}x+2$ award 2/3 ✓✓×
2. (a) $P=\frac{3}{2}d+2 \rightarrow 2P=3d+4$ award 3/3

   (b) $P=\frac{6}{4}d+2 \rightarrow 4P=6d+8$ award 2/3 ✓✓×
3. $m=\frac{6}{4}=0\cdot67 \rightarrow y-20=0\cdot67(x-12) \rightarrow P=0\cdot67d+11\cdot96$ award 2/3 ✓✓×
4. $m=\frac{6}{4}=\frac{3}{4}=0\cdot75 \rightarrow y-20=0\cdot75(x-12) \rightarrow P=0\cdot75d+11$ award 2/3 ✓✓×
5. $m=\frac{4}{6}=\frac{2}{3} \rightarrow y-20=\frac{2}{3}(x-12) \rightarrow P=\frac{2}{3}d+12$ award 2/3 ×✓✓
6. $m=\frac{3}{4}=0\cdot75 \rightarrow y-20=0\cdot75(x-12) \rightarrow P=0\cdot75d+11$ award 2/3 ×✓✓

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		•1 calculate cost	•1 (£) 9·50	1

Notes:

1. Correct answer without working award 1/1
2. Do not penalise omission of £
3. Do not accept 9·5 or $\frac{19}{2}$
4. Follow through mark from part (a) is only available if 5 is multiplied or divided by a non-unitary fraction (or decimal equivalent) followed by an addition or subtraction

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
8.			•1 find discriminant •2 state nature of roots	•1 -24 •2 no real roots	**2**

Notes:

1. Correct answer without working award 0/2
2. $16-40<0 \rightarrow$ no real roots, award 2/2
3. Do **not** accept 'no roots', 'no real (or) distinct roots', 'no real (and) distinct roots'
4. Expected answer(s) for the award of •2, when
   (a) $b^2-4ac>0$: 'two real (and) distinct roots'
   (b) $b^2-4ac=0$: 'one repeated real root' or 'two equal real roots'

Commonly Observed Responses:

1. $\frac{-4\pm\sqrt{16-40}}{4}=\frac{-4\pm\sqrt{-24}}{4}$ award 1/2 ✓×
2. $\sqrt{16-40}=\sqrt{-24}$ award 1/2 ✓×

Question			Generic scheme	Illustrative scheme	Max mark
9.			•1 calculate the size of an interior angle of the decagon **or** angle JKL •2 calculate the size of angle KJL	•1 interior angle $=72+72$ **or** JKL $=36$ •2 127	**2**

Notes:

1. Correct answer without working award 2/2
2. Degree signs are not required
3. Full marks may be awarded for information marked on the diagram
4. For a **final** answer of 36 which is **not** named or shown at JKL award 0/2
5. Where JKL has been calculated incorrectly •2 is only available where there is **clear evidence** that JKL has been calculated by using the interior angle or exterior angle of the decagon

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
10.			•[1] correct substitution into cosine rule •[2] calculate XY^2 •[3] calculate XY	•[1] $10^2+8^2-2\times10\times8\times\frac{1}{8}$ •[2] 144 •[3] 12 (cm)	**3**

Notes:

1. Correct answer without working award 0/3
2. For $10^2+8^2-2\times10\times8\times\cancel{\cos}\frac{1}{8}=164-160\times\cancel{\cos}\frac{1}{8}=144\rightarrow12$
   where $\cos$ is scored out in **each line** of working award 3/3
3. •[3] is available for
   (a) expressing $\sqrt{x}$ as a surd in its simplest form
   eg $\sqrt{10^2+8^2}=\sqrt{164}=2\sqrt{41}$ award 1/3 ××✓
   [•[3] is not available where $\sqrt{x}$ cannot be simplified]
   (b) calculating $\sqrt{x}$ where x is a perfect square greater than 100
   eg $\sqrt{10^2-8^2}=\sqrt{36}=6$ award 0/3

Commonly Observed Responses:

1. $10^2+8^2-2\times10\times8\times\cos\frac{1}{8}=12$ award 2/3 ×✓✓
2. $10^2+8^2-2\times10\times8\times\cos\frac{1}{8}$ award 0/3

Question			Generic scheme	Illustrative scheme	Max mark
11.			$\bullet^1$ express as equivalent fraction with rational denominator $\bullet^2$ express in simplest form	$\bullet^1$ $\frac{9\sqrt{6}}{6}$ $\bullet^2$ $\frac{3\sqrt{6}}{2}$	**2**

Notes:

1. Correct answer without working award 0/2

2. Accept $1{\cdot}5\sqrt{6}$

3. For subsequent incorrect working, the final mark is not available

   eg $\frac{9\sqrt{6}}{6} = \frac{3\sqrt{6}}{2} = 3\sqrt{3}$ award 1/2 ✓×

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
12.			•1 state value	•1 $-0\cdot5$	**1**

Notes:

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
13.			•1 state coordinates of B •2 state coordinates of C	•1 $(4,\ 8,\ 5)$ •2 $(6,\ 8,\ 0)$	**2**

Notes:

1. The maximum mark available is 1/2 where
   (a) brackets are omitted (unless already penalised in Q4)
   (b) answers are given in component form (unless already penalised in Q4)

2. (a) For $(4,\ 8,\ 5)$ and $(6,\ 8,\ 0)$ award 2/2
   (b) For $C(4,\ 8,\ 5)$ and $B(6,\ 8,\ 0)$ award 1/2

3. For eg $(5,\ 4,\ 8)$ **and** $(0,\ 6,\ 8)$ [repeated error] award 1/2

4. •2 is available for answers of the form $B(x,\ y,\ z)$, $C(x+2,\ y,\ z-5)$
   eg $(2,\ 8,\ 5)$ and $(4,\ 8,\ 0)$

Commonly Observed Responses:

1. 4,8,5 and 6,8,0 award 1/2 ×✓
   (award 2/2 if omission of brackets has already been penalised in Q4)

2. $\begin{pmatrix}4\\8\\5\end{pmatrix}$ and $\begin{pmatrix}6\\8\\0\end{pmatrix}$ or $\begin{matrix}4\\8\\5\end{matrix}$ and $\begin{matrix}6\\8\\0\end{matrix}$ award 1/2 ×✓
   (award 2/2 if use of coordinates instead of components has already been penalised in Q4)

3. $\begin{pmatrix}5\\8\\4\end{pmatrix}$ and $\begin{pmatrix}6\\8\\0\end{pmatrix}$ award 0/2

Question	Generic scheme	Illustrative scheme	Max mark
14.	• [1] subtract h • [2] divide by g • [3] square	• [1] $y-h=g\sqrt{x}$ • [2] $\sqrt{x}=\dfrac{y-h}{g}$ • [3] $x=\left(\dfrac{y-h}{g}\right)^2$	**3**

Notes:

1. Correct answer without working award 1/3

2. For subsequent incorrect working, the final mark is not available

Commonly Observed Responses:
Working must be shown.

