N5 APPLICATIONS 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
Applications 1.4 Applying statistical skills to analysing data	comparing data sets using statistics including a measure of spread forming a linear model from a given set of data	Q1 Q2

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: $V = \frac{4}{3}\pi r^3$

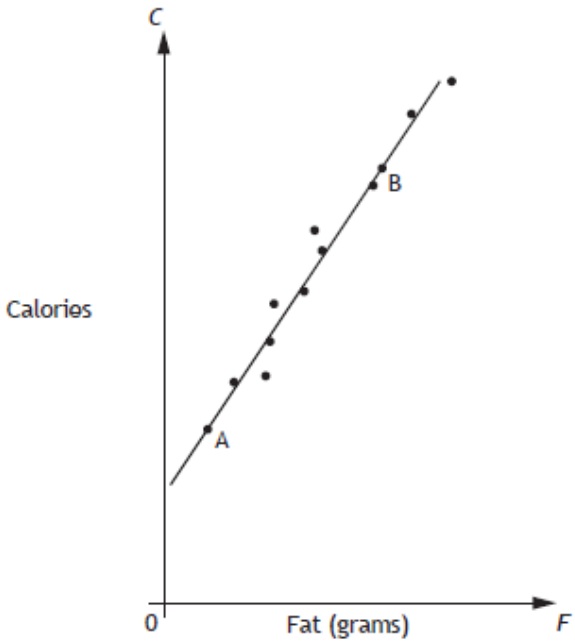
Volume of a cone: $V = \frac{1}{3}\pi r^2 h$

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	3. (*a*) During his lunch hour, Luke records the number of birds that visit his bird-table. The numbers recorded last week were: 28 32 14 19 18 26 31. Find the mean and standard deviation for this data. (*b*) Over the same period, Luke's friend, Erin also recorded the number of birds visiting her bird-table. Erin's recordings have a mean of 25 and a standard deviation of 5. Make **two** valid comparisons between the friends' recordings.	4 2
2 P1	6. McGregor's Burgers sells fast food. The graph shows the relationship between the amount of fat, *F* grams, and the number of calories, *C*, in some of their sandwiches.  A line of best fit has been drawn. Point A represents a sandwich which has 5 grams of fat and 200 calories. Point B represents a sandwich which has 25 grams of fat and 500 calories. (a) Find the equation of the line of best fit in terms of *F* and *C*. (b) A Super Deluxe sandwich contains 40 grams of fat. Use your answer to part (a) to estimate the number of calories this sandwich contains. Show your working.	3 (2.1) 1 (2.2)

Section A

MARKING SCHEME

Section A - Marking Scheme

1

3 (a) **Ans: 24, 7**

• mean	• 24
• substitution into formula	• as far as 294 or 4326
• processing	• $\sqrt{49}$
• solution	• 7

4KU

Notes:

x	$x-\bar{x}$	$(x-\bar{x})^2$		x^2
28	4	16	.....	784
32	8	64	.....	1024
14	-10	100	.....	196
19	-5	25	.....	361
18	-6	36	.....	324
26	2	4	.....	676
31	7	49	.....	961
		294	.....	4326

$$s=\sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}}$$
$$=\sqrt{\frac{294}{6}}$$
$$=\sqrt{49}$$
$$=7$$

$$s=\sqrt{\frac{\Sigma x^2-\frac{(\Sigma x)^2}{n}}{n-1}}$$
$$=\sqrt{\frac{4326-\frac{168^2}{7}}{6}}$$
$$=\sqrt{49}$$
$$=7$$

(b) **Ans: valid comments**

• comparing means	• on average, more birds visit Erin's table
• comparing standard deviations	• the number of birds visiting Luke's table varies more

2RE

Notes:

(i) responses about mean must give a comparison of number of birds

(ii) responses about standard deviation must give a comparison of variation or spread

<u>unacceptable responses</u>

(a) … the average number of birds ….. is more / less.

(b) … the mean ……. is more / less.

(c) … the s.d….. is more/less.

2

6.	(a)		Ans: $C = 15F + 125$ Method 1: $y = mx + c$ •[1] find gradient •[2] substitute gradient and a point into $y = mx + c$ •[3] calculate c, then state equation in simplest form in terms of F and C	3	•[1] $\frac{300}{20}$ •[2] e.g. $200 = \frac{300}{20} \times 5 + c$ •[3] $C = 15F + 125$ or equivalent
			Method 2: $y - b = m(x - a)$ •[1] find gradient •[2] substitute gradient and a point into $y - b = m(x - a)$ •[3] expand brackets and rearrange equation into simplest form in terms of F and C		•[1] $\frac{300}{20}$ •[2] e.g. $y - 200 = \frac{300}{20}(x - 5)$ •[3] $C = 15F + 125$ or equivalent
Notes: 1. For correct answer without working, award 3/3 2. For $y = 15x + 125$ award 2/3 3. For $y = 15x$ award 1/3 4. Where m and/or c are incorrect the working must be followed through to give the possibility of awarding 1/3 or 2/3 5. If the equation is stated incorrectly and there is no working, 1/3 can be awarded for correct gradient or correct y-intercept 6. For an incorrect equation (ie both m and c incorrect), without working, eg $C = 125F + 15$ award 0/3					
	(b)		Ans: 725 calories •[1] calculate value using the equation	1	•[1] $C = 15 \times 40 + 125 = 725$
Notes: 1. For a correct answer without working award 0/1 2. Follow through mark from part (a) is only available if the calculation involves a multiplication or division and an addition or subtraction					

Section B

Section B

Paper 1 Questions

<table>
<tr><th>Q</th><th></th><th>Marks</th></tr>
<tr><td>1</td><td>7. The 4th term of each number pattern below is the mean of the previous three terms.

