N5 National Qualifications 2016

2016 Mathematics Paper 1 (Non-calculator)

National 5

Finalised Marking Instructions

Detailed Marking Instructions for each question

Question			Generic Scheme	Illustrative Scheme	Max Mark
1.			**Ans:** $\begin{pmatrix} -3 \\ -4 \end{pmatrix}$		**2**
			$\bullet^1$ calculate $\frac{1}{2}\mathbf{p}$	$\bullet^1$ $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$	
			$\bullet^2$ solution	$\bullet^2$ $\begin{pmatrix} -3 \\ -4 \end{pmatrix}$	

Notes:

1. Correct answer without working award 2/2
2. Treat $\begin{pmatrix} \frac{-3}{-4} \end{pmatrix}$ as bad form award 2/2
3. Where there are no brackets ie $\begin{matrix} -3 \\ -4 \end{matrix}$ award 1/2
4. For $\frac{-3}{-4}$ award 1/2
5. Where there is invalid subsequent working $\bullet^2$ is not available
   eg award 1/2 ✓× for the following:

   $\begin{pmatrix} -3 \\ -4 \end{pmatrix} \rightarrow$ (a) $(-3,-4)$

   (b) $-3+(-4)=-7$

   (c) $\sqrt{(-3)^2+(-4)^2}=5$

Commonly Observed Responses:

1. $\begin{pmatrix} 4 \\ -6 \end{pmatrix}+\begin{pmatrix} -5 \\ -1 \end{pmatrix}=\begin{pmatrix} -1 \\ -7 \end{pmatrix}$ award 1/2

2. $\frac{1}{2}\left(\begin{pmatrix} 4 \\ -6 \end{pmatrix}+\begin{pmatrix} -5 \\ -1 \end{pmatrix}\right)=\begin{pmatrix} -0{\cdot}5 \\ -3{\cdot}5 \end{pmatrix}$ award 1/2

3. $\begin{pmatrix} 4 \\ -6 \end{pmatrix}+\frac{1}{2}\begin{pmatrix} -5 \\ -1 \end{pmatrix}=\begin{pmatrix} 1{\cdot}5 \\ -6{\cdot}5 \end{pmatrix}$ award 1/2

Question			Generic Scheme	Illustrative Scheme	Max Mark
2.			Ans: $\frac{13}{28}$		2
			Method 1		
			•1 start the calculation correctly	•1 $\frac{7}{21}+\frac{6}{21}$	
			•2 consistent answer in simplest form	•2 $\frac{13}{28}$	
			Method 2		
			•1 start the calculation correctly	•1 $\frac{3}{12}+\frac{6}{28}$ or equivalent	
			•2 consistent answer in simplest form	•2 $\frac{13}{28}$	

Notes:

1. Correct answer without working award 0/2.
2. Final answer must be in simplest form eg for $\frac{39}{84}$ award 1/2 ✓×
3. •2 is only available where simplifying is required.
4. For subsequent incorrect working, •2 is not available eg for $\frac{13}{28}=2\frac{2}{28}=2\frac{1}{14}$ award 1/2 ✓×

Commonly Observed Responses:

1. For an answer of $\frac{9}{40}$ obtained from

   (a) Method 1: $\frac{3}{4}\left(\frac{1}{3}+\frac{2}{7}\right)=\frac{3}{4}\times\frac{3}{10}=\frac{9}{40}$ award 0/2

   (b) Method 2: $\frac{3}{12}+\frac{6}{28}=\frac{9}{40}$ award 1/2 ✓×

Question			Generic Scheme	Illustrative Scheme	Max Mark
3.			**Ans: 157 cm^2**		**3**
			Method 1		
			•^{1} appropriate fraction	•^{1} $\frac{45}{360}$ or equivalent	
			•^{2} correct substitution into area of sector formula	•^{2} $\frac{45}{360} \times 3 \cdot 14 \times 20^2$	
			•^{3} calculate area of sector	•^{3} 157 (cm^2)	
			Method 2		
			•^{1} appropriate fraction	•^{1} $\frac{360}{45}$ or equivalent	
			•^{2} correct substitution into area of sector formula	•^{2} $3 \cdot 14 \times 20^2 \div \frac{360}{45}$	
			•^{3} calculate area of sector	•^{3} 157 (cm^2)	

Notes:

1. Correct answer without working award 0/3.

2. Accept "$\div 8$" in working as evidence of $\frac{45}{360}$.

3. Accept "× 3·14" in working as evidence of substitution into formula.

Commonly Observed Responses:

1.	$\frac{45}{360} \times \pi r^2 = 8 \times 3 \cdot 14 \times 20^2 = 10048\,(\text{cm}^2)$	award 2/3 ✓✓×
2.	$\frac{360}{45} \times \pi r^2 = 8 \times 3 \cdot 14 \times 20^2 = 10048\,(\text{cm}^2)$	award 2/3 ✓×✓
3.	$\frac{45}{360} \times 3 \cdot 14 \times 20^2 \left(= \frac{45}{360} \times 3 \cdot 14 \times 40\right) = 15 \cdot 7\,(\text{cm}^2)$	award 2/3 ✓✓×
4.	$\frac{45}{360} \times 3 \cdot 14 \times 40 = 15 \cdot 7\,(\text{cm}^2)$	award 2/3 ✓×✓
5.	$\frac{45}{360} \times \pi \times 20^2$	award 1/3 ✓××
6.	$3 \cdot 14 \times 20^2 = 1256\,(\text{cm}^2)$	award 0/