1. $x=\left(\dfrac{y}{g}-\dfrac{h}{g}\right)^2$ award 3/3
2. $x=\dfrac{y-h}{g}^{\ 2}$ award 2/3 ✓✓×

Question			Generic scheme	Illustrative scheme	Max mark
15.			•1 start process •2 complete process	•1 $\frac{4}{9}$ **or** p^8 •2 $\frac{4}{9}p^8$	**2**

Notes:

1. For a correct answer without working award 2/2

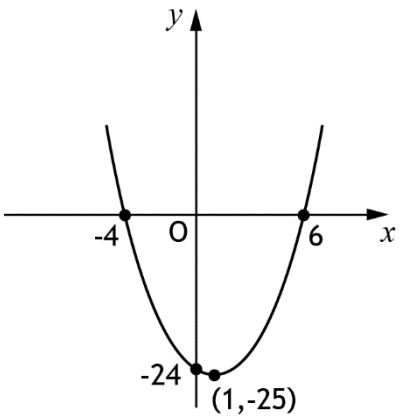
2. For subsequent incorrect working, the final mark is not available

3. **BEWARE** : For $\frac{2}{3}p^4+\frac{2}{3}p^4=\frac{4}{3}p^8$ award 0/2

4. Award •1 for an incorrect expansion leading to $\frac{4}{9}+\ldots$ **or** $\ldots+p^8$

   eg $\left(\frac{2}{3}p^4\right)\left(\frac{2}{3}p^4\right)=\frac{4}{9}+\frac{2}{3}p^4+\frac{2}{3}p^4+p^8=\frac{4}{9}+\frac{4}{3}p^4+p^8$ award 1/2 ✓×

Commonly Observed Responses:

Question	Generic scheme	Illustrative scheme	Max mark
16.	• [1] identify roots • [2] identify turning point **OR** y-intercept • [3] identify the turning point **AND** the y-intercept and sketch a consistently annotated parabola	• [1] -4 **AND** 6 • [2] $(1, -25)$ **OR** -24 • [3] $(1, -25)$ **AND** -24 and consistently annotated parabola (see Note 1). 	**3**

Notes:

1. • [3] is only available where the roots, turning point **AND** y-intercept are clearly marked and consistently annotated on the sketch

2. Accept correctly calculated roots and/or y-intercept annotated as $(0, -4)$, $(0, 6)$ and $(-24, 0)$ as evidence for the award of • [3] (treat as bad form)

3. • [3] is not available if graph is not a parabola
   eg roots $= -6 \text{ and } 4 \rightarrow (-1, -21)$ or -24 award 1/3 ×✓×

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
17.			**Method 1**	**Method 1**	**3**
			•[1] start substitution into formula	•[1] $\frac{1}{3}\times 6^2\times h$ or $\frac{1}{3}Ah=138$	
			•[2] complete substitution into formula	•[2] $\frac{1}{3}\times 6^2\times h=138$	
			•[3] calculate height	•[3] 11·5 (cm)	
			Method 2	**Method 2**	
			•[1] change subject to h	•[1] $\frac{3V}{A}$ or $\frac{V}{\frac{1}{3}A}$	
			•[2] correct substitution into formula	•[2] $\frac{3\times 138}{6\times 6}$ or $\frac{138}{\frac{1}{3}\times 6\times 6}$	
			•[3] calculate height	•[3] 11·5 (cm)	

Question	Generic scheme	Illustrative scheme	Max mark

Notes:

1. For a correct answer without working award 0/3
2. For an answer obtained by guess and check award 0/3
3. Accept $\frac{23}{2}$ or $11\frac{1}{2}$
4. For subsequent incorrect working, the final mark is not available
   eg $\frac{23}{2} = 11{\cdot}1$
5. Calculation must involve division by a number greater than 10 for the award of $\bullet^3$

Commonly Observed Responses:
Working must be shown.

1. (a) $\frac{1}{3}\times 6^2 \times h = 138 \rightarrow \frac{1}{3}\times 12 \times h = 138 \rightarrow 4h = 138 \rightarrow h = 34{\cdot}5$ award 2/3 ✓✓×

   (b) $\frac{1}{3}\times 12 \times h = 138 \rightarrow 4h = 138 \rightarrow h = 34{\cdot}5$ award 1/3 ✓××

2. $\frac{1}{3}\times 18 \times h = 138 \rightarrow 6h = 138 \rightarrow h = 23$ $[A = \frac{1}{2}\times 6^2]$ award 1/3 ✓××

3. $\frac{1}{3}\times 24 \times h = 138 \rightarrow 8h = 138 \rightarrow h = 17{\cdot}25$ $[A = 4\times 6]$ award 1/3 ✓××

4. (a) $V = \frac{1}{3}Ah \rightarrow \frac{1}{3}\times 6 \times h = 138 \rightarrow 2h = 138 \rightarrow h = 69$ award 1/3 ✓××

   (b) $h = \frac{3V}{A} \rightarrow h = \frac{3\times 138}{6} \rightarrow h = 69$ award 1/3 ✓××

   (c) $\frac{1}{3}\times 6 \times h = 138 \rightarrow 2h = 138 \rightarrow h = 69$ award 0/3

Question			Generic scheme	Illustrative scheme	Max mark
18.			•¹ correct substitution for $\tan x$ •² express in simplest form	•¹ $\sin x \cos x \dfrac{\sin x}{\cos x}$ •² $\sin^2 x$	**2**

Notes:

1. For $\sin^2 x$ without working award 0/2
2. Degree signs are not required
3. Accept $(\sin x)^2$ but **not** $\sin x^2$
4. •¹ is not available if there are no variables
   eg $\sin\cos\dfrac{\sin}{\cos} = \sin^2$ award 1/2 ×✓
5. •¹ is not available if candidate simply states $\tan x = \dfrac{\sin x}{\cos x}$ then proceeds no further
6. •² is not available if there is invalid subsequent working
   eg (a) $\sin x \cos x \dfrac{\sin x}{\cos x} = \sin^2 x = 1 - \cos x$ award 1/2 ✓×
   (b) $\sin x \cos x \dfrac{\sin x}{\cos x} = \sin^2 x = 1 - \cos^2 x$ award 2/2
7. Alternative acceptable strategy:
   •¹ $\left(\dfrac{o}{h}\right)\left(\dfrac{a}{h}\right)\left(\dfrac{o}{a}\right)$
   •² $\dfrac{o^2}{h^2} = \sin^2 x$ award 2/2

Commonly Observed Responses:

1. $\sin x \cos x \dfrac{\sin x}{\cos x} = \sin x^2$ award 1/2 ✓×
2. $1 \times \dfrac{\sin x}{\cos x} = \tan x$ award 1/2 ✓×
3. $\sin x \cos x \dfrac{\cos x}{\sin x} = \cos^2 x$ award 1/2 ×✓

Question			Generic scheme	Illustrative scheme	Max mark
19.	(a)	(i)	•[1] correct bracket with square •[2] complete process	•[1] $(x-3)^2\ldots$ •[2] $(x-3)^2-90$	**2**

Notes:

1. Correct answer without working award 2/2
2. If the solution to (a)(i) only appears in (a)(ii) then both marks are available

Commonly Observed Responses:
No working necessary:

1. Award 2/2 for (a) $(x-3)^2+(-90)$ or $(x-3)^2+-90$
   (b) $(x-3)(x-3)-90$

2. Award 1/2 ×✓ for (a) $(x-3)-90$
   (b) $(x^2-3)-90$
   (c) $(x^2-3)^2-90$
   (d) $(x-3x)^2-90$
   (e) $(x-6)^2-117$

3. (a) $(x-6)^2-117$ award 1/2 ×✓
   (b) $(x-6)^2-90$ award 0/2

		(ii)	•[1] state equation of axis of symmetry	•[1] $x=3$	**1**

Notes:

1. For 3 or axis of symmetry $=3$ award 0/1
2. Answer must be consistent with answer to 19(a)(i) [unless no answer given to 19(a)(i)]