(a) When the first three terms are 1, 6, and 8, calculate the 4th term.

(b) When the first three terms are x, $(x + 7)$ and $(x + 11)$, calculate the 4th term.

(c) When the first, second and fourth terms are

$-2x$, $(x + 5)$, _____, $(2x + 4)$,

calculate the 3rd term.</td><td>

1

1

1
(2.1)</td></tr>
<tr><td>2</td><td>6. A driving examiner looks at her diary for the next 30 days.
She writes down the number of driving tests booked for each day as shown below.

<table>
<tr><td>Number of tests booked</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Frequency</td><td>1</td><td>1</td><td>3</td><td>2</td><td>9</td><td>10</td><td>4</td></tr>
</table>

(a) Find the median for this data.

(b) Find the probability that more than 4 tests are booked for one day.</td><td>

2

1</td></tr>
<tr><td>3</td><td>3. A group of people attended a course to help them stop smoking.
The following table shows the statistics before and after the course.

<table>
<tr><th></th><th>Mean number of cigarettes smoked per person per day</th><th>Standard deviation</th></tr>
<tr><td>Before</td><td>20·8</td><td>8·5</td></tr>
<tr><td>After</td><td>9·6</td><td>12·0</td></tr>
</table>

Make two valid comments about these results.</td><td>2</td></tr>
</table>

Paper 2 Questions

Q		Marks
4	**2.** In a class, 30 pupils sat a test. The marks are illustrated by the stem and leaf diagram below. **Test Marks** 0 | 9 1 | 6 6 7 8 2 | 0 4 5 7 9 9 9 3 | 2 2 3 5 5 6 8 4 | 0 2 3 4 5 5 7 7 8 5 | 0 0 n = 30 1 | 6 = 16 (*a*) Write down the median and the modal mark. (*b*) Find the probability that a pupil selected at random scored **at least** 40 marks.	2 1
5	**5.** Tom looked at the cost of 10 different flights to New York. He calculated that the mean cost was £360 and the standard deviation was £74. A tax of £12 is then added to each flight Write down the new mean and standard deviation.	2
6	**3.** A machine is used to put drawing pins into boxes. A sample of 8 boxes is taken and the number of drawing pins in each is counted. The results are shown below: 102 102 101 98 99 101 103 102 (*a*) Calculate the mean and standard deviation of this sample. (*b*) A sample of 8 boxes is taken from another machine. This sample has a mean of 103 and a standard deviation of 2·1. Write down two valid comparisons between the samples.	3 2

7

2. Before training, athletes were tested on how many sit-ups they could do in one minute.

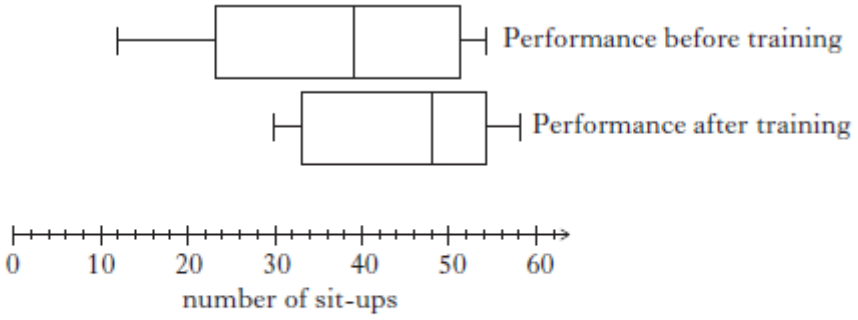
The following information was obtained:

lower quartile (Q_1)	23
median (Q_2)	39
upper quartile (Q_3)	51

(*a*) Calculate the semi-interquartile range. 1

After training, the athletes were tested again.

Both sets of data are displayed as boxplots.



(*b*) Make **two** valid statements to compare the performances before and after training. 2

8

4. A runner has recorded her times, in seconds, for six different laps of a running track.

53 57 58 60 55 56

(a) (i) Calculate the mean of these lap times. 1
Show clearly all your working.

(ii) Calculate the standard deviation of these lap times. 3
Show clearly all your working.

4. (continued)

(b) She changes her training routine hoping to improve her consistency. 1 (2.2)
After this change, she records her times for another six laps.
The mean is 55 seconds and the standard deviation 3·2 seconds.
Has the new training routine improved her consistency?
Give a reason for your answer.