Question			Generic Scheme	Illustrative Scheme	Max Mark
4.	(a)		**Ans:** $2c+3d=9\cdot 6$ •1 construct equation	 •1 $2c+3d=9\cdot 6$	1
Notes:					
Commonly Observed Responses:					
	(b)		**Ans:** $3c+4d=13\cdot 3$ •1 construct equation	 •1 $3c+4d=13\cdot 3$	1
Notes:					
Commonly Observed Responses:					
	(c)		**Ans: A cloak requires 1·5 m^2 of material A dress requires 2·2 m^2 of material** •1 evidence of scaling •2 follow a valid strategy through to produce values for c and d •3 calculate correct values for c and d •4 communicate answers in **square metres**	 •1 eg $6c+9d=28\cdot 8$ $6c+8d=26\cdot 6$ •2 values for c and d •3 $c=1\cdot 5$ and $d=2\cdot 2$ •4 cloak 1·5 m^2 dress 2·2 m^2	4

Notes:
1. Correct answer without working award 0/4.
2. •4 is not available if either c or d is negative.
3. (a) where a candidate calculates values for c and d , •4 can only be awarded for a **conclusion** containing the words 'cloak' and 'dress' along with the **correct units** in **both** cases
   (b) where a candidate only calculates a value for **either** c **or** d , •4 can only be awarded If the **conclusion** contains the word 'cloak' or 'dress' along with the **correct units**

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
5.	(a)		**Ans:** $W = 20A + 40$		**3**
			$\bullet^1$ gradient	$\bullet^1$ $\frac{240}{12}$ or equivalent	
			$\bullet^2$ substitute gradient and a point into $y = mx + c$ or $y - b = m(x - a)$	$\bullet^2$ $y - 100 = \frac{240}{12}(x - 3)$ or $y - 340 = \frac{240}{12}(x - 15)$ or $100 = \frac{240}{12} \times 3 + c$ or $340 = \frac{240}{12} \times 15 + c$	
			$\bullet^3$ state equation in terms of W and A **and** in simplest form (remove any brackets and collect constants)	$\bullet^3$ $W = 20A + 40$ or equivalent	

Notes:

1. Correct answer without working award 3/3.
2. $\bullet^3$ is not available for invalid subsequent working
   eg $W = 20A + 40 \rightarrow W = 2A + 4$ award 2/3 ✓✓×
3. Where $\frac{240}{12}$ is simplified incorrectly $\bullet^2$ is still available
   eg $\text{m} = \frac{240}{12} = \frac{20}{3} \rightarrow y - 100 = \frac{20}{3}(x - 3) \rightarrow \text{W} = \frac{20}{3}\text{A} + 80$ award 2/3 ✓✓×

Commonly Observed Responses:

1. $y = 20x + 40$ award 2/3 ✓✓×
2. $y = 20x$ award 1/3 ✓××
3. $W = \frac{20}{1}A + 40$ award 2/3 ✓✓×
4. $y - 100 = 20x - 3 \rightarrow W = 20A + 97$ award 2/3 ✓×✓

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		**Ans:** $20 \times 12 + 40 = 280$ kg		**1**
			$\bullet^1$ calculate weight using equation from part (a)	$\bullet^1$ $20 \times 12 + 40 = 280$ (kg) stated explicitly	

Notes:

1. Correct answer without working award 0/1
2. Follow through mark from part (a) is only available if 12 is multiplied or divided by a whole number greater than 10 or a non-integer value followed by an addition or subtraction.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
6.			**Ans: real and distinct**		**2**
			•[1] find discriminant	•[1] 53 $\left[5^2 - 4 \times 7 \times (-1)\right]$	
			•[2] state nature of roots	•[2] real and distinct (or equivalent)	

Notes:

1. Correct answer without working award 0/2
2. 25 + 28 $\rightarrow$ real and distinct award 2/2
3. eg 25 + 28 = 52 $\rightarrow$ real and distinct award 1/2 ×✓
4. Accept '**real** roots'
5. Do not accept 'two distinct roots'
6. Do not award •[2] where conclusion is ambiguous
   eg 53 $\rightarrow$ roots are real and even award 1/2 ✓×

Commonly Observed Responses:

1. $\dfrac{-5 \pm \sqrt{5^2 - 4 \times 7 \times (-1)}}{2 \times 7} = \dfrac{-5 \pm \sqrt{53}}{2 \times 7}$ award 1/2 ✓×
2. $-3 \rightarrow$ no real roots award 1/2 ×✓
3. $-3 \rightarrow$ no roots award 0/2

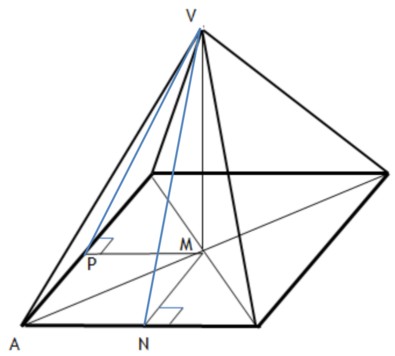
Question			Generic Scheme	Illustrative Scheme	Max Mark
7.	(a)		**Ans: (8, 4, 0)** •¹ state coordinates of B	 •¹ (8, 4, 0)	**1**

Notes:
1. Brackets must be shown.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		**Ans: 7** •¹ know how to find AM^2 •² know how to find AV •³ find length of AV	 •¹ 3^2+2^2 •² $\sqrt{6^2+(3^2+2^2)}$ •³ 7	**3**

Notes:
1. Correct answer without working award 0/3
2. Alternative methods:



(a)[know how to find AM^2....]
- •1 $\frac{1}{4}(6^2+4^2)$
- •2 $\sqrt{6^2+\frac{1}{4}(6^2+4^2)}$
- •3 7

(b)[know how to find VN^2....]
- •1 6^2+2^2
- •2 $\sqrt{3^2+(6^2+2^2)}$
- •3 7

(c)[know how to find VP^2....]
- •1 6^2+3^2
- •2 $\sqrt{2^2+(6^2+3^2)}$
- •3 7

Commonly Observed Responses:

1. •¹ $\begin{pmatrix}3\\2\\6\end{pmatrix}$ $\rightarrow$ •² $\sqrt{3^2+2^2+6^2}$ $\rightarrow$ •³ = 7 award 3/3

2. $\begin{pmatrix}7\\2\\6\end{pmatrix}$ $\rightarrow$ $\sqrt{7^2+2^2+6^2}=\sqrt{89}$ award 1/3 ×✓×

Question			Generic Scheme	Illustrative Scheme	Max Mark
8.			Ans: $x=-\frac{5}{8}$		3
			Method 1		
			$\bullet^1$ multiply throughout by 6	$\bullet^1$ $4x-5=12x$	
			$\bullet^2$ rearrange	$\bullet^2$ $-8x=5$ or $-5=8x$	
			$\bullet^3$ solve for x	$\bullet^3$ $x=-\frac{5}{8}$ or $x=-0\cdot625$	
			Method 2		
			$\bullet^1$ rearrange	$\bullet^1$ $\frac{4}{3}x=-\frac{5}{6}$	
			$\bullet^2$ start to solve for x	$\bullet^2$ $x=-\frac{5}{6}\times\frac{3}{4}$ or $24x=-15$ or equivalent	
			$\bullet^3$ solve for x	$\bullet^3$ $x=-\frac{5}{8}$ or $x=-0\cdot625$	

Notes:

1. Correct answer without working award 0/3
2. $\bullet^1$ is available for multiplying throughout by any common multiple of 3 and 6
3. $\bullet^1$ is not available for $\frac{4x-5}{6}=2x, \frac{12x-15}{18}=2x$ etc.
4. For the award of $\bullet^3$, the answer must be a non-integer value

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
9.			Ans: $\frac{2\sqrt{5}}{5}$		
			$\bullet^1$ correct substitution	$\bullet^1$ $\frac{2}{\sqrt{5}}$	
			$\bullet^2$ consistent answer	$\bullet^2$ $\frac{2\sqrt{5}}{5}$	

Notes:

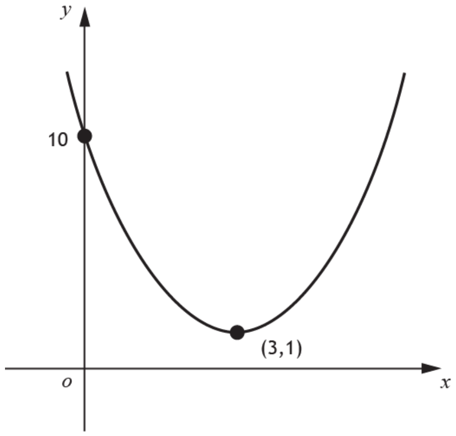
1. Correct answer without working award 0/2.

Commonly Observed Responses:

1. $\bullet^2$ is not available where there is invalid subsequent working

eg $\frac{2\sqrt{5}}{5}=2\sqrt{5}$ award 1/2 ✓×

2. $\frac{2}{\sqrt{x}}\times\frac{\sqrt{x}}{\sqrt{x}}=\frac{2\sqrt{x}}{x}$ award 1/2 ×✓

Question			Generic Scheme	Illustrative Scheme	Max Mark
10.			**Ans:** 		3
			•[1] coordinates of turning point correct	•[1] (3,1)	
			•[2] sketch parabola with **minimum** turning point consistent with •[1]	•[2] parabola with **minimum** turning point consistent with •[1]	
			•[3] y-intercept correct	•[3] (0,10) or 10	

Notes:

1. Correct answer without working award 3/3.
2. Where the coordinates of the turning point are not stated elsewhere, then for a sketch of a parabola with minimum turning point (3,–1), (–3,±1) or (±1,±3) award •[2] but not •[1]. Otherwise •[2] is only available where the minimum turning point indicated on the sketch is consistent with that stated elsewhere.
3. The sketch of the parabola need not meet or cut the y-axis for the award of •[2].
4. •[2] is not available if the parabola has a maximum turning point.
5. •[3] is not available if the minimum turning point is on the y-axis.
6. Award •[3] where the y-intercept is calculated to be at $y = 10$ and is plotted on the diagram at (0,10) but annotated as (10,0). Treat this special case as bad form.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
11.			**Ans:** $\sin^2 x°$		2
			•¹ identify correct trigonometric identity to be used	•¹ $\frac{\sin x}{\cos x}$ **or** $\frac{\sin^2 x}{\cos^2 x}$	
			•² use correct trigonometric identity to simplify expression	•² $\frac{\sin^2 x}{\cos^2 x} \times \cos^2 x = \sin^2 x$	

Notes:

1. $\sin^2 x$ without working award 0/2
2. Degree signs are not required
3. •² is not available if there is invalid subsequent working

   eg (a) $\frac{\sin^2 x}{\cos^2 x} \times \cos^2 x = \sin^2 x = 1 - \cos x$ award 1/2 ✓×

   (b) $\frac{\sin^2 x}{\cos^2 x} \times \cos^2 x = \sin^2 x = 1 - \cos^2 x$ award 2/2
4. •¹ is not available if there are no variables e.g. $\frac{\sin^2}{\cos^2} \times \cos^2 = \sin^2$ award 1/2 ×✓
5. •¹ is not available if candidate simply states $\tan x = \frac{\sin x}{\cos x}$ **and** $\sin^2 x + \cos^2 x = 1$ then proceeds no further
6. Alternative acceptable strategies

