

Exam statistics and score distribution

All 18 scanned exams | No curve or letter-grade boundaries applied