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
19.	(b)		**Ans:** $d=3, e=10$		**4**
			Method 1	**Method 1**	
			$\bullet^1$ equate complete square form to zero	$\bullet^1$ $(x-3)^2-90=0$	
			$\bullet^2$ start to solve	$\bullet^2$ $x-3=\pm\sqrt{90}$	
			$\bullet^3$ solve equation	$\bullet^3$ $x=3\pm\sqrt{90}$	
			$\bullet^4$ complete process	$\bullet^4$ $d=3, e=10$ or $3\pm3\sqrt{10}$	
			Method 2	**Method 2**	
			$\bullet^1$ correct substitution into quadratic formula	$\bullet^1$ $\dfrac{6\pm\sqrt{(-6)^2-4\times1\times(-81)}}{2\times1}$	
			$\bullet^2$ evaluate discriminant	$\bullet^2$ 360 (stated or implied by $\bullet^3$)	
			$\bullet^3$ express discriminant in simplest form	$\bullet^3$ $6\sqrt{10}$	
			$\bullet^4$ complete process	$\bullet^4$ $d=3, e=10$ or $3\pm3\sqrt{10}$	

Notes:

1. Correct answer without working award 0/4
2. Where a, b and c are all positive $\bullet^2$ is not available
3. Where b^2-4ac is calculated incorrectly, $\bullet^3$ and $\bullet^4$ are only available if $b^2-4ac>0$ (See CORs 2 – 5)
4. $\bullet^4$ is only available where a correct simplification of $\sqrt{\text{discriminant}}$ leads to a final answer of the form $d\pm d\sqrt{e}$ (See COR 6)

Commonly Observed Responses:
Working must be shown.

1. $\frac{6\pm\sqrt{(-6)^2-4\times1\times(-81)}}{2\times1}\rightarrow\frac{6\pm\sqrt{360}}{2}\rightarrow\frac{6\pm3\sqrt{40}}{2}\rightarrow3\pm1{\cdot}5\sqrt{40}$ award 2/4 ✓✓××

2. $\frac{6\pm\sqrt{(-6)^2-4\times1\times(-81)}}{2\times1}\rightarrow\frac{6\pm\sqrt{-288}}{2}\rightarrow\frac{6\pm12\sqrt{2}}{2}\rightarrow3\pm6\sqrt{2}$ award 1/4 ✓×××

   (**BEWARE:** candidate may get $\sqrt{-288}$ then change it to $\sqrt{288}$)

3. $\frac{6\pm\sqrt{(-6)^2-4\times1\times(-81)}}{2\times1}\rightarrow\frac{6\pm\sqrt{288}}{2}\rightarrow\frac{6\pm12\sqrt{2}}{2}\rightarrow3\pm6\sqrt{2}$ award 2/4 ✓×✓×

4. $\frac{6\pm\sqrt{(-6)^2-4\times1\times81}}{2\times1}\rightarrow\frac{6\pm\sqrt{-288}}{2}\rightarrow\frac{6\pm12\sqrt{2}}{2}\rightarrow3\pm6\sqrt{2}$ award 1/4 ×✓××

   (**BEWARE:** candidate may get $\sqrt{-288}$ then change it to $\sqrt{288}$)

5. $\frac{-6\pm\sqrt{6^2-4\times1\times81}}{2\times1}\rightarrow\frac{-6\pm\sqrt{-288}}{2}\rightarrow\frac{-6\pm12\sqrt{2}}{2}\rightarrow-3\pm6\sqrt{2}$ award 0/4

   (**BEWARE:** candidate may get $\sqrt{-288}$ then change it to $\sqrt{288}$)

6. $\frac{6\pm\sqrt{(-6)^2-4\times1\times81}}{2\times1}\rightarrow\frac{6\pm\sqrt{288}}{2}\rightarrow\frac{6\pm12\sqrt{2}}{2}\rightarrow3\pm6\sqrt{2}$ award 1/4 ××✓×

7. $\frac{6\pm\sqrt{(-6)^2-4\times1\times(-81)}}{2\times1}\rightarrow\frac{6\pm\sqrt{288}}{2}\rightarrow\frac{6\pm6\sqrt{8}}{2}\rightarrow3\pm3\sqrt{8}$ award 2/4 ✓××✓

8. $6\pm\sqrt{(-6)^2-4\times1\times(-81)}\rightarrow6\pm\sqrt{360}\rightarrow6\pm6\sqrt{10}$ award 2/4 ×✓✓×

[END OF MARKING INSTRUCTIONS]

National
Qualifications
2018

2018 Mathematics

National 5 - Paper 2

Finalised Marking Instructions

General marking principles for National 5 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.

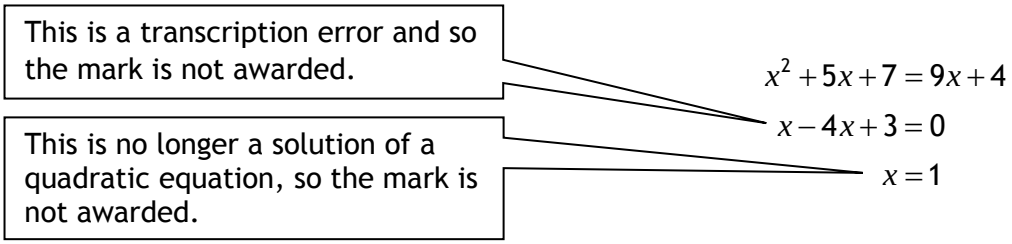
(d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.

(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.

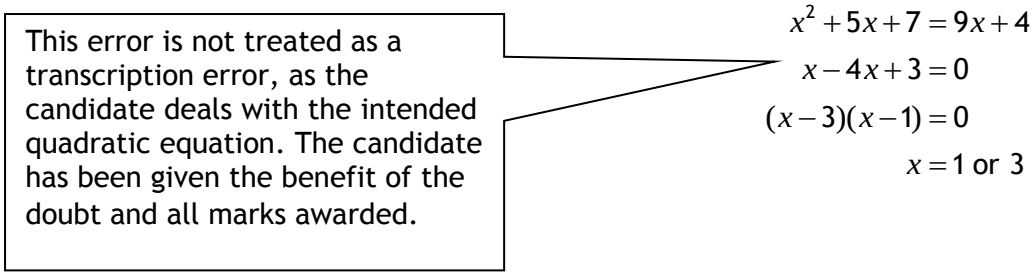
(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(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:

	$\bullet^5$	$\bullet^6$
$\bullet^5$	$x=2$	$x=-4$
$\bullet^6$	$y=5$	$y=-7$

Horizontal: $\bullet^5$ $x=2$ and $x=-4$ Vertical: $\bullet^5$ $x=2$ and $y=5$
$\bullet^6$ $y=5$ and $y=-7$ $\bullet^6$ $x=-4$ 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

$\frac{15}{0\cdot3}$ must be simplified to 50 $\frac{\frac{4}{5}}{3}$ must be simplified to $\frac{4}{15}$

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

*The square root of perfect squares up to and including 100 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.