   (a) •¹ $\tan x \cos x = \sin x$

   •² $\tan^2 x \cos^2 x = \sin^2 x$

   award 2/2

   (b) •¹ $\left(\frac{o}{a}\right)^2 \left(\frac{a}{h}\right)^2$

   •² $\frac{o^2 a^2}{a^2 h^2} = \frac{o^2}{h^2} = \sin^2 x$

   award 2/2

Commonly Observed Responses:

1. $\frac{\cos^2 x}{\sin^2 x} \times \cos^2 x = \frac{\cos^4 x}{\sin^2 x}$ award 0/2

2. $\tan^2 x(1 - \sin^2 x) = \tan^2 x - \tan^2 x \sin^2 x$ award 0/2

Question			Generic Scheme	Illustrative Scheme	Max Mark
12.	(a)		**Ans:** $(2x+1)(x+8)$ •[1] find an expression for the area of the rectangle	 [1] $(2x+1)(x+8)$ or equivalent	1

Notes:

1. If solution to (a) appears in (b) or (c) award 1/1
2. (a) Accept $(2x+1)\times(x+8)$, $2x+1 \times x+8$

   (b) Do **not** accept $2x+1(x+8)$, $x+8(2x+1)$ unless correct expansion appears in (a) (b) or (c)

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
12.	(b)		**Ans: proof** •[1] find **expanded** expression for area of the rectangle •[2] find **expanded** expression for area of the triangle •[3] equate expanded expressions and rearrange into required form	 •[1] $2x^2+16x+x+8$ •[2] $3x^2+15x$ •[3] $2x^2+16x+x+8=3x^2+15x$ $\Rightarrow x^2-2x-8=0$	3

Notes:

1. If solution to (b) appears in (a) or (c) then all three marks are available

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
12.	(c)		**Ans: 12 cm and 9 cm** •[1] factorise x^2-2x-8 •[2] solve equation •[3] reject invalid value of x **and** state length and breadth of rectangle	 •[1] $(x-4)(x+2)$ •[2] $x=4$ **and** $x=-2$ •[3] 12 (cm) and 9 (cm)	**3**

Notes:

1. Correct answer without working award 0/3.
2. If solution to (c) appears in (a) or (b) then all three marks are available.
3. •[1] is available for $\dfrac{2\pm\sqrt{(-2)^2-4\times1\times(-8)}}{2\times1}$
4. For an answer obtained by guess and check award 0/3

Commonly Observed Responses:

1.(a) $(2x+1)(x+8)=0 \rightarrow x=-\frac{1}{2}$ and $x=-8$ award 1/3 ×✓×

(b) $x=-\frac{1}{2}$ and $x=-8$ without factorised quadratic equation stated award 0/3

[END OF MARKING INSTRUCTIONS]

N5 National Qualifications 2016

2016 Mathematics Paper 2

National 5

Finalised Marking Instructions

Detailed Marking Instructions for each question

Question			Generic Scheme	Illustrative Scheme	Max Mark
1.			**Ans: 27·(25408) grams** •[1] know how to decrease by 8% •[2] know how to calculate the sugar content after 3 years •[3] evaluate	 •[1] $\times 0\cdot 92$ •[2] $35\times 0\cdot 92^3$ •[3] $27\cdot(25408)$ (grams)	**3**

Notes:

1. Correct answer without working award 3/3

2. Do not penalise incorrect rounding

3. Where an incorrect percentage is used, the working must be followed through to give the possibility of awarding 2/3
   eg For $35\times 0\cdot 08^3 = 0\cdot 01792$, with working award 2/3 ×✓✓

4. Where division is used,
   (a) along with $0\cdot 92$, •[1] is not available
   eg $35\div 0\cdot 92^3 = 44\cdot 94...$ award 2/3 ×✓✓
   (b) along with an incorrect percentage, •[1] and •[2] are not available
   eg $35\div 1\cdot 08^3 = 27\cdot 78...$ award 1/3 ××✓

Commonly Observed Responses:

Working must be shown

1. $35\times 1\cdot 08^3 = 44\cdot 0...$ award 2/3 ×✓✓
2. $35\times 0\cdot 08 = 2\cdot 8 \rightarrow 35 - 3\times 2\cdot 8 = 26\cdot 6$ award 1/3 ✓××
3. $35\times 0\cdot 92 = 32\cdot 2$ award 1/3 ✓××
4. $35\times 0\cdot 92\times 3 = 96\cdot 6$ award 1/3 ✓××
5. $35\times 0\cdot 08\times 3 = 8\cdot 4$ award 0/3

Question			Generic Scheme	Illustrative Scheme	Max Mark
2.			**Ans: 8×10^{-9} grams** •1 correct method •2 answer	 •1 $12\div\left(1\cdot5\times10^{9}\right)$ •2 8×10^{-9}	2

Notes:

1. Correct answer without working award 2/2
2. •2 is still available if there is additional multiplication or division by 1000 (but by no other numbers).
   eg award 1/2 ×✓ for
   (a) $12\div\left(1\cdot5\times10^{9}\right)\div1000=8\times10^{-12}$
   (b) $\left(1\cdot5\times10^{9}\right)\div12\times1000=1\cdot25\times10^{11}$

Commonly Observed Responses:

No working necessary

1. $(1\cdot5\times10^{9})\div12=1\cdot25\times10^{8}$ award 1/2 ×✓
2. $\left(1\cdot5\times10^{9}\right)\div12=1\cdot2\times10^{8}$ or $1\cdot3\times10^{8}$ award 1/2 ×✓
3. $(1\cdot5\times10^{9})\times12=1\cdot8\times10^{10}$ award 1/2 ×✓