Section B

MARKING SCHEME

Section B – Marking Scheme

Marking Scheme

Paper 1

Q				Marks
1	7 (a)	**Ans:** 5 • value	• 5 **1KU**	
	(b)	**Ans:** $x+6$ • expression	• $x+6$ **1RE**	
	(c)	**Ans:** $7x+7$ • dealing with mean • find term	• $\frac{-2x+(x+5)+3^{rd}\text{ term}}{3}=2x+4$ • $7x+7$ **2RE**	
	Notes: (i) for $7x+7$, with or without working, award $\frac{2}{2}$			
2	6 (a)	**Ans:** 4 • method • solution	• $15\cdot5^{th}$ value • 4 tests booked **2KU**	
	NOTES: (i) for an answer of 4 with/without working award 2/2			
	(b)	**Ans:** $\frac{7}{15}$ • solution	• $\frac{14}{30}$ or equivalent **1KU**	

3

3 A group of people attended a course to help them stop smoking.
The following table shows the statistics before and after the course.

	Mean number of cigarettes smoked per person per day	*Standard deviation*
Before	20·8	8·5
After	9·6	12·0

Make **two** valid comments about these results.

Ans: see below **2**

•[1]	comment about mean	•[1] on average fewer cigarettes were smoked per person after the course
•[2]	comment about standard deviation	•[2] the number of cigarettes smoked per person was more varied after the course

(RE)

Notes:

(i) do not accept 'the average number of cigarettes smoked per person was less'

(ii) do not accept 'the standard deviation after the course was greater'

Paper 2

Q				Marks
4	2 (a)	**Ans: 34, 29** • median • mode	• 34 • 29 **2KU**	
	(b)	**Ans:** $\frac{11}{30}$ • probability	• $\frac{11}{30}$ or equivalent **1KU**	
	Notes: (i) for median = 29 and mode = 34 award $\frac{1}{2}$			
5	5	**Ans: £372, £74** • mean • standard deviation	• 372 • 74 **2RE**	
6	3 (a)	**Ans: 101, 1·69** • calculating mean • starting to calculate standard deviation • standard deviation	• 101 • as far as 20 or 81 628 • 1·69 **3KU**	

NOTES:

x	$x-\bar{x}$	$(x-\bar{x})^2$		x^2
101	1	1	.....	10404
102	1	1	.....	10404
101	0	0	.....	10201
98	−3	9	.....	9604
99	−2	4	.....	9801
101	0	0	.....	10201
103	2	4	.....	10609
102	1	1	.....	10404
		20	.....	81628

$$s=\sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}}=\sqrt{\frac{20}{7}}=\sqrt{2\cdot857}=1\cdot69$$

$$s=\sqrt{\frac{\Sigma x^2-\frac{(\Sigma x)^2}{n}}{n-1}}=\sqrt{\frac{81628-\frac{808^2}{8}}{7}}=\sqrt{2\cdot857}=1\cdot69$$

	(b)	**Ans: two valid statements** • comparing means • comparing standard deviations	• the second sample has on average, a greater number of pins per box • the second sample has a greater variability in the number of pins per box **2RE**

7

2 (a)	**Ans: 14** • SIQR	• 14 **1KU**
(b)	**Ans: two valid statements** • one valid comparison • a second valid comparison	• on average the **number** of sit-ups per athlete has risen • the number of sit-ups is less varied **2RE**

NOTES:

(i) other valid statements could compare

- least number of sit-ups
- greatest number of sit-ups

(ii) since numerical comparisons are not required, do not penalise numerical inaccuracies

(ii) as a comparison between performances/sit-ups is required do not accept

- everyone could do more sit-ups after training
- the median is higher
- the range is smaller

8

4.	**(a)**	**(i)**	**Ans: $\bar{x}=56{\cdot}5$** •[1] calculate mean	**1**	•[1] $\bar{x}=56{\cdot}5$

Notes:
1. Do not accept 56·5 rounded to 57.

		(ii)	**Ans: $s=2{\cdot}4$** •[1] calculate $(x-\bar{x})^2$ •[2] substitute into formula •[3] calculate standard deviation	**3**	•[1] 0·25, 0·25, 2·25, 2·25, 12·25, 12·25 •[2] $\sqrt{\frac{29{\cdot}5}{5}}$ •[3] 2·4(2....)

Notes:
1. For use of alternative formula, award marks as follows:

•[1] calculate $\sum x$ and $\sum x^2$	•[1] 339, 19183
•[2] substitute into formula	•[2] $\sqrt{\frac{19183-\frac{339^2}{6}}{5}}$
•[3] calculate standard deviation	•[3] 2·4(2....)

2. For correct answer without working award 0/3

	(b)		**Ans: No, standard deviation is greater** **OR No, times are more spread out** •[1] no, with valid explanation	**1**	•[1] e.g. No, standard deviation is greater

Notes:
1. Answer must be consistent with answer to part (a)(ii).
2. Accept "No, as 3·2 > 2·4"
3. Only award the mark if it is clear that the reason is based on standard deviation only.
4. Do not accept "No, times are less consistent" without further explanation.