



Further Math with Ali Hashir

Non-Parametric Tests

Topical Mark Schemes (CIE 9231)

Mark schemes corresponding to the topical questions booklet for this topic, compiled from official CIE 9231 marking schemes (2015–2025). Question numbers match the questions booklet.

About this resource: I teach CIE A Level Further Mathematics, and over the years I found that there simply weren't many well-organised, topic-wise resources available for this subject – it's a niche A Level with relatively few candidates, so it doesn't get much attention from resource makers. These topical booklets are my attempt to fix that: every past-paper question, sorted by topic, with its official mark scheme alongside it.

Help us improve these documents for future students. If you spot a mistake, email us at vectorspacepk@gmail.com.

What kind of mistakes might you find? These booklets are compiled by hand from hundreds of past-paper PDFs. I've checked them as carefully as I can, but I'm only human, and the odd error may have slipped through – so please help me catch what I missed. Things to look out for:

- Spelling or typing mistakes
- Wrong final answers
- A mark scheme that doesn't line up with its question (misaligned pages)
- A mark scheme that belongs to the wrong question entirely
- Pre-2020 questions that are technically out of the current syllabus (the syllabus changed in 2020, but some older questions are still included here for practice)
- Missing, extra, or wrongly-labelled marks (e.g. an M1 or A1 that shouldn't be there, or one that's missing)
- Diagrams or images that are unclear, missing, or don't match the question
- Questions placed under the wrong topic

If you spot any of these (or anything else that looks off), please let me know.

This is **Version 1** of this booklet. As readers point out errors, I'll keep correcting and improving these documents, so I'd recommend checking back on the website from time to time and using the latest version rather than relying on a saved copy.

If you think these documents brought you value, consider following me on social media – it helps more than you'd think.

Contents

Click a question number below to jump straight to its mark scheme. Every box is a live link.

For the best hyperlink experience, open this PDF in a dedicated reader – such as Adobe Acrobat, Apple Preview, or your browser’s built-in PDF viewer – rather than a basic in-app or embedded preview, where links sometimes don’t work.

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
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Q1

9231/41, 9231/42 • May/June 2020 • Question 2

[↑ Back to contents](#)**Mark scheme.****(a)**

H_0 : population median is 6.40, H_1 : population median $\neq$ 6.40	B1
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Differences: 0.04, -0.24, -0.78, -0.58, 0.11, 0.22, -0.21, 0.02, -0.06, -0.12; signed ranks: 2, -8, -10, -9, 4, 7, -6, 1, -3, -5	M1A1
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Test statistic = $4 + 7 + 2 + 1 = 14$	A1
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Compare with correct critical value 8	M1
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Accept H_0 : insufficient evidence to reject claim (FT their test statistic)	A1 FT
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(b)

Symmetrically distributed about the median	B1
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Total: 7Spotted a mistake? Email us at vectorspacepk@gmail.com.

Q2

9231/43 • May/June 2020 • Question 6

[↑ Back to contents](#)**Mark scheme.****(a)**

Difference of location test for populations not known to be normal	B1
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(b)

Rank all 24 values: Group <i>A</i> ranks = {2, 7, 12, 14, 15, 16, 17, 18, 21, 22, 23, 24}; Group <i>B</i> ranks = {1, 3, 4, 5, 6, 8, 9, 10, 11, 13, 19, 20}	M1
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Total ranks: 109 or 191	A1
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$H_0 : m_x = m_y, H_1 : m_x > m_y$	B1
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Use normal approximation with attempts at mean and variance	M1
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mean = 150, variance = 300	A1
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$\frac{109.5 - 150}{\sqrt{300}} = -2.338$	M1A1
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Probability 0.0097	A1
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This is less than 0.05, so reject H_0	M1
---	-----------

There is evidence of an effect on growth	A1
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Q3

9231/41, 9231/43 • October/November 2020 • Question 2

[↑ Back to contents](#)**Mark scheme.**

B1 $H_0 : m = 200$, $H_1 : m < 200$ (allow 'median' in words, allow m not defined)	(a)
Signed differences: 10, -14, -12, 8, -16, -9, 15, -2, -4 (at most 3 errors)	M1
Ranks: 5, -7, -6, 3, -9, -4, 8, -1, -2 (correct rank order, ignore signs)	A1
Sum ranks $T = 16$ (CWO)	A1
Critical value 8; compare '16' > 8	M1
Accept H_0 : insufficient evidence to support scientist's belief	A1
B1 Magnitude of differences from median are taken into account (must mention magnitude and differences)	(b)
Total: 7	