Detailed marking instructions for each question

Question	Generic scheme	Illustrative scheme	Max mark
1.	• [1] know how to decrease by 2% • [2] know how to calculate new total • [3] carry out calculations correctly within a valid strategy	• [1] $\times 0 \cdot 98$ • [2] $125\ 000 \times 0 \cdot 98^3$ • [3] 117 649 (tonnes)	**3**

Notes:

1. Correct answer without working award 3/3
2. Where an incorrect percentage is used, the working must be followed through to give the possibility of awarding 2/3, with working
   eg $125\ 000 \times 0 \cdot 02^3 = 1$, with working award 2/3 ×✓✓
3. Where division is used
   (a) along with $0 \cdot 98$, • [1] is not available
   eg $125\ 000 \div 0 \cdot 98^3 = 132810(\cdot 3\ldots)$ award 2/3 ×✓✓
   (b) along with an incorrect percentage, • [1] and • [2] are not available
   eg $125\ 000 \div 1 \cdot 02^3 = 117790(\cdot 2\ldots)$ award 1/3 ××✓

Commonly Observed Responses:
Working must be shown:

1. $125\ 000 \times 1 \cdot 02^3 = 132651$ award 2/3 ×✓✓
2. $125\ 000 \times 0 \cdot 98 = 122500$ award 1/3 ✓××
3. $125\ 000 \times 0 \cdot 98 \times 3 = 367500$ award 1/3 ✓××
4. $125\ 000 \times 0 \cdot 02 = 2500 \rightarrow 125000 - 3 \times 2500 = 117500$ award 1/3 ✓××
5. $125\ 000 \times 0 \cdot 02 \times 3 = 7500$ award 0/3

Question			Generic scheme	Illustrative scheme	Max mark
2.			**Method 1** •[1] appropriate fraction •[2] correct substitution into arc length formula •[3] calculate arc length **Method 2** •[1] appropriate fraction •[2] correct substitution into arc length formula •[3] calculate arc length	**Method 1** •[1] $\frac{320}{360}$ •[2] $\frac{320}{360}\times 2\times\pi\times 7\cdot 4$ •[3] $41(\cdot 32\ldots)\ (\text{cm})$ **Method 2** •[1] $\frac{360}{320}$ •[2] $2\times\pi\times 7\cdot 4\div\frac{360}{320}$ •[3] $41(\cdot 32\ldots)\ (\text{cm})$	**3**

Question	Generic scheme	Illustrative scheme	Max mark

Notes:

1. Correct answer without working award 0/3

2. Do not penalise variations in π
   eg $\frac{320}{360}\times 2\times 3\cdot 14\times 7\cdot 4 = 41(\cdot 30\ldots)$ award 3/3

3. Premature rounding: rounded working must be to at least 2 significant figures
   eg (a) $\frac{320}{360}\times 2\times \pi\times 7\cdot 4 = 0\cdot 89\times 2\times \pi\times 7\cdot 4 = 41(\cdot 38\ldots)$ award 3/3
   (b) $\frac{320}{360}\times 2\times \pi\times 7\cdot 4 = 0\cdot 9\times 2\times \pi\times 7\cdot 4 = 42$ or $41\cdot 8(46\ldots)$ award 2/3 ✓✓×

4. Accept $2\times \pi\times 7\cdot 4 - \frac{40}{360}\times 2\times \pi\times 7\cdot 4 = 41$ or $41(\cdot 32\ldots)$ award 3/3

5. For subsequent incorrect working, the final mark is not available
   eg $2\times \pi\times 7\cdot 4 - \frac{320}{360}\times 2\times \pi\times 7\cdot 4 = 5$ or $5(\cdot 16\ldots)$ award 2/3 ✓✓×

Commonly Observed Responses:
Working must be shown:

1. $\frac{320}{360}\times \pi\times 7\cdot 4 = 21$ or $20\cdot 6(64\ldots)$ award 2/3 ✓×✓

2. $\frac{320}{360}\times \pi\times 7\cdot 4^2 = 153$ or $152\cdot 9(18\ldots)$ award 2/3 ✓×✓

3. $\frac{40}{360}\times 2\times \pi\times 7\cdot 4 = 5(\cdot 16\ldots)$ award 2/3 ×✓✓

4. $\frac{40}{360}\times \pi\times 7\cdot 4 = 3$ or $2\cdot 6$ or $2\cdot 5(83\ldots)$ award 1/3 ××✓

5. $\frac{40}{360}\times \pi\times 7\cdot 4^2 = 19(\cdot 11\ldots)$ award 1/3 ××✓

6. $2\times \pi\times 7\cdot 4 = 46(\cdot 49\ldots)$ award 0/3

Question			Generic scheme	Illustrative scheme	Max mark
3.			$\bullet^1$ start process $\bullet^2$ solution	$\bullet^1$ $24^2+\left(-12\right)^2+8^2$ $\bullet^2$ 28	**2**

Notes:

1. Correct answer without working award 2/2
2. Accept $24^2+12^2+8^2$ for the award of $\bullet^1$
3. For eg $\sqrt{24^2+(-12)^2}=\sqrt{720}=26\cdot8(3\ldots)$ or $12\sqrt{5}$ award 0/2

Commonly Observed Responses:
No working necessary:

1. $\sqrt{784}$ or 784 award 1/2 ✓×
2. $22\cdot2(7\ldots)$ or $4\sqrt{31}$ $\left(\sqrt{24^2-12^2+8^2}=\sqrt{496}\right)$ award 1/2 ×✓
3. $\sqrt{496}$ award 0/2
4. $\sqrt{20}=4\cdot4\ldots$ $\left(\sqrt{24\ -12\ +8}\right)$ award 0/2

Question			Generic scheme	Illustrative scheme	Max mark
4.			• [1] start to process right hand side • [2] collect like terms • [3] solve for x	• [1] $6x-6-12$ • [2] $-3x<-18$ or $18<3x$ • [3] $x>6$ or $6<x$	**3**

Notes:

1. Correct answer without valid working award 0/3
   Treat guess and check as invalid working

2. For subsequent incorrect working final mark is not available
   eg $6<x \rightarrow x<6$ award 2/3

Commonly Observed Responses:

1. $3x<6x-6-12 \rightarrow 3x<-18 \rightarrow x<-6$ award 1/3 ✓××

2. $3x<6x-1-12 \rightarrow -3x<-13 \rightarrow x>\frac{13}{3}$ award 2/3 ×✓✓

3. (a) $3x=6x-6-12 \rightarrow -3x=-18 \rightarrow x=6 \rightarrow x>6$ award 3/3
   (b) $3x=6x-6-12 \rightarrow -3x=-18 \rightarrow x=6$ award 2/3 ✓✓×

Question			Generic scheme	Illustrative scheme	Max mark
5.	(a)		**Method 1** •[1] calculate mean •[2] calculate $\left(x-\overline{x}\right)^2$ •[3] substitute into formula •[4] calculate standard deviation **Method 2** •[1] calculate mean •[2] calculate $\sum x$ and $\sum x^2$ •[3] substitute into formula •[4] calculate standard deviation	**Method 1** •[1] 126 •[2] 36, 0, 1, 25, 16, 4 •[3] $\sqrt{\frac{82}{5}}$ •[4] 4(·049…) **Method 2** •[1] 126 •[2] 756, 95338 •[3] $\sqrt{\frac{95338-\frac{756^2}{6}}{5}}$ •[4] 4(·049…)	**4**

Notes:

1. For 126 and 4(·04…) without working award 1/4 ✓×××
2. Accept (standard deviation =) 4·04 with working
3. (a) For 126 and $\frac{\sqrt{82}}{5}=4(\cdot 049...)$ award 4/4

   (b) For 126 and $\frac{\sqrt{82}}{5}=1(\cdot 811...)$ award 3/4 ✓✓×✓

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
5.	(b)		•[1] compare means •[2] compare standard deviations	•[1] eg on average the number of customers was higher on Saturday •[2] eg the number of customers was less varied on Saturday	**2**

