N5 RELATIONSHIPS 1.4

This resource is to support pupils in passing the appropriate National 5 Assessment Standard. The questions and marking schemes used are from SQA past papers and as such test the topics in their entirety from grade A to C and *may* include other areas from the course.

In addition the questions from **Paper 1 (P1)** should be completed **without** the use of a calculator and questions from **Paper 2 (P2)** permit the use of a calculator.

Each Assessment Standard is used to ensure pupils have the minimum competency on the specified sub-skills for the National 5 course. As such each Assessment Standard will test grade C work on that specific topic.

This resource is divided into two sections:
- Section A has an example on each sub skill for the relevant Assessment Standard and the marking scheme for these questions
- Section B has extra practice questions on this Assessment Standard and the marking scheme for these questions

Unit Assessment Standard	Sub skills	Section A – Question Number
Relationships 1.4 Applying geometric skills to lengths, angles and similarity	applying the converse of Pythagoras' theorem	Q1
	applying the properties of shapes to determine an angle involving at least two steps	Q2
	using similarity to calculate a volume	Q3

FORMULAE LIST

The roots of $ax^2 + bx + c = 0$ are $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

Cosine rule: $a^2 = b^2 + c^2 - 2bc\cos A$ or $\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$

Area of a triangle: $A = \frac{1}{2}ab\sin C$

Volume of a sphere: $V = \frac{4}{3}\pi r^3$
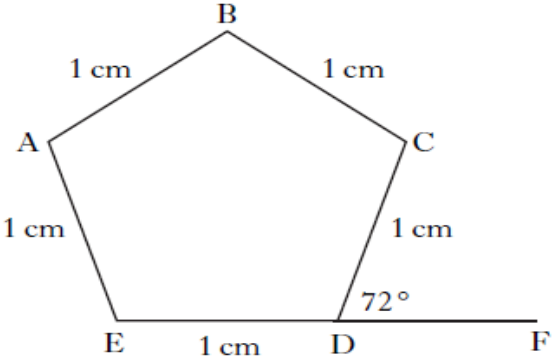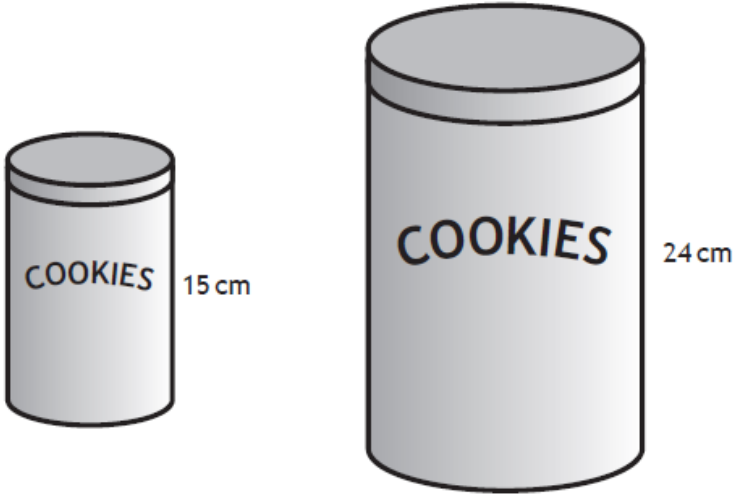
Volume of a cone: $V = \frac{1}{3}\pi r^2 h$

Volume of a pyramid: $V = \frac{1}{3}Ah$

Standard deviation: $s = \sqrt{\dfrac{\Sigma(x-\bar{x})^2}{n-1}} = \sqrt{\dfrac{\Sigma x^2 - (\Sigma x)^2/n}{n-1}}$, where n is the sample size.

Section A

Section A

Q		Marks

1
P2
	6. The diagram below shows the position of three towns.
	
	Lowtown is due west of Midtown.
	
	The distance from
	
	  • Lowtown to Midtown is 75 kilometres.
	  • Midtown to Hightown is 110 kilometres.
	  • Hightown to Lowtown is 85 kilometres.
	
	Hightown
	
	85 km 110 km
	
	Lowtown 75 km Midtown
	
	Is Hightown directly north of Lowtown?
	