Question			Generic Scheme	Illustrative Scheme	Max Mark
3.			**Ans: v − u** •[1] correct answer	 •[1] **v − u** or -**u + v** or **v + − u**	1
Notes:					
Commonly Observed Responses:					
4.			**Ans:** $3(x+4)(x-4)$ •[1] begin to factorise •[2] factorise fully	 •[1] $3(x^2-16)$ •[2] $3(x+4)(x-4)$	2
Notes: 1. Correct answer without working award 2/2 2. •[1] is also available for $(3x+12)(x-4)$ or $(3x-12)(x+4)$ 3. •[1] is not available for 3 **or** (x^2-16) alone 4. All three factors must be shown **together** to obtain •[2]. 5. Special cases (a) award 1/2 for $3(x-4)^2$ or $(x+4)(x-4)$ or $3(x+8)(x-8)$ (b) award 0/2 for eg $(3x-8)(x+6)$					
Commonly Observed Responses:					
5.			**Ans: ABC = 74°** •[1] calculate the size of angle AOE or CAO •[2] calculate the size of angle CAB •[3] calculate the size of angle ABC	 •[1] 37 •[2] 53 •[3] 74	3
Notes: 1. Full marks may be awarded for information marked on the diagram 2. For an answer of 74° with no **relevant** working award 0/3 3. •[3] is available for correct calculation of 180 – 2 × angle CAB					
Commonly Observed Responses:					

Question			Generic Scheme	Illustrative Scheme	Max Mark
6.	(a)		**Ans: mean = 13 minutes, st dev = 5·7 minutes**		4
			•¹ calculate mean	•¹ 13 (minutes)	
			•² calculate $\left(x-\bar{x}\right)^2$	•² 0, 9, 9, 81, 64, 1	
			•³ substitute into formula	•³ $\sqrt{\frac{164}{5}}$	
			•⁴ calculate standard deviation	•⁴ 5·7… (minutes)	

Notes:

1. For an answer of 13 and 5·7 without working award 1/4 ✓×××.
2. For use of alternative formula award •², •³ and •⁴ as follows:

•² calculate $\sum x$ and $\sum x^2$	•² 78, 1178
•³ substitute into formula	•³ $\sqrt{\dfrac{1178-\frac{78^2}{6}}{5}}$
•⁴ calculate standard deviation	•⁴ 5·7… (minutes)

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
	(b)		**Ans: valid statements**		2
			•¹ compare means	•¹ On average Sophie's waiting time was longer.	
			•² compare standard deviations	•² Sophie's waiting times were more consistent.	

Question	Generic Scheme	Illustrative Scheme	Max Mark

Notes:

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

2. Statements regarding the mean must show an understanding that mean is an average.
   (a) eg Accept
   - Sophie's average waiting time is more
   - In general her time is more
   - Sophie's waiting time is more overall

   (b) eg Do not accept
   - Sophie's mean waiting time is more
   - Sophie's waiting time is longer (this implies that all her waiting times are longer)

3. Statements regarding the standard deviation must show an understanding that standard deviation is a measure of spread.
   (a) eg Accept
   - The spread of Sophie's times is less
   - Sophie's times are more consistent
   - Her waiting is less varied

   (b) eg Do not accept
   - Sophie's standard deviation is less
   - The range of Sophie's times is less
   - On average her waiting times are less varied
   - The standard deviation is more consistent

4. Statements must refer to Sophie/Jack or she/he
   eg do not accept "on average the waiting time was longer".

5. Accept statements using 'waiting time', 'call time', 'time' or 'waiting'.

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
7.			**Ans: 5300 cubic centimetres**		5
			•1 know to find difference in two volumes	•1 evidence of difference in two volumes	
			•2 substitute correctly into formula for volume of large cone	•2 $\frac{1}{3}\times\pi\times16^2\times24\ \ (=6433\cdot98\ldots)$	
			•3 substitute correctly into formula for volume of small cone	•3 $\frac{1}{3}\times\pi\times9^2\times13\cdot5\ \ (=1145\cdot11\ldots)$	
			•4 carry out all calculations correctly (must involve difference or sum of two volume calculations and include a fraction)	•4 $5288\cdot87\ldots$	
			•5 round **final answer** to 2 significant figures **and state correct units**	•5 $5300\,\text{cm}^3$	

Notes:

1. Correct answer without working award 0/5.
2. Accept variations in π.

   eg $\frac{1}{3}\times3\cdot14\times16^2\times24-\frac{1}{3}\times3\cdot14\times9^2\times13\cdot5=6430\cdot72-1144\cdot53=5286\cdot19=5300\,\text{cm}^3$

3. In awarding •5

   (a) Intermediate calculations need not be shown

   eg $\frac{1}{3}\times\pi\times16^2\times24-\frac{1}{3}\times\pi\times9^2\times13\cdot5=5300\,\text{cm}^3$ award 5/5

   (b) Where intermediate calculations are shown, they must involve at least three significant figures

   eg $6433\cdot98\ldots-1145\cdot11\ldots=6400-1100=5300\,\text{cm}^3$ award 4/5 ✓✓✓✓×

   (c) Where the volume of **only one** cone is calculated •5 is available

   eg $\frac{1}{3}\times\pi\times16^2\times24=6400\,\text{cm}^3$ award 2/5 ×✓××✓

   (d) Accept 5300 ml or 5·3 litres.