Notes:

1. Answers must be consistent with answers to part (a)

2. Statements must involve
   (a) reference to number of customers **and** a chronological comparison or reference to Saturday and/or Sunday
   - Accept eg 'there were more customers on Saturday'
     'on average the number of customers decreased'
   - Do **not** accept eg 'there were more visits on Saturday',
     'the customers were more consistent on Saturday'
     'on average the number of customers was more'

3. For the award of •[1]
   (a) eg Accept
   - Saturday's average number of customers was more
   - The amount of people was higher on Saturday

   (b) eg Do **not** accept
   - The mean number of customers on Saturday was more
   - There were more customers at each stall on Saturday
   - The average number of people visiting the stalls was better

4. For the award of •[2]
   (a) eg Accept
   - The spread of customer numbers on Saturday was less
   - The number of customers on Saturday was more consistent
   - Saturday's customer numbers were less varied

   (b) eg Do **not** accept
   - The standard deviation on Saturday was less
   - The range of customer numbers on Saturday was less
   - The customers on Saturday were less varied
   - On average the number of customers on Saturday was less varied
   - The standard deviation is more consistent

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
6.			•[1] valid strategy •[2] state value of a	•[1] $5+4a=73$ or $5+4\times17$ •[2] $(a=)17$	**2**

Notes:

1. Correct answer without working award 2/2
2. Accept $f(17)=73$ without working award 2/2
3. Accept use of x in place of a

Commonly Observed Responses:

1. $5+4\times73=297$ award 0/2
2. $5+4a=73$ or $5+4\times17\rightarrow a=17\rightarrow f(a)=17$ award 2/2
3. $5+4a=73$ or $5+4\times17\rightarrow f(a)=17$ award 1/2 ✓×
4. $f(73)=5+4x\rightarrow x=17$ award 2/2

Question			Generic scheme	Illustrative scheme	Max mark
7.			• [1] substitute into formula • [2] calculate volume • [3] round to 2 significant figures	• [1] $\frac{4}{3}\times\pi\times3\cdot2^3$ • [2] $137\cdot2\ldots$ • [3] $140\left(\text{cm}^3\right)$	**3**

Notes:

1. Correct answer without working award 0/3
2. Accept variations in π
   eg $\frac{4}{3}\times3\cdot14\times3\cdot2^3=137\cdot188\ldots=140$

Commonly Observed Responses:

1. $\frac{4}{3}\times\pi\times6\cdot4^3=1098\cdot0\ldots=1100$ award 2/3 ×✓✓
2. $\frac{4}{3}\times\pi\times3\cdot2^2=42\cdot8\ldots=43$ award 2/3 ×✓✓
3. $\frac{4}{3}\times\pi\times3\cdot2^3=42\cdot8\ldots=43$ award 2/3 ✓×✓
4. $\frac{4}{3}\times\pi\times3\cdot2=13\cdot4\ldots=13$ award 1/3 ××✓

Question			Generic scheme	Illustrative scheme	Max mark
8.			• [1] rearrange equation • [2] calculate value of x • [3] calculate 2nd value of x	• [1] $\sin x = \frac{1}{7}$ • [2] $8\cdot2(1\ldots)$ • [3] $171\cdot8$ or $171\cdot7(8\ldots)$	**3**

Notes:

1. Correct answers without working award 1/3 ××✓
2. Accept 8 and 172 with valid working
3. Degree signs are not required
4. Premature rounding: rounded working must be to at least 2 decimal places
   eg (a) $\sin x = \frac{1}{7} = 0\cdot14 \rightarrow x = 8(\cdot04\ldots), 172$ or $171\cdot(95\ldots)$ award 3/3
   (b) $\sin x = \frac{1}{7} = 0\cdot1 \rightarrow x = 6$ or $5(\cdot73\ldots), 174\cdot(26\ldots)$ award 2/3 ✓×✓
5. Inappropriate use of RAD or GRAD should only be penalised once in Q8, Q9, Q13 or Q17
   (a) 0·143… ,179·856… (RAD)
   (b) 9·125…. ,170·874… (GRAD)

Commonly Observed Responses:

1. $\sin x = \frac{5}{7} \rightarrow x = 45\cdot6, 134\cdot4$ award 2/3 ×✓✓
2. (a) $\sin x = -\frac{1}{7} \rightarrow x = 188\cdot2, 351\cdot8$ award 2/3 ×✓✓
   (b) $\sin x = -\frac{1}{7} \rightarrow x = 8\cdot2, 171\cdot8$ award 0/3

Question			Generic scheme	Illustrative scheme	Max mark
9.			• [1] correct substitution into sine rule • [2] re-arrange formula • [3] calculate length	• [1] $\frac{20}{\sin 37} = \frac{DC}{\sin 105}$ • [2] $\frac{20\sin 105}{\sin 37}$ • [3] $32(\cdot 1\ldots \text{ cm})$	**3**

Notes:

1. Correct answer without working award 0/3
2. Degree signs are not required
3. **BEWARE** $\frac{20}{\sin 37} = \frac{DC}{\sin 75} \rightarrow 32(\cdot 1\ldots)$ award 2/3 ×✓✓
4. Disregard errors due to premature rounding provided there is evidence
5. Inappropriate use of RAD or GRAD should only be penalised once in Q8, Q9, Q13 or Q17
   (a) 30(·16...) (RAD)
   (b) 36(·31...) (GRAD)

Commonly Observed Responses:

1. $\frac{20}{\sin 37} = \frac{?}{\sin 38} \rightarrow \frac{20\sin 38}{\sin 37} = 20(\cdot 46\ldots)$ award 2/3 ×✓✓
2. $\frac{20}{37} = \frac{DC}{105} \rightarrow 57$ or $56(\cdot 7\ldots)$ award 0/3

Question			Generic scheme	Illustrative scheme	Max mark
10.			$\bullet^1$ express $\overrightarrow{ED}$ in terms of $\mathbf{u}$ and $\overrightarrow{DC}$ in terms of $\mathbf{w}$ $\bullet^2$ express $\overrightarrow{BC}$ in terms of $\mathbf{u}$ and $\mathbf{w}$ in simplest form	$\bullet^1$ $\overrightarrow{ED} = 2\mathbf{u}$ and $\overrightarrow{DC} = \frac{1}{2}\mathbf{w}$ $\bullet^2$ $\mathbf{u} - \frac{1}{2}\mathbf{w}$	**2**

Notes:

1. Correct answer without working award 2/2
2. Accept $\mathbf{u} + -\frac{1}{2}\mathbf{w}$ award 2/2
3. Evidence for the award of $\bullet^1$ may appear on the diagram
4. For the award of $\bullet^1$ accept
   (a) $-\mathbf{u} - \mathbf{w} + 2\mathbf{u} + \frac{1}{2}\mathbf{w}$
   (b) $-\mathbf{u} - \mathbf{w} + 2\overrightarrow{AB} + \frac{1}{2}\overrightarrow{EA}$
5. $\overrightarrow{BA} + \overrightarrow{AE} + \overrightarrow{ED} + \overrightarrow{DC}$ alone is not enough for the award of $\bullet^1$
6. For $-\mathbf{u} + \frac{1}{2}\mathbf{w}$ (a) without working award 0/2
   (b) but **may** be worth 1/2 if there is valid working

Commonly Observed Responses:

Question	Generic scheme	Illustrative scheme	Max mark
11.	$\bullet^1$ know that $85\% = 9\cdot3\times10^{11}$	$\bullet^1$ $85\% = 9\cdot3\times10^{11}$	**3**
	$\bullet^2$ begin valid strategy	$\bullet^2$ $1\% = \dfrac{9\cdot3\times10^{11}}{85}$	
	$\bullet^3$ complete calculation within valid strategy	$\bullet^3$ $1\cdot094...\times10^{12}$ (km^3) or 1094117647000 (km^3)	

Notes:

1. $1\cdot1\times10^{12}$
   (a) with valid working award 3/3
   (b) without working award 0/3

2. **BEWARE**
   115% of $9\cdot3\times10^{11} = 1\cdot1\times10^{12}$ or $1\cdot06...\times10^{12}$
   (a) **and** evidence of $\bullet^1$ award 1/3 ✓××
   (b) otherwise award 0/3

3. 85% of $9\cdot3\times10^{11} = 7\cdot9(05)\times10^{11}$
   (a) **and** evidence of $\bullet^1$ award 1/3 ✓××
   (b) otherwise award 0/3

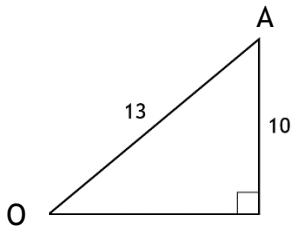
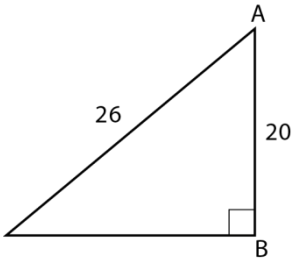
4. Do not accept eg $10\cdot94...\times10^{11}$ for the award of $\bullet^3$

Commonly Observed Responses:

1. $\dfrac{9\cdot3\times10^{11}}{0\cdot85} = 1\cdot094...\times10^{12}$ award 3/3

2. $115\% = 9\cdot3\times10^{11} \rightarrow \dfrac{9\cdot3\times10^{11}}{1\cdot15} = 8\cdot086...\times10^{11}$ award 2/3 ×✓✓

3. $15\% = 9\cdot3\times10^{11} \rightarrow \dfrac{9\cdot3\times10^{11}}{0\cdot15} = 6\cdot2\times10^{12}$ award 2/3 ×✓✓

Question			Generic scheme	Illustrative scheme	Max mark
12.			**Method 1** •[1] marshal facts and recognise right angled triangle	•[1]  	**4**
			•[2] consistent Pythagoras statement	•[2] $x^2 = 13^2 - 10^2$	
			•[3] calculate x	•[3] $8 \cdot 3(\ldots)$	
			•[4] calculate width	•[4] $21 \cdot 3(\ldots \text{ cm})$	
			Method 2 •[1] marshal facts and recognise right angled triangle	•[1]  	
			•[2] consistent Pythagoras statement	•[2] $x^2 = 26^2 - 20^2$	
			•[3] calculate x	•[3] $16 \cdot 6(\ldots)$	
			•[4] calculate width	•[4] $21 \cdot 3(\ldots \text{ cm})$	

Question	Generic scheme	Illustrative scheme	Max mark

Notes:

1. Correct answer without working award 0/4

2. In the absence of a diagram accept $x^2 = 13^2 - 10^2$ or $x^2 = 26^2 - 20^2$ as evidence for the award of $\bullet^1$ and $\bullet^2$

3. **BEWARE**
   Where a diagram is shown, working must be consistent with the diagram
   $\bullet^2$ is not available for an **incorrect** diagram leading to $x^2 = 13^2 - 10^2$ or $x^2 = 26^2 - 20^2$

4. $\bullet^2$ is available for a valid trig. method

5. Where a candidate **assumes** the sizes of one or both of the smaller angles in the right-angled triangle, only $\bullet^1$ and $\bullet^4$ are available

6. $\bullet^4$ is only available following a Pythagoras (or trig.) calculation within a right-angled triangle involving 13 and 10 or 26 and 20

7. Disregard errors due to premature rounding provided there is evidence

Commonly Observed Responses:

1. $x^2 = 13^2 + 10^2 \rightarrow x = 16 \cdot 4$; width $= 29 \cdot 4$
   (a) working inconsistent with correct diagram — award 3/4 ✓×✓✓
   (b) working consistent with candidate's diagram (cosine rule may be used to calculate X) — award 3/4 ×✓✓✓
   (c) no diagram — award 2/4 ××✓✓

2. $x^2 = 26^2 + 20^2 \rightarrow x = 32 \cdot 8$; width $= 29 \cdot 4$
   (a) working inconsistent with correct diagram — award 3/4 ✓×✓✓
   (b) working consistent with candidate's diagram (cosine rule may be used to calculate X) — award 3/4 ×✓✓✓
   (c) no diagram — award 2/4 ××✓✓

3. $x^2 = 20^2 - 13^2 \rightarrow x = 15 \cdot 2$; width $= 28 \cdot 2$
   (a) working consistent with candidate's diagram (cosine rule may be used to calculate X) — award 2/4 ×✓✓×
   (b) no diagram — award 1/4 ××✓×

Question			Generic scheme	Illustrative scheme	Max mark
13.			•[1] correct substitution into cosine rule	•[1] $\frac{10\cdot3^2+5\cdot6^2-7\cdot2^2}{2\times10\cdot3\times5\cdot6}$	**4**
			•[2] correct calculation of $\cos$ YTF	•[2] $\frac{85\cdot61}{115\cdot36}\left(=0\cdot742\ldots\right)$	
			•[3] calculate angle YTF	•[3] 42(·088...)	
			•[4] calculate bearing	•[4] 282(·088...)	

Question	Generic scheme	Illustrative scheme	Max mark

Notes:

1. Correct answer without working award 0/4

2. For subsequent invalid working $\bullet^4$ is not available
   eg $282 \rightarrow 360 - 282 = 078$

3. Degree signs are not required

4. Where an incorrect angle has been calculated $\bullet^4$ can only be awarded where there is clear evidence of an intention to calculate angle T
   eg $\cos T = \dfrac{10 \cdot 3^2 + 7 \cdot 2^2 - 5 \cdot 6^2}{2 \times 10 \cdot 3 \times 7 \cdot 2}$ **OR** $T = 31$ **OR** angle marked at T on the diagram

5. $\bullet^4$ can only be awarded for adding 240 to a value previously calculated using trig.

6. Disregard errors due to premature rounding provided there is evidence

7. Inappropriate use of RAD or GRAD should only be penalised once in Q8, Q9, Q13 or Q17
   (a) 240·73… (RAD)
   (b) 286·76… (GRAD)

Commonly Observed Responses:
Working must be shown.