	Justify your answer.
		4
		(2.2)

2

P2

7. ABCDE is a regular pentagon with each side 1 centimetre.

Angle CDF is 72°.

EDF is a straight line.

(a) Write down the size of angle ABC.

(b) Calculate the length of AC.

3

P2

5. A supermarket sells cylindrical cookie jars which are mathematically similar.

The smaller jar has a height of 15 centimetres and a volume of 750 cubic centimetres.

The larger jar has a height of 24 centimetres.

Calculate the volume of the larger jar.

6

Section A

MARKING

SCHEME

	# Section A - Marking Scheme	
1		**8**

6.			Ans: no, with valid reason.	4	
			•[1] valid strategy		•[1] use Converse of Pythagoras' Theorem eg 110^2 and $85^2 + 75^2$
			•[2] evaluation		•[2] 12 100 and 12 850
			•[3] comparison		•[3] e.g. $110^2 \neq 75^2 + 85^2$
			•[4] valid conclusion		•[4] No, since not right angled

Notes:

1. For alternative methods, award marks as follows:

(i)
•[1] valid strategy	•[1] use Pythagoras' Theorem eg $85^2 + 75^2$
•[2] evaluation	•[2] h = 113·36
•[3] comparison	•[3] e.g. 113·36 > 110
•[4] valid conclusion	•[4] No, since not right angled

(ii)
•[1] valid strategy	•[1] substitute correctly into cosine rule eg $\dfrac{85^2 + 75^2 - 110^2}{2 \times 85 \times 75}$
•[2] evaluation	•[2] 86·6°
•[3] comparison	•[3] 86·6° < 90°
•[4] valid conclusion	•[4] No, since not right angled

2. There must be an explicit comparison for the award of the third mark.
   eg $\sqrt{85^2 + 75^2} = 113 \cdot 36$.
   No, since not right angled. award 3/4 ✓✓✗✓

3. Conclusion must involve reference to "not a right angle".
   eg $110^2 = 85^2 + 75^2 \rightarrow 12100 \neq 12850$.
   No, Hightown is not due north of Lowtown. award 3/4 ✓✓✓✗

4. The final mark is not available where the candidate's only conclusion is an invalid statement involving the word bearing.
   eg "No, Hightown is on a bearing of 87° from Lowtown, not 90°"

2		7 (a)	Ans: 108°				9
			• solution	• 108°			
					1KU		
		(b)	Ans: 1·62 cm				
			• strategy	• use of appropriate trigonometry			
			• substitution/processing	• correct application of valid strategy			
			• solution	• 1·62			
					3KU		

NOTES:

(i)   chosen triangle must lead to calculation of AC
       eg use △ CDE → CE → AC

(ii)   use of invalid triangle (eg angle sum ≠ 180°)   award 0/3

(iii) accept solutions in radians or gradians

(iv)   evidence for ∠ABC=108° may appear in part(b)

(v)   part(a)   part(b)

       angle = x°   angle = x°   max 3/3
       angle = 90°   angle = 90°   max 2/3
       angle = x°   angle = y°   max 2/3
       angle = x°   angle = 90°   max 1/3

3
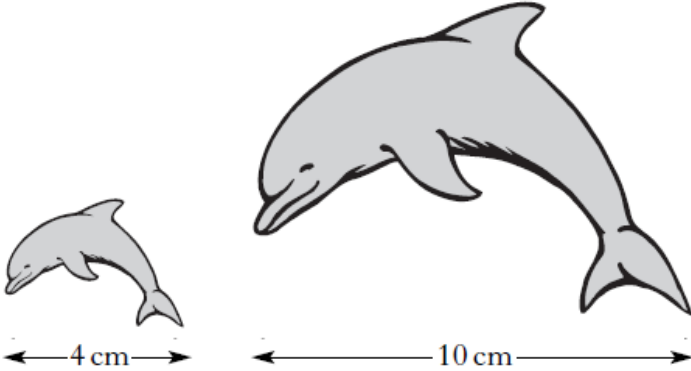
Question			Expected Answer(s) Give one mark for each •	Max Mark	Illustrations of evidence for awarding a mark at each •
5.			Ans: 3072 cm³	3	
			•¹ state linear scale factor		•¹ $\frac{24}{15}$ or 1·6
			•² state volume scale factor		•² $\left(\frac{24}{15}\right)^3$ or $1{\cdot}6^3$ (= 4·096)
			•³ calculate volume (calculation must involve a power of the scale factor) and state correct units		•³ 3072cm³