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Q4

9231/42 • October/November 2020 • Question 2

[↑ Back to contents](#)**Mark scheme.**

B1 B1 H_0 : difference in (population) medians = 0; H_1 : difference in (population) medians < 0 (or > 0) (correct hypotheses; all notation identified)	(a)
Differences: -3, 4, 5, -1, -8, -19, -11, 10, -13, -7, 9, -16 (at most 3 errors)	M1
Ranks: -2, 3, 4, -1, -6, -12, -9, 8, -10, -5, 7, -11 (correct rank order, ignore signs)	A1
Sum $T = 3 + 4 + 8 + 7 = 22$ (cwo)	A1
Compare with critical value 17: '22' > 17	M1
Accept H_0 : data does not support student's claim	A1
M1 Rank for A becomes +2, $T = 24$	(b)
Changing sign of difference can only reduce evidence in favour of the claim; still > 17 and test result unchanged	A1
Total: 9	

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Q5

9231/41, 9231/42 • May/June 2021 • Question 5

[↑ Back to contents](#)**Mark scheme.****(a)**

Underlying distribution or population of differences is unknown / underlying distributions or population of scores for both X and Y are unknown (not known to be normal; condone "scores for X and Y cannot be assumed to be normally distributed")	B1
---	-----------

(b)

H_0 : difference of population medians = 0 (correct hypotheses, allow m but not μ or mean)	B1
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H_1 : difference of population median $\neq 0$ ('population' included)	B1
--	-----------

Differences: 4, -1, -21, 3, -7, -9, -5, 8, -10, -12, -11 (allow one error)	M1
--	-----------

Ranks: 3, -1, -11, 2, -5, -7, -4, 6, -8, -10, -9 (allow one sign error)	M1
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$[Q = -55,] P = 11$	A1
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Critical tabular value = 13; $11 < 13$ so reject H_0 (comparison with 13 and correct ft conclusion)	M1
---	-----------

Sufficient evidence of a preference for one of the uniforms OE	A1
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Q6

9231/43 • May/June 2021 • Question 2

[↑ Back to contents](#)**Mark scheme.**

H_0 : difference in population medians = 0 ($m_a = m_b$) (correct hypotheses, allow m_d , do not allow μ or mean)	B1
H_1 : difference in population medians $\neq 0$ ($m_a \neq m_b$) ('population' included)	B1
Diff: 12, -14, -1, 3, -13, 8, -5, 15, 6 (allow one error)	M1
Rank: 6, -8, -1, 2, -7, 5, -3, 9, 4 (allow one error)	M1
Smaller sum 19 (other sum is 26)	A1
Critical tabular value = 8; $19 > 8$ so accept H_0 (comparison with 8 and correct FT conclusion)	M1
There is insufficient evidence that marks differ (correct conclusion, in context, following correct work, except possibly the hypotheses)	A1

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Q7

9231/41, 9231/43 • October/November 2021 • Question 6

[↑ Back to contents](#)**Mark scheme.**

Attempt at ranking (women: 51,55,75,98,137,152,167,235,238,242,256 → ranks 1,2,4,6,7,8,9,13,14,15,16; men: 72,86,170,175,220,260,262,302,311,320,333,351 → ranks 3,5,10,11,12,17,18,19,20,21,22,23).	M1
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Total ranks (women): 95.	A1
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$H_0 : m_x = m_y$ and $H_1 : m_x \neq m_y$ (allow words, must include 'population').	B1
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Use normal approximation with attempts at mean and variance.	M1
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Mean = 132, variance = 264.	A1
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$\frac{95.5 - 132}{\sqrt{264}}$ (allow no or wrong continuity correction for M1 only).	M1
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-2.246 (CAO).	A1
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Critical value is -1.96: $-2.246 < -1.96$, reject H_0 . Compare their value with -1.96, or area comparison, and correct conclusion.	M1
--	-----------

There is sufficient evidence of a difference in levels, in context, with level of uncertainty in language.	A1
--	-----------