1. (a) $\cos T = \dfrac{10 \cdot 3^2 + 7 \cdot 2^2 - 5 \cdot 6^2}{2 \times 10 \cdot 3 \times 7 \cdot 2} = \dfrac{126 \cdot 57}{148 \cdot 32} \rightarrow 31 \rightarrow 271$ award 3/4 ×✓✓✓ (see Note 4)

   (b) $\dfrac{10 \cdot 3^2 + 7 \cdot 2^2 - 5 \cdot 6^2}{2 \times 10 \cdot 3 \times 7 \cdot 2} = \dfrac{126 \cdot 57}{148 \cdot 32} \rightarrow 31 \rightarrow 271$ award 2/4 ×✓✓×

2. (a) $\cos T = \dfrac{7 \cdot 2^2 + 5 \cdot 6^2 - 10 \cdot 3^2}{2 \times 7 \cdot 2 \times 5 \cdot 6} = \dfrac{-22 \cdot 89}{80 \cdot 64} \rightarrow 106 \rightarrow 346$ award 3/4 ×✓✓✓ (see Note 4)

   (b) $\dfrac{7 \cdot 2^2 + 5 \cdot 6^2 - 10 \cdot 3^2}{2 \times 7 \cdot 2 \times 5 \cdot 6} = \dfrac{-22 \cdot 89}{80 \cdot 64} \rightarrow 106 \rightarrow 346$ award 2/4 ×✓✓×

Question			Generic scheme	Illustrative scheme	Max mark
14.			**Method 1** •[1] isolate term in y or divide throughout by 5 •[2] state coordinates (**must** use brackets) **Method 2** •[1] substitute $x=0$ into equation •[2] state coordinates (**must** use brackets)	**Method 1** •[1] $-5y=\ldots+20$ or $\ldots-20=5y$ or $\frac{2x}{5}-\frac{5y}{5}=\frac{20}{5}$ •[2] $(0,-4)$ **Method 2** •[1] $2\times0-5y=20$ •[2] $(0,-4)$	**2**

Notes:

1. Correct answer without working award 2/2
2. Disregard errors in the x term for the award of •[1]
3. For finding where the line crosses the x-axis, (10, 0), with working award 1/2

Commonly Observed Responses

1. $0,-4$ (no working necessary) award 1/2 ✓×
2. $y=-4$ (no working necessary) award 1/2 ✓×

Question	Generic scheme	Illustrative scheme	Max mark
15.	•1 start to divide fractions	•1 $\frac{n}{n^2-4} \times \frac{n-2}{3}$	**3**
	•2 factorise	•2 $(n+2)(n-2)$	
	•3 multiply and simplify	•3 $\frac{n}{3(n+2)}$ or $\frac{n}{3n+6}$ S	

Notes:

1. Correct answer without working 0/3
2. For subsequent incorrect working, the final mark is not available

   eg (a) $\frac{n}{3(n+2)} = \frac{n}{3n+2}$ award 2/3 ✓✓×

   (b) $\frac{\not{n}}{3(\not{n}+2)} = \frac{1}{3(1+2)} = \frac{1}{9}$ award 2/3 ✓✓×

Commonly Observed Responses:

1. $\frac{n}{n^2-4} \div \frac{3(n+2)}{n^2-4} \rightarrow \frac{n}{n^2-4} \times \frac{n^2-4}{3(n+2)} \rightarrow \frac{n}{3(n+2)}$ award 3/3

Question			Generic scheme	Illustrative scheme	Max mark
16.			$\bullet^1$ start valid strategy	$\bullet^1$ 40^2+40^2 or 40^2+70^2 (stated or implied by $\bullet^2$)	**4**
			$\bullet^2$ continue strategy	$\bullet^2$ $\sqrt{40^2+40^2+70^2}$	
			$\bullet^3$ calculate length of space diagonal	$\bullet^3$ 90	
			$\bullet^4$ valid conclusion with comparison	$\bullet^4$ Yes, since $85 < 90$	

Question	Generic scheme	Illustrative scheme	Max mark

Notes:

1. Correct answer without working 0/4

2. Accept correct use of cosine rule

3. Accept eg $\begin{pmatrix} -40 \\ 40 \\ 70 \end{pmatrix} \rightarrow \sqrt{(-40)^2 + 40^2 + 70^2}$ for the award of $\bullet^1$ and $\bullet^2$

4. $\bullet^4$ can only be awarded for a valid conclusion and comparison made with a value obtained from a Pythagoras (or trigonometric) calculation

5. Award of $\bullet^4$:

   eg (a) $\sqrt{40^2 + 40^2 + 70^2} = 90$; Yes, since the umbrella is **only** 85 — award 4/4

   (b) $\sqrt{40^2 + 40^2 + 70^2} = 90$; Yes — award 3/4 ✓✓✓×

   (c) $\sqrt{40^2 + 70^2} = 80 \cdot 62\ldots$; No, since the locker is **only** $80 \cdot 62\ldots$ — award 2/4 ✓××✓

Commonly Observed Responses:

1. (a) $\sqrt{40^2 + 70^2} = 80 \cdot 62\ldots$; No, since $85 > 80 \cdot 62\ldots$ award 2/4 ✓××✓

   (b) $\sqrt{40^2 + 40^2} = 56 \cdot 56\ldots$; No, since $85 > 56 \cdot 56\ldots$ award 2/4 ✓××✓

2. (a) $\sqrt{40^2 + 40^2} = 56 \cdot 56\ldots = 57 \rightarrow \sqrt{57^2 + 70^2} = 90 \cdot 27 = 90$; Yes, since $85 < 90$ award 4/4

   (b) $\sqrt{40^2 + 70^2} = 80 \cdot 62\ldots = 81 \rightarrow \sqrt{81^2 + 40^2} = 90 \cdot 33 = 90$; Yes, since $85 < 90$ award 4/4

3. (a) $40^2 + 40^2 + 70^2 = 8100;\ 85^2 = 7225$ Yes, since $8100 > 7225$ award 4/4

   (b) $40^2 + 40^2 + 70^2 = 8100;\ 85^2 = 7225$ Yes, since $8100 \neq 7225$ award 3/4 ✓✓✓×

4. (a) $40^2 + 40^2 = 3200;\ 85^2 = 7225$ No, since $3200 < 7225$ award 2/4 ✓××✓

   (b) $40^2 + 40^2 = 3200;\ 85^2 = 7225$ No, since $3200 \neq 7225$ award 1/4 ✓×××

   (c) $40^2 + 70^2 = 6500;\ 85^2 = 7225$ No, since $6500 < 7225$ award 2/4 ✓××✓

   (d) $40^2 + 70^2 = 6500;\ 85^2 = 7225$ No, since $6500 \neq 7225$ award 1/4 ✓×××

5. $40^2 + 40^2 = 3200;\ 70^2 = 4900$ No, since $3200 < 4900$ award 1/4 ✓×××

Question			Generic scheme	Illustrative scheme	Max mark
17.			• [1] substitute correctly into area of triangle formula	• [1] $\frac{1}{2}\times 38\times 55\times \sin 75 \left(=1009\cdot 39...\right)$	**5**
			• [2] appropriate fraction for sector	• [2] $\frac{75}{360}$	
			• [3] substitute correctly into area of sector formula	• [3] $\frac{75}{360}\times \pi \times 30^2 \left(=589\cdot 04...\right)$	
			• [4] know to subtract area of sector from area of triangle	• [4] evidence of area of triangle − area of sector	
			• [5] calculate area of shaded region **and** state correct units	• [5] $420\left(\cdot 3...\right)$ cm^2	

Question	Generic scheme	Illustrative scheme	Max mark

Notes:

1. Correct answer without working award 0/5
2. Accept variations in π
3. Disregard errors due to premature rounding provided there is evidence
4. Inappropriate use of GRAD leading to $376(\cdot 40\ldots)\text{ cm}^2$ should only be penalised once in Q8, Q9, Q13 or Q17
5. The following answers should be awarded
   - 4/5 if the use of RAD has already been penalised in Q8, Q9 or Q13
   - 3/5 if the use of RAD has **not** already been penalised in Q8, Q9 or Q13