Notes:
1. Some common answers

(a) 3072   award 2/3   ✓✓✗

(b)1920cm³ ($\left(\frac{24}{15}\right)^2 \times 750$)   award 2/3   ✓✗✓

(c)1200cm³ ($\left(\frac{24}{15}\right) \times 750$)   award 1/3   ✓✗✗

(d)675000000cm³ ($\left(\frac{24}{15}\right) \times 750^3$)   award 1/3   ✓✗✗

(e)183cm³ ($\left(\frac{15}{24}\right)^3 \times 750$)   award 2/3   ✗✓✓

(f) 933cm³ ($\left(\frac{15}{24}\right)^3 \times 750 + 750$)   award 2/3   ✗✓✓

2. The third mark is not available where premature rounding leads to an incorrect answer.
   eg 4·1 × 750 = 3075cm³   award 2/3   ✓✓✗

3.   Alternative Method

•¹ know how to find radius of smaller cylinder   •¹ $\sqrt{\frac{750}{15\pi}}$

•² know how to find radius of larger cylinder   •² $\left(\frac{24}{15}\right) \times \sqrt{\frac{750}{15\pi}}$

•³ calculate volume and state correct units   •³ 3072cm³
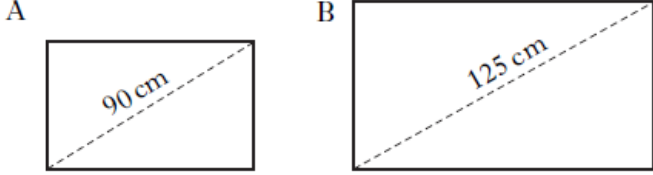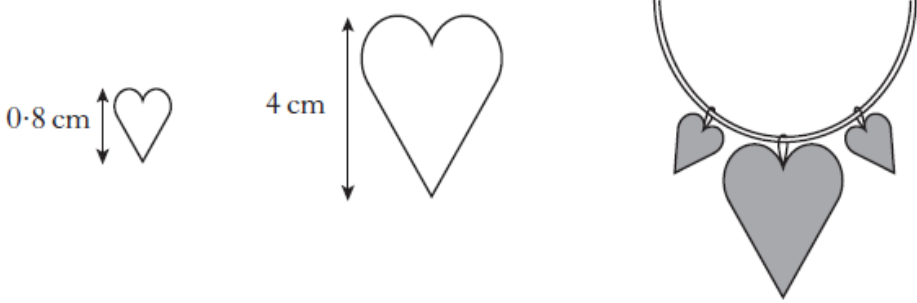
Section B

Section B

No Paper 1 Questions

Paper 2 Questions

Q		Marks
1	4. Two fridge magnets are mathematically similar. One magnet is 4 centimetres long and the other is 10 centimetres long. ←—4 cm—→ ←————— 10 cm —————→ The area of the smaller magnet is 18 square centimetres. Calculate the area of the larger magnet.	3 (2.1) (2.2)
2	7. Shampoo is available in travel size and salon size bottles. The bottles are mathematically similar. HAIR WASH 12 cm 200 ml travel HAIR WASH h cm 1600 ml salon The travel size contains 200 millilitres and is 12 centimetres in height. The salon size contains 1600 millilitres. Calculate the height of the salon size bottle.	3 (2.1) (2.2)

3

6. Two rectangular solar panels, A and B, are mathematically similar.

Panel A has a diagonal of 90 centimetres and an area of 4020 square centimetres.

A   B

90 cm   125 cm

A salesman claims that panel B, with a diagonal of 125 centimetres, will be double the area of panel A.

Is this claim justified?

Show all your working.

4

4

8. A necklace is made of beads which are mathematically similar.

0·8 cm   4 cm

The height of the smaller bead is 0·8 centimetres and its area is 0·6 square centimetres.