Question	Generic Scheme	Illustrative Scheme	Max Mark

Commonly Observed Responses:

Working must be shown

1.	$\frac{1}{3}\times\pi\times16^2\times24+\frac{1}{3}\times\pi\times9^2\times13\cdot5=7600\,\text{cm}^3$	award 4/5 ×✓✓✓✓
2.	$\frac{1}{3}\times\pi\times32^2\times24-\frac{1}{3}\times\pi\times18^2\times13\cdot5=21000\,\text{cm}^3$	award 4/5 ✓×✓✓✓
3.	$\frac{1}{3}\times\pi\times16^2\times24-\frac{1}{3}\times\pi\times9^2\times10\cdot5=5500\,\text{cm}^3$	award 4/5 ✓✓×✓✓
4.	$\frac{1}{3}\times\pi\times16^2\times24+\frac{1}{3}\times\pi\times9^2\times10\cdot5=7300\,\text{cm}^3$	award 3/5 ×✓×✓✓
5.	$\frac{1}{3}\times\pi\times16^2\times10\cdot5-\frac{1}{3}\times\pi\times9^2\times13\cdot5=1700\,\text{cm}^3$	award 4/5 ✓×✓✓✓
6.	$\frac{1}{3}\times\pi\times16^2\times10\cdot5+\frac{1}{3}\times\pi\times9^2\times13\cdot5=4000\,\text{cm}^3$	award 3/5 ××✓✓✓
7.	$\pi\times16^2\times24-\pi\times9^2\times13\cdot5=16000\,\text{cm}^3$	award 3/5 ✓×✓×✓
8.	$\frac{4}{3}\times\pi\times16^3-\frac{4}{3}\times\pi\times9^3=14000\,\text{cm}^3$	award 3/5 ✓××✓✓

Question			Generic Scheme	Illustrative Scheme	Max Mark
8.			**Ans: 78°** •[1] correct substitution into sine rule •[2] re-arrange formula •[3] find x	 •[1] $\frac{\sin x}{150}=\frac{\sin 66}{140}$ or $\frac{150}{\sin x}=\frac{140}{\sin 66}$ •[2] $\sin x=\frac{150\sin 66}{140}$ •[3] $x=78(\cdot 18...)$	**3**

Notes:

1. Correct answer without working award 0/3.
2. Do not penalise incorrect rounding in the final answer
   eg $\sin x=\frac{150\sin 66}{140}=0\cdot 978 \rightarrow x=77\cdot 9$ award 3/3
3. Premature rounding: rounded working must be to at least 2 decimal places.
4. Premature truncation: truncated working must be to at least 3 decimal places.
5. $\pm 0\cdot 028...$ (uses rad) award 2 marks (working must be shown)
6. $75,\ 74\cdot 72...$ (uses grad) award 3 marks (working must be shown)

Commonly Observed Responses:

1. Examples of premature rounding/truncation (apply notes 2 and 3)

(a) Premature rounding:

$$\sin x=\frac{150\sin 66}{140}$$
$$=0\cdot 98 \rightarrow x=78\cdot 5$$

award 3/3

(b)Premature rounding:

$$\sin x=\frac{150\sin 66}{140}$$
$$=\frac{150\times 0\cdot 9}{140}$$
$$=0\cdot 964...\rightarrow x=74\cdot 6$$

award 2/3 ✓✓×

(c) Premature truncation:

$$\sin x=\frac{150\sin 66}{140}\quad (=0\cdot 978...)$$
$$=0\cdot 97 \rightarrow x=75\cdot 9$$

award 2/3 ✓✓×

Question			Generic Scheme	Illustrative Scheme	Max Mark
9.			**Ans:** $(x+4)^2-23$ •[1] correct bracket with square •[2] complete process	 •[1] $(x+4)^2$ •[2] $(x+4)^2-23$	2

Notes:

1. Correct answer without working award 2/2

Commonly Observed Responses:
No working necessary:

1. Award 2/2 for (a) $(x+4)^2+(-23)$ or $(x+4)^2+-23$
   (b) $(x+4)(x+4)-23$
2. Award 1/2 ×✓ for (a) $(x+4)-23$
   (b) $(x^2+4)-23$
   (c) $(x^2+4)^2-23$
   (d) $(x+4x)^2-23$
   (e) $(x+8)^2-71$
3. Award 0/2 for eg $(x+8)^2-23$

Question			Generic Scheme	Illustrative Scheme	Max Mark
10.			**Ans:** $\dfrac{1}{n^4}$		3
			Method 1		
			$\bullet^1$ simplify $\left(n^2\right)^3$	$\bullet^1$ n^6	
			$\bullet^2$ simplify $n^6 \times n^{-10}$	$\bullet^2$ n^{-4}	
			$\bullet^3$ express with a positive power	$\bullet^3$ $\dfrac{1}{n^4}$	
			Method 2		
			$\bullet^1$ simplify $\left(n^2\right)^3$	$\bullet^1$ n^6	
			$\bullet^2$ express with a positive power	$\bullet^2$ $\dfrac{1}{n^{10}}$	
			$\bullet^3$ simplify $n^6 \times \dfrac{1}{n^{10}}$	$\bullet^3$ $\dfrac{1}{n^4}$	

Notes:

1. Correct answer without working award 3/3

Commonly Observed Responses:

Question			Generic Scheme	Illustrative Scheme	Max Mark
11.			**Ans:** £4·95 **Method 1** •[1] linear scale factor •[2] know to multiply cost by the square of the linear scale factor •[3] find cost of smaller picture (calculation must involve a power of the scale factor) **Method 2** •[1] linear scale factor •[2] know to divide cost by the square of the linear scale factor •[3] find cost of smaller picture (calculation must involve a power of the scale factor)	 •[1] $\frac{60}{100}$ •[2] $13\cdot75\times\left(\frac{60}{100}\right)^2$ •[3] (£)4·95 • $\frac{100}{60}$ •[2] $13\cdot75\div\left(\frac{100}{60}\right)^2$ •[3] (£)4·95	

Notes:
1. Correct answer without working award 3/3
2. Disregard incorrect units or omission of units
3. Answer must be rounded to nearest penny if required.

Commonly Observed Responses:

1. $13\cdot75\times\frac{60}{100}=8\cdot25$ award 1/3 ✓××
2. $13\cdot75\times\left(\frac{60}{100}\right)^3=2\cdot97$ award 2/3 ✓×✓
3. $(13\cdot75)^2\times\frac{60}{100}=113\cdot44$ award 1/3 ✓××
4. $13\cdot75\times\left(\frac{100}{60}\right)^2=38\cdot19$ award 2/3 ✓×✓
5. $13\cdot75\div\left(\frac{100}{60}\right)^2=13\cdot75\div1\cdot67^2=4\cdot93$ award 2/3 ✓✓×
   (Premature rounding leads to inaccurate answer)
6. $13\cdot75\times\left(\frac{100}{60}\right)^2=13\cdot75\times1\cdot67^2=38\cdot35$ award 1/3 ✓××
   (Premature rounding leads to inaccurate answer)

Question			Generic Scheme	Illustrative Scheme	Max Mark
12.			**Ans:** $k = \frac{L^2 + p}{4t}$		**3**
			$\bullet^1$ square	$\bullet^1$ $L^2 = 4kt - p$	
			$\bullet^2$ add p	$\bullet^2$ $4kt = L^2 + p$	
			$\bullet^3$ divide by $4t$	$\bullet^3$ $k = \frac{L^2 + p}{4t}$	

Notes:

1. Correct answer without working award 3/3.
2. Final answer should be in simplest form

   (a) $\frac{1}{4}\left(\frac{L^2 + p}{t}\right)$ award 3/3

   (b) $\frac{\left(\frac{L^2 + p}{t}\right)}{4}$ award 2/3 ✓✓×

3. For subsequent incorrect working, $\bullet^3$ is not available.

Commonly Observed Responses:

1. For the response below award 1/3

• add p	$L + p = \sqrt{4kt}$	×
• divide by 4t	$\frac{L + p}{4t} = \sqrt{k}$	×
• square	$k = \left(\frac{L + p}{4t}\right)^2$	✓

Question			Generic Scheme	Illustrative Scheme	Max Mark
13.			**Ans:** $\dfrac{8x-7}{(x-2)(x+1)}$		**3**
			•1 correct denominator	•1 $(x-2)(x+1)$	
			•2 correct numerator	•2 $3(x+1)+5(x-2)$	
			•3 remove brackets and collect like terms in numerator	•3 $\dfrac{8x-7}{(x-2)(x+1)}$	

Notes:

1. Correct answer without working award 3/3.
2. Accept $\dfrac{3(x+1)}{(x-2)(x+1)}+\dfrac{5(x-2)}{(x-2)(x+1)}$ for the award of •1 and •2.
3. Do **not** accept $x-2(x+1)$ or $x+1(x-2)$ for the award of •1 unless the correct expansion appears in the final answer.
4. Where a candidate chooses to expand the brackets in the denominator, then •1 is only available for a correct expansion.

eg (a) $\dfrac{3(x+1)}{(x-2)(x+1)}+\dfrac{5(x-2)}{(x-2)(x+1)}=\dfrac{8x-7}{x^2-x-2}$ award 3/3

(b) $\dfrac{3(x+1)}{(x-2)(x+1)}+\dfrac{5(x-2)}{(x-2)(x+1)}=\dfrac{8x-7}{x^2-2}$ award 2/3 ✓✓×

(c) $\dfrac{3(x+1)}{x^2-2}+\dfrac{5(x-2)}{x^2-2}=\dfrac{8x-7}{x^2-2}$ award 2/3 ×✓✓

Commonly Observed Responses:

1. $\dfrac{3x+1}{(x-2)(x+1)}+\dfrac{5x-2}{(x-2)(x+1)}=\dfrac{8x-1}{(x-2)(x+1)}$ award 1/3 ✓××

Question			Generic Scheme	Illustrative Scheme	Max Mark
14.			**Ans: x = 102·5, 282·5** •[1] rearrange equation •[2] find one value of x •[3] find another value of x	 •[1] $\tan x = -\frac{9}{2}$ •[2] x = 102·5 •[3] x = 282·5	3

Notes:
1. Correct answer without working award 2/3
2. For x = 178·6, 358·6 (uses RAD), award 3/3 (with working), 2/3 (without working)
3. For x = 93·9, 273·9 (uses GRAD), award 3/3 (with working), 2/3 (without working)
4. Do not penalise omission of degree signs throughout the question

Commonly Observed Responses:

1. If $\tan x° < 0$ then award •[2] and •[3] for correct 2nd and 4th quadrant angles

   eg $\tan x = -\frac{9}{2} \rightarrow$ (a) $x = 77\cdot5, 102\cdot5$ award 2/3 ✓×✓

   (b) $x = 77\cdot5, 282\cdot5$ award 2/3 ✓×✓

   (c) $x = 77\cdot5, 257\cdot5$ award 1/3 ✓××

2. If $\tan x > 0$ then •[2] is not available (working eased) but award •[3] for correct 3rd quadrant angle

   eg $\tan x° = \frac{9}{2} \rightarrow$ (a) $x = 77\cdot5, 257\cdot5$ award 1/3 ××✓

   (b) $x = 77\cdot5, 102\cdot5$ award 0/3

   (c) $x = 77\cdot5, 282\cdot5$ award 0/3

   (d) $\tan x° = \frac{1}{2} \rightarrow x = 26\cdot6, 206\cdot6$ award 1/3 ××✓

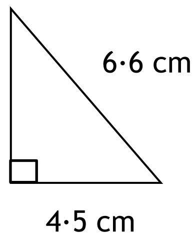
3. $\tan x° = -\frac{9}{2} \rightarrow x = -77\cdot5$

   (a) $x = 257\cdot5$ $[180-(-77\cdot5)]$, $437\cdot5$ $[360-(-77\cdot5)]$ award 1/3 ✓××

   (incorrect application of CAST diagram and $437\cdot5 > 360$)

   (b) $x = 102\cdot5$ $[-77\cdot5+180]$, $282\cdot5$ $[102\cdot5+180]$ award 3/3

   (correct application of periodicity of $\tan x°$)

Question			Generic Scheme	Illustrative Scheme	Max Mark
15.			**Ans: 11·4… (cm)**		4
			•[1] marshal facts and recognise right-angled triangle	•[1] 	
			•[2] correct Pythagoras statement	•[2] $x^2 = 6\cdot6^2 - 4\cdot5^2$	
			•[3] correct calculation of x	•[3] 4·8…	
			•[4] find height of label	•[4] 11·4… (cm)	

Notes:

1. For correct answer without working award 0/4
2. •[4] is for adding 6·6 to a previously calculated value
3. In the absence of a diagram accept $x^2 = 6\cdot6^2 - 4\cdot5^2$ as evidence for the award of •[1] and •[2].
4. Where a candidate assumes an angle of 45° in the right-angled triangle, only •[1] and •[4] are available.

Commonly Observed Responses:

1. For $x^2 = 6\cdot6^2 + 4\cdot5^2 \rightarrow x = 7\cdot988\ldots \rightarrow$ height $= 14\cdot588\ldots$
   (a) with correct diagram award 3/4 ✓×✓✓
   (b) without a diagram award 2/4 ××✓✓

Question			Generic Scheme	Illustrative Scheme	Max Mark
16.			**Ans:** $6\cdot 8$ **cm**		4
			$\bullet^1$ identify $\cos A$ or angle A	$\bullet^1$ $\cos A = \frac{3}{4}$ or $A = 41\cdot 4$	
			$\bullet^2$ substitute into cosine rule (**cos A or angle A must have been found using trigonometry**)	$\bullet^2$ $BC^2 = 6^2 + 10^2 - 2\times 6\times 10\times \frac{3}{4}$ **or** $BC^2 = 6^2 + 10^2 - 2\times 6\times 10\times \cos 41\cdot 4$	
			$\bullet^3$ calculate BC^2	$\bullet^3$ BC = 46	
			$\bullet^4$ calculate BC correct to one decimal place	$\bullet^4$ $BC = 6\cdot 8$ (cm)	

Notes:
1. Correct answer without working award 0/4
2. Do not accept the substitution of a length or the value of sin A or tan A in place of angle A in the cosine rule.
3. $\bullet^3$ and $\bullet^4$ are only available for calculations within a valid strategy
4. Alternative valid strategies:

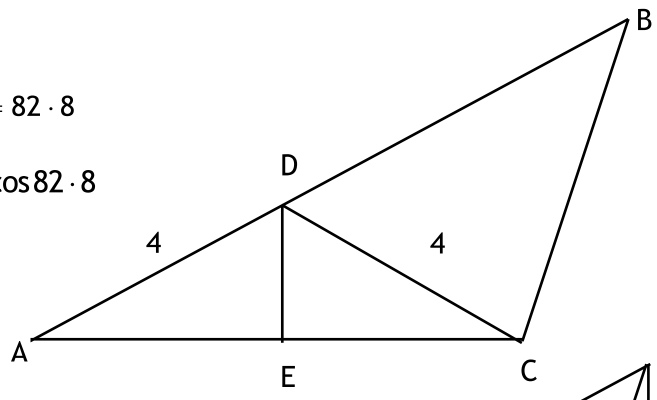
(a) $\bullet^1$ $ADE = \sin^{-1}\left(\frac{3}{4}\right) = 48\cdot 6$

$\Rightarrow BDC = 180 - 2\times 48\cdot 6 = 82\cdot 8$

$\bullet^2$ $BC^2 = 6^2 + 4^2 - 2\times 6\times 4\times \cos 82\cdot 8$

$\bullet^3$ $BC^2 = 45\cdot 984...$

$\bullet^4$ $BC = 6\cdot 8$ (cm)

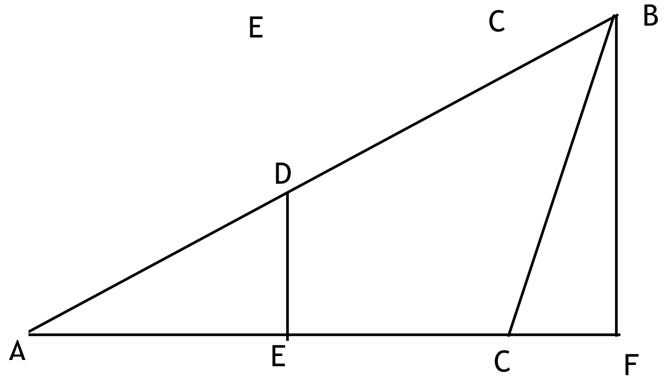


(b) $\bullet^1$ $AF = \frac{10}{4}\times 3 = 7\cdot 5$

$\bullet^2$ $BF^2 = 10^2 - 7\cdot 5^2 = 43\cdot 75$

$\bullet^3$ $BC^2 = 43\cdot 75 + 1\cdot 5^2 = 46$

$\bullet^4$ $BC = 6\cdot 8$ (cm)



5. If premature rounding leads to an answer other than 6·8 then $\bullet^4$ is not available.

Commonly Observed Responses:
1. $DE^2 = 4^2 - 3^2 = 7 \rightarrow DE = 2\cdot 6$ award 0/4
2. $BC^2 = 6^2 - 4^2 = 20 \rightarrow BC = 4\cdot 5$ award 0/4
   [incorrectly assuming that angle BCD = 90° in note 4(a) diagram]

[END OF MARKING INSTRUCTIONS]