   (a) $-405(\cdot 23\ldots)-589(\cdot 04)=-994(\cdot 28\ldots)\text{ cm}^2$

   (b) $405(\cdot 23\ldots)-589(\cdot 04)=-183(\cdot 81\ldots)\text{ cm}^2$

   (c) $589(\cdot 04)-405(\cdot 23\ldots)=183(\cdot 81\ldots)\text{ cm}^2$

   (d) $589(\cdot 04)-(-405(\cdot 23\ldots))=994(\cdot 28\ldots)\text{ cm}^2$
6. $\bullet^5$ is only available for calculating the sum or difference of the area of a triangle and the area of a sector, where the area of the triangle is calculated using trigonometry

Commonly Observed Responses:
Working must be shown:

1. $\frac{1}{2}\times 38\times 55\times\sin 75-\frac{75}{360}\times\pi\times 60=970(\cdot 1\ldots)\text{ cm}^2$ award 4/5 ✓✓×✓✓
2. $\frac{1}{2}\times 38\times 55\times\sin 75+\frac{75}{360}\times\pi\times 30^2=1598(\cdot 4\ldots)\text{ cm}^2$ award 4/5 ✓✓✓×✓
3. $\frac{1}{2}\times 38\times 55\times\sin 75+\frac{75}{360}\times\pi\times 60=1048(\cdot 6\ldots)\text{ cm}^2$ award 3/5 ✓✓××✓
4. $\frac{75}{360}\times\pi\times 30^2=589(\cdot 0\ldots)\text{ cm}^2$ award 2/5 ×✓✓××
5. $\frac{1}{2}\times 38\times 55\times\sin 75=1009(\cdot 3\ldots)\text{ cm}^2$ award 1/5 ✓××××
6. $\pi\times 30^2=2827(\cdot 4\ldots)\text{ cm}^2$ award 0/5

Question			Generic scheme	Illustrative scheme	Max mark
18.	(a)		**Method 1**	**Method 1**	**3**
			•[1] state linear scale factor	•[1] eg $\frac{24}{16}$ or equivalent	
			•[2] know to multiply volume by cube of linear scale factor	•[2] $576\times\left(\frac{24}{16}\right)^3$	
			•[3] correct calculation (must involve a power of the scale factor), valid comparison and conclusion	•[3] $1944\neq1125$, so the cartons are not similar	
			Method 2	**Method 2**	
			•[1] state linear scale factor	•[1] eg $\frac{16}{24}$ or equivalent	
			•[2] know to divide volume by cube of linear scale factor	•[2] $576\div\left(\frac{16}{24}\right)^3$	
			•[3] correct calculation (must involve a power of the scale factor), valid comparison and conclusion	•[3] $1944\neq1125$, so the cartons are not similar	
			Method 3	**Method 3**	
			•[1] state volume scale factor	•[1] eg $\frac{1125}{576}$ or equivalent	
			•[2] know to multiply depth by cube root of volume scale factor	•[2] $\sqrt[3]{\frac{1125}{576}}\times16$	
			•[3] correct calculation (must involve a root of the volume scale factor), valid comparison and conclusion	•[3] $20\neq24$, so the cartons are not similar	
			Method 4	**Method 4**	
			•[1] state linear scale factor	•[1] eg $\frac{24}{16}$ or equivalent	
			•[2] know to compare cube of linear scale factor with volume scale factor	•[2] $\left(\frac{24}{16}\right)^3$ and $\frac{1125}{576}$	
			•[3] correct calculation (must involve a power of the scale factor), valid comparison and conclusion	•[3] $3\cdot375\neq1\cdot95\ldots$, so the cartons are not similar	

Question			Generic scheme	Illustrative scheme	Max mark
18.	(a)		**Method 5** •[1] state volume scale factor •[2] know to compare cube root of volume scale factor with linear scale factor •[3] correct calculation(must involve a root of the volume scale factor), valid comparison and conclusion	**Method 5** •[1] eg $\frac{1125}{576}$ or equivalent •[2] $\sqrt[3]{\frac{1125}{576}}$ and $\frac{24}{16}$ •[3] $1{\cdot}25 \neq 1{\cdot}5$, so the cartons are not similar	

Notes:

1. Correct answer without working award 0/3
2. For the award of •[1] accept a rounded or truncated decimal equivalent (to at least 2 decimal places) for evidence of the scale factor eg $\frac{1125}{576} = 1{\cdot}95$, $\frac{16}{24} = 0{\cdot}66$; but see Note 3
3. Where premature rounding leads to an inaccurate answer, •[3] is not available
   eg $1125 \times \left(\frac{16}{24}\right)^3 \rightarrow 1125 \times 0{\cdot}7^3 = 385{\cdot}875; 385{\cdot}875 \neq 576$, so the cartons are not similar
   award 2/3 ✓✓×
4. For the award of •[3] there must be a numerical comparison or a statement such as 'the two scale factors are different'; a simple statement of 'not similar' is not sufficient

Commonly Observed Responses:

1. $1125 \times \left(\frac{16}{24}\right)^3 = 333{\cdot}3\ldots$; $333{\cdot}3 \neq 576$, so the cartons are not similar — award 3/3
2. (a) $576 \times \frac{24}{16} = 864$; $864 \neq 1125$, so the cartons are not similar — award 1/3 ✓××
   (b) $576 \times \frac{16}{24} = 384$; $384 \neq 1125$, so the cartons are not similar — award 1/3 ✓××
3. (a) $576 \times \left(\frac{24}{16}\right)^2 = 1296$; $1296 \neq 1125$, so the cartons are not similar — award 2/3 ✓×✓
   (b) $576 \times \left(\frac{16}{24}\right)^2 = 256$; $256 \neq 1125$, so the cartons are not similar — award 2/3 ✓×✓
4. (a) $\frac{576}{16^3} = 0{\cdot}14\ldots, \frac{1125}{24^3} = 0{\cdot}08\ldots; 0{\cdot}14\ldots \neq 0{\cdot}08\ldots$, so the cartons are not similar — award 3/3
   (b) $\frac{576}{16^2} = 2{\cdot}25, \frac{1125}{24^2} = 1{\cdot}95\ldots; 2{\cdot}25 \neq 1{\cdot}95\ldots$, so the cartons are not similar — award 2/3 ✓×✓
   (c) $\frac{576}{16} = 36, \frac{1125}{24} = 46{\cdot}875; 36 \neq 46{\cdot}875$, so the cartons are not similar — award 1/3 ✓××

Question			Generic scheme	Illustrative scheme	Max mark
18.	**(b)**		**Method 1** •[1] find volume scale factor •[2] correct calculation to find height (must involve a root of the volume scale factor) **Method 2** •[1] find volume scale factor •[2] correct calculation to find height (must involve a root of the volume scale factor)	**Method 1** •[1] $\frac{1500}{576}$ •[2] $\sqrt[3]{\frac{1500}{576}} \times 16 = 22 (\cdot 0\ldots \text{ cm})$ **Method 2** •[1] $\frac{576}{1500}$ •[2] $16 \div \sqrt[3]{\frac{576}{1500}} = 22 (\cdot 0\ldots \text{ cm})$	**2**

Notes:

1. Correct answer without working award 0/2
2. Disregard errors due to premature rounding provided there is evidence

Commonly Observed Responses:

1. $\frac{1500}{576} \times 16 = 41 \cdot 66\ldots$ award 1/2 ✓×
2. $\sqrt{\frac{1500}{576}} \times 16 = 25 \cdot 81\ldots$ award 1/2 ✓×
3. $\sqrt[3]{\frac{1500}{1125}} \times 24 = 26 \cdot 41\ldots$ award 1/2 ×✓

[END OF MARKING INSTRUCTIONS]