The height of the larger bead is 4 centimetres.

Find the area of the larger bead.

3

5

13. Asim has a poster which is 25 centimetres wide and 40 centimetres high.
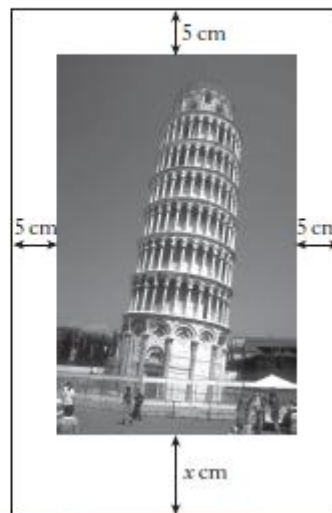
40 cm

25 cm
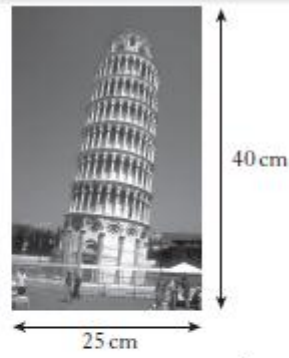
He decides to place it on a white card.

The card and the poster are mathematically similar.

5 cm

5 cm   5 cm

The border is 5 centimetres wide on three sides and x centimetres wide on the fourth side as shown.

Calculate the value of x.

x cm

Section B

MARKING

SCHEME

Section B – Marking Scheme

Marking Scheme

Paper 1

Q		Marks
	No questions	

Paper 2

Q		Marks

1

4   Ans: 112.5 cm^2

- linear scale factor   • $\dfrac{10}{4}$ or $\dfrac{4}{10}$

- area scale factor   • $\left(\dfrac{5}{2}\right)^2$ or $\left(\dfrac{2}{5}\right)^2$

- solution   • 112.5

3KU

NOTES:

(i)   for 112.5 with or without working   award 3/3

(ii)   for 45 with or without working   award 1/3

2

7   Ans: 24 cm

- volume scale factor   • 8 or equivalent

- linear scale factor   • $\sqrt[3]{8}$

- calculating height   • 24

3KU

NOTES:

(i)   for 96 with or without working   award 2/3

3	6	Ans: no, plus justification		
		• linear scale factor	• $\dfrac{125}{90}$	
		• area scale factor	• $\left(\dfrac{125}{90}\right)^2$	
		• multiplying by area scale factor	• 7754·6	
		• communication	• no, as 7754·6 ≠ 8040 (8040 must be explicit)	
				4RE

NOTES:

(i) for using a linear factor throughout, only the 1st and 4th marks are available

eg $\dfrac{125}{90} \times 4020 = 5583$

No, as 5583 ≠ 8040   award 2/4

(ii) Alternative strategy

• linear scale factor $\dfrac{125}{90}$

• area scale factor $\left(\dfrac{125}{90}\right)^2$

• evaluate area scale factor   1·929

• communication   No, as 1·929 ≠ 2
                                        (2 must be explicit)

4	8	Ans: 15 cm²		
		• linear scale factor	• $\dfrac{4}{0\cdot 8}$	
		• area scale factor	• $\left(\dfrac{4}{0\cdot 8}\right)^2 = 25$	
		• solution	• 15	
				3KU

NOTES:

(i) for a final answer of 3 $\left(\dfrac{4}{0\cdot 8} \times 0\cdot 6\right)$ award 1/3

5	13		Ans: $x = 11$	4		
			Method 1			
			•¹ strategy		•¹ scale factor $=\dfrac{35}{25}$	
			•² applying scale factor		•² $\left(\dfrac{7}{5}\right) \times 40$	
			•³ processing		•³ 56	
			•⁴ solution		•⁴ 11	
			Ans: $x = 11$			
			Method 2			
			•¹ strategy		•¹ $\dfrac{25}{40}$ or $\dfrac{35}{45+x}$	
			•² equating ratios		•² $\dfrac{25}{40} = \dfrac{35}{45+x}$	
			•³ cross multiplication		•³ $25(45 + x) = 35 \times 40$	
			•⁴ solution		•⁴ 11	
				(RE)		