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Q8

9231/42 • October/November 2021 • Question 4

[↑ Back to contents](#)**Mark scheme.****(a)**

Attempt at ranking (Test A : 12,18,25,29,32,33,40,46 → ranks 1,2,3,5,6,7,12,14; Test B : 28,31,35,36,37,41,48,49 → ranks 4,6,8,9,10,13,15,16). **M1**

Test statistic: 52. **A1**

$H_0 : m_x = m_y$ and $H_1 : m_x \neq m_y$ (allow in words, 'population' must be included). **B1**

Critical value for (8, 8) is 49 (allow 51 if clearly one-tailed test in hypotheses). ***B1**

52 > 49, accept H_0 ; compare their calculated value with 49 and correct FT conclusion. **DM1**

Insufficient evidence of difference in medians, in context, with level of uncertainty in language. **A1**

(b)

Not a paired sample. **B1**

Underlying distribution/population not (known to be) normal / underlying distribution unknown. **B1**

Total: 8

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Q9

9231/41, 9231/42 • May/June 2022 • Question 6

[↑ Back to contents](#)**Mark scheme.**

Attempt at differences, allow 4 errors. Differences: 0.2, -0.5, -1.6, -2.9, 2.5, 8.5, 1.2, 5.2, -0.1, 0.8, 7.8, 1.9, -0.3, -1.8, -0.7, -1.4, -0.9, 2.1, 2.3, -5.4, -2.0, 3.4, 4.7, 0.4; ranks: 2, -5, -11, -18, 17, 24, 9, 21, -1, 7, 23, 13, -3, -12, -6, -10, -8, 15, 16, -22, -14, 19, 20, 4. **M1, A1**

$Q = 110$, $P = 190$ (either sum correct). **A1**

H_0 : population median = 18.0 and H_1 : population median $\neq$ 18.0 (must be 'population', allow m). **B1**

Normal approximation: mean = $\frac{1}{4}n(n+1) = \frac{1}{4} \times 24 \times 25 = 150$. **B1**

Variance = $\frac{1}{24}n(n+1)(2n+1) = \frac{1}{24} \times 24 \times 25 \times 49 = 1225$. **B1**

$\frac{110.5 - 150}{\sqrt{1225}}$ (attempt at test statistic, allow incorrect or missing cc, FT their 110). **M1**

-1.129. **A1**

10% 2-tail, critical value is 1.645. $-1.129 > -1.645$ or $0.1296 > 0.05$, accept H_0 (compare with -1.645, correct FT conclusion). **M1**

Insufficient evidence to suggest median is not 18.0 / insufficient evidence to reject teacher's claim (correct conclusion in context). **A1**

Total: 10

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Q10

9231/43 • May/June 2022 • Question 5

[↑ Back to contents](#)

Mark scheme.

Signs: + – – + + + – + + + and use Binomial (11 signs, values not needed, allow one error).	M1
Consider $B(11, 0.5)$ with $P(X \geq 8)$ or $P(X \leq 3)$ (use of correct binomial).	M1
Compare 0.227 with 0.1 or 0.113 with 0.05.	A1
Differences: 0.06, –0.05, –0.03, 0.08, 0.04, 0.02, 0.10, –0.15, 0.09, 0.01, 0.12 (allow one error).	M1
Signed ranks: 6, –5, –3, 7, 4, 2, 9, –11, 8, 1, 10 (allow one swap).	M1
$(P = 47), Q = 19$.	A1
Critical value from table = 13.	B1
$19 > 13$, accept H_0 (FT their 19 compared with 13 and correct FT conclusion).	M1
Insufficient evidence to support median not being 5.50 (both conclusions correct from correct working, in context, with level of uncertainty in language).	A1
Total: 9	

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Q11

9231/41, 9231/43 • October/November 2022 • Question 3

[↑ Back to contents](#)

Mark scheme.

Differences: 4, -8, 3, 1, -7, 11, 19, 6, 10, -13, 14, 5, -9, 12 (allow 2 errors)	M1
Signed ranks: 3, -7, 2, 1, -6, 10, 14, 5, 9, -12, 13, 4, -8, 11 (allow 4 errors)	M1
$P = 72$, $Q = 33$, so $T = 33$ (33 clearly identified)	A1
H_0 : difference in population medians = 0; H_1 : difference in population medians > 0	B1
Critical tabular value = 25	B1
$33 > 25$, accept H_0 (compares their value of sum of ranks with their 25 and gives conclusion)	M1
Insufficient evidence to support claim. (b)	A1
Underlying/population distribution of differences is unknown (not known to be normal).	B1
Total: 8	

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Q12

9231/42 • October/November 2022 • Question 6

[↑ Back to contents](#)**Mark scheme.**

Attempt at rankings of the combined sample (allow up to 4 errors). Ranks: A: 359(3), 374(5), 398(7), 415(10), 427(11), 452(14), 461(16), 482(18), 502(20), 512(22), 545(23), 612(24); B: 342(1), 355(2), 361(4), 384(6), 401(8), 414(9), 437(12), 443(13), 454(15), 472(17), 491(19), 506(21)	M1
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Test statistic = 127 (clearly identified)	A1
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H_0 : population medians are equal; H_1 : population median for X (company A) is greater than population median for Y (company B)	B1
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Mean = $\frac{1}{2} \times 12 \times 25 = 150$	B1
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Variance = $\frac{1}{12} \times 12 \times 12 \times 25 = 300$	B1
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$\frac{127.5 - 150}{\sqrt{300}}$ (allow incorrect or no continuity correction)	M1
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-1.299	A1
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Compare with -1.645: $-1.299 > -1.645$, or $0.097 > 0.05$, accept H_0	M1
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Insufficient evidence to support manager's claim. (b)	A1
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Not appropriate/no – the samples are not the same people (individuals in the samples cannot be paired up).	B1
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Total: 10Spotted a mistake? Email us at vectorspacepk@gmail.com.

Q13

9231/41, 9231/42 • May/June 2023 • Question 4

[↑ Back to contents](#)

Mark scheme.

Differences: 2, 5, 1, -6, 42, 11, -3, 7, 20, 12, -8, -10, 50. Allow up to 3 errors.	M1
Correct rank order (ignore signs): 2, 4, 1, -5, 12, 9, -3, 6, 11, 10, -7, -8, 13.	A1
$P = 68$, $Q = 23$. CWO.	A1
H_0 : difference in population medians = 0; H_1 : population median in 2022 > population median in 2018. 'Population' required. Accept use of m , not μ . Do not accept 'difference between population medians > 0' without 2022, 2018 OE specified.	B1
Critical value 21.	B1
'23' > '21' and accept H_0 . Compare their 23 with their 21 and FT conclusion. Their 23 must be less than 46.	M1
Insufficient evidence to support researcher's belief / insufficient evidence that the (median) number of employees in 2022 is greater than the (median) number of employees in 2018. Correct conclusion in context, level of uncertainty in language, no contradictions. A0 if hypotheses reversed. (b)	A1
Rank for G will now be +3, giving $Q = 20$ which is < 21. Must include numbers, ft their 21 from part (a) and ft their 20 ($23 - 3$).	M1
Change in conclusion. CWO. Condone 'reject H_0 ' OE.	A1
Total: 9	

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Q14

9231/43 • May/June 2023 • Question 3

[↑ Back to contents](#)**Mark scheme.**

Differences: 5, 7, -6, 1, -4, 2, 8, 26, -10. Allow at most 2 errors.	M1
Correct rank order (ignore signs): 4, 6, -5, 1, -3, 2, 7, 9, -8.	A1
$P = 29$, $Q = 16$. Condone P not excluded.	A1
H_0 : population medians equal or $m_1 = m_2$; H_1 : population median $X >$ population median Y or $m_1 > m_2$. 'Population' required. Accept use of m , not μ . Do not accept 'difference between population medians > 0 ' without X , Y OE specified.	B1
Critical value = 8.	B1
$16 > 8$ and accept H_0 / not significant. Compare their '16' with their '8' and conclusion. Their '16' must be less than 23. Condone 'reject H_1 '.	M1
Insufficient evidence to support teacher's belief or insufficient evidence that the marks/median in Paper 1 are/is higher than the marks/median in Paper 2. Correct conclusion in context, level of uncertainty in language, no contradictions. A0 if hypotheses wrong way round. (b)	A1
The population differences are symmetrical (about the median difference). Words in bold, or their equivalent, are required.	B1
Total: 8	

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Q15

9231/41, 9231/43 • October/November 2023 • Question 6

[↑ Back to contents](#)**Mark scheme.**

H_0 : population medians are equal; H_1 : population median after > population median before (do not accept ‘differences between population medians < 0’ unless difference defined; allow $H_0 : m = 22$, $H_1 : m > 22.0$).	B1
Signed differences (allow at most 4 errors).	M1
Attempt at ranks (ignore signs).	M1
$W_+ = 214$, $W_- = 111$ (CAO identified/used as test statistic).	A1
Normal approximation mean = $\frac{1}{4}n(n+1) = \frac{1}{4}(25)(26) = 162.5$.	B1
Variance = $\frac{1}{24}n(n+1)(2n+1) = \frac{1}{24}(25)(26)(51) = 1381.25$.	B1
$z = \frac{111.5 - 162.5}{\sqrt{1381.25}}$ (allow missing/incorrect continuity correction; their 111 must come from ranks).	M1
$z = -1.37$ (CAO).	A1
Tabular value -1.645 : $-1.37 > -1.645$, or $0.915 < 0.95$, accept H_0 (consistent signs, allow ‘not significant’).	M1
Insufficient evidence to support the teacher’s claim / insufficient evidence that distances thrown are further when hot (all correct, correct conclusion in context; A0 if hypotheses wrong way round or missing).	A1
Total: 10	

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Q16

9231/42 • October/November 2023 • Question 5 (part a)

[↑ Back to contents](#)

Mark scheme.

H ₀ : population medians are equal ($m_x = m_y$); H ₁ : population median for X $\neq$ population median for Y ($m_x < m_y$) (do not accept 'difference between population medians < 0 ' without X or Y specified).	B1
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Rankings of combined sample (allow at most 3 errors).	M1
---	-----------

Test statistic (rank sum for X) = 55.	A1
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Tabular value for $m = 8$, $n = 9$ is 54.	B1
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55 > 54, accept H ₀ /not significant (FT their 55 from ranks, FT their tabular value).	M1
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Insufficient evidence to support the manager's claim / insufficient evidence that median time of machine X is less than median time of machine Y (correct conclusion in context; A0 if hypotheses wrong way round or missing).	A1
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Total: 6

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Q17

9231/41, 9231/42 • May/June 2024 • Question 2

[↑ Back to contents](#)**Mark scheme.**

H_0 : practical results and written results are equal; H_1 : practical results are greater than written results.	B1
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There are 10 + signs; $B(15, 0.5)$ soi.	M1
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$(P(X \geq 10) = 1 - P(X \leq 9) =) 1 - 0.849 = 0.151.$	A1
---	-----------

Compare with 0.1: '0.151' > 0.1 accept H_0 .	M1
--	-----------

Insufficient evidence to suggest that practical results are greater than written results.	A1
---	-----------

Total: 5

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Q18

9231/41, 9231/42 • May/June 2024 • Question 3

[↑ Back to contents](#)**Mark scheme.**

Signed differences: 0.4, -1.1, 0.8, -0.5, 1.2, 0.9, 1.9, -0.3, -2.2, 1.6, 0.6, 1.0. Allow one error.	M1
---	-----------

Ranks: 2, -8, 5, -3, 9, 6, 11, -1, -12, 10, 4, 7. Attempt at ranking.	M1
---	-----------

$(P_+ = 54)$, $P_- = 24$. All ranks must be correct.	A1
--	-----------

H_0 : population median = 22.0; H_1 : population median $\neq$ 22.0.	B1
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Critical value from table = 17.	B1
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'24' > '17' Accept H_0 .	M1
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Insufficient evidence to support (population) median not being 22.0; insufficient evidence against the manager's claim. (b)	A1
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Distribution is symmetric about the population median. (Underlying/population distribution is symmetric about the median.)	B1
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Total: 8Spotted a mistake? Email us at vectorspacepk@gmail.com.

Q19

9231/43 • May/June 2024 • Question 1

[↑ Back to contents](#)

Mark scheme.

Attempt at ranking from 1 to 19. A1 for all correct. Ranks: X : 4, 15, 18, 8, 1, 5, 9, 3, 7; Y : 2, 11, 16, 6, 10, 13, 12, 14, 17, 19. **M1 A1**

Test statistic: 70. (If ranks reversed, then sum of ranks = 110, and then $9(9 + 10 + 1) - 110 = 70$.) **A1**

H_0 : population median of X = population median of Y ; H_1 : population median of X < population median of Y . **B1**

Critical value for $m = 9$, $n = 10$ is 61. **B1**

'70' > '61' accept H_0 . **M1**

Insufficient evidence to suggest that population medians of X and Y are not equal / insufficient evidence to suggest that population median of X is less than median of Y / insufficient evidence to support the interviewer's belief. **A1**

Total: 7

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Q20

9231/41, 9231/43 • October/November 2024 • Question 2

[↑ Back to contents](#)**Mark scheme.****(a)**Signed differences: 2, 4, -8, 5, 10, 7, -3, 6, -12, 9, 14, 11 (allow one error). **M1**Attempt at ranking: 1, 3, -7, 4, 9, 6, -2, 5, -11, 8, 12, 10. **M1**Sum of + ranks = 58; test statistic = 20. **A1** H_0 : population median for Teacher 2 = population median for Teacher 1; H_1 : population median for Teacher 2 > population median for Teacher 1. **B1**Critical value, from tables, is 17. **B1** $20 > 17$, accept H_0 . **M1**Insufficient evidence to support the claim / insufficient evidence that the scores of Teacher 2 are higher than those of Teacher 1. **A1****(b)**New test statistic is 13 (their 20 minus 7). **B1 FT** $13 < 17$, so conclusion is now 'reject H_0 ' (sufficient evidence to support claim). **B1****Total: 9**Spotted a mistake? Email us at vectorspacepk@gmail.com.

Q21

9231/42 • October/November 2024 • Question 6

[↑ Back to contents](#)**Mark scheme.**

Signed differences from 51.0 (allow up to 2 errors): 0.3, 1.0, 2.4, -1.8, -1.7, 0.1, 1.2, -3.8, 2.0, -2.5, -1.6, -0.7, -0.2, 0.6, -1.9, 1.3, 0.8, 1.4, -3.1, -2.1, -0.4, 0.9.	M1
Attempt at ranking of signed differences: 3, 9, 19, -15, -14, 1, 10, -22, 17, -20, -13, -6, -2, 5, -16, 11, 7, 12, -21, -18, -4, 8.	M1
Smaller sum is 102 (total = 253, so larger sum 151).	A1
H_0 : population median is 51.0 seconds; H_1 : population median is less than 51.0 seconds.	B1
Normal approximation: mean = 126.5, variance = 948.75 (both).	B1
$\frac{102 + 0.5 - 126.5}{\sqrt{948.75}}$ (allow no continuity correction).	M1
= -0.779 (accept p -value = 0.218).	A1
-0.779 > -1.645, accept H_0 (or 0.218 > 0.05).	M1
Insufficient evidence to suggest that the population median is less than 51.0 seconds / insufficient evidence to support the claim.	A1

Total: 9Spotted a mistake? Email us at vectorspacepk@gmail.com.

Q22

9231/41, 9231/42 • May/June 2025 • Question 5

[↑ Back to contents](#)**Mark scheme.**

B1 $H_0 : m_s = m_c$, $H_1 : m_s > m_c$ (population medians). (a)

M1 Attempt at differences d : 21, 19, -2, 22, -10, 4, 16, 27, 35, 29.

M1 Attempt at signed ranks: 6, 5, -1, 7, -3, 2, 4, 8, 10, 9.

A1 $T = 4$ (min of $P = 51$, $Q = 4$).

M1 Compare their 4 with critical value 10 and appropriate conclusion.

A1 $4 \leq 10$, reject H_0 ; sufficient evidence that children complete the cartoon puzzle more quickly on average (supports researcher's belief).

B1 $X \sim B(10, 0.5)$, $P(X \leq 2) = 0.0547$. (b)

M1 Compare 0.0547 with 0.05, appropriate conclusion.

A1 $0.0547 > 0.05$, accept H_0 (not significant); opposite conclusion to part (a).

B1 The order of the tests means children may do the second test quicker (or slower) due to practice (or tiredness) – confounding/order effect. (c)

Total: 10

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Q23

9231/43 • May/June 2025 • Question 4

[↑ Back to contents](#)**Mark scheme.**

H_0 : population medians are equal for under-25s and over-50s ($m_{<25} = m_{>50}$); H_1 : $m_{<25} < m_{>50}$.	B1
---	-----------

Attempt at ranks using integers 1 to 14 (ranks may be reversed).	M1
--	-----------

Sum of ranks for sample of size 6: $R_6 = 60$.	A1
---	-----------

$6(6 + 8 + 1) - R_6 = 30$.	M1
-----------------------------	-----------

$W = \min(60, 30) = 30$.	A1
---------------------------	-----------

Critical value for $n = 6, m = 8$ is 31.	B1
--	-----------

Compare their 30 with 31 and appropriate conclusion.	M1
--	-----------

$30 \leq 31$, reject H_0 (significant); sufficient evidence to suggest that older people take longer to react (supports researcher's claim).	A1
---	-----------

Total: 8

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Q24

9231/44 • May/June 2025 • Question 2

[↑ Back to contents](#)

Mark scheme.

B1 H_0 : population median = 8.00; H_1 : population median > 8.00. (a)

M1 Attempt at (signed) differences: -0.34, 0.48, 0.21, -0.02, 0.01, -0.23, 0.25, 0.11, 0.03, 0.16, -0.08.

M1 Attempt at (signed) ranks: -10, 11, 7, -2, 1, -8, 9, 5, 3, 6, -4.

A1 $T = 24$ (min of $P = 42$, $Q = 24$).

M1 Compare their 24 with critical value 13 and appropriate conclusion.

A1 $24 > 13$, accept H_0 (not significant); insufficient evidence to support/suggest that the average sound level is more than 8.00.

B1 It is not known if the population/(underlying) distribution is normal. (b)

Total: 7

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Q25

9231/41, 9231/43 • October/November 2025 • Question 4

[↑ Back to contents](#)**Mark scheme.**

$\frac{1}{4} \times 28 \times 29 = 203$ and $\frac{1}{24} \times 28 \times 29 \times 57 = 1928.5$ (both expressions correct).	B1
Correct form/expression for CI with any z -value: $z = \frac{T + 0.5 - 203}{\sqrt{1928.5}}$.	M1
Compares their z with -2.576 : $\frac{T + 0.5 - 203}{\sqrt{1928.5}} > -2.576$.	M1
$T > 89.4$.	A1
$T = 90$ (all correct, correct continuity correction).	A1
Total: 5	

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Q26

9231/42 • October/November 2025 • Question 1

[↑ Back to contents](#)**Mark scheme.**

Data has outliers / is skewed / lacks symmetry, suggesting the population/distribution may not be symmetrical (in context). (b)	B1
---	-----------

H_0 : population median is \$32,500; H_1 : population median is not \$32,500.	B1
---	-----------

Test statistic = 4 (or 11).	B1
-----------------------------	-----------

$X \sim B(15, 0.5)$, $P(X \leq 4) = 0.0592$ (or $P(X \geq 11) = 0.0592$).	B1
---	-----------

Compare their 0.0592 with 0.05 (or 0.1 for 1-tail), appropriate result.	M1
---	-----------

Insufficient evidence to reject the company's claim / to suggest that the median salary is not \$32,500.	A1
--	-----------

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Q27

9231/44 • October/November 2025 • Question 6

[↑ Back to contents](#)**Mark scheme.**

H_0 : population median mark for school A equals population median mark for school B ; H_1 : not equal.	B1
---	-----------

$\frac{1}{2} \times 123(123 + 147 + 1) = 16666.5$ and $\frac{1}{12} \times 123 \times 147(123 + 147 + 1) = 408329.25$ (both correct).	B1
--	-----------

$\frac{15355 + 0.5 - 16666.5}{\sqrt{408329.25}}$ (or attempt to find critical value / p -value).	M1
--	-----------

-2.05 (AWRT; or $CV = 15414$ or $p = 0.0201$).	A1
---	-----------

Compare $-2.05 < -1.96$ (consistent signs), reject H_0 / significant.	M1
---	-----------

Sufficient evidence to suggest a difference in average marks between the students in school A and B . (b)	A1
---	-----------

The (underlying) distributions are symmetrical/similar shape (or no repeated marks).	B1
--	-----------

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Help us improve these documents for future students. If you spot a mistake, email us at vectorspacepk@gmail.com.

Written by Ali Hashir.

Questions available in the companion questions booklet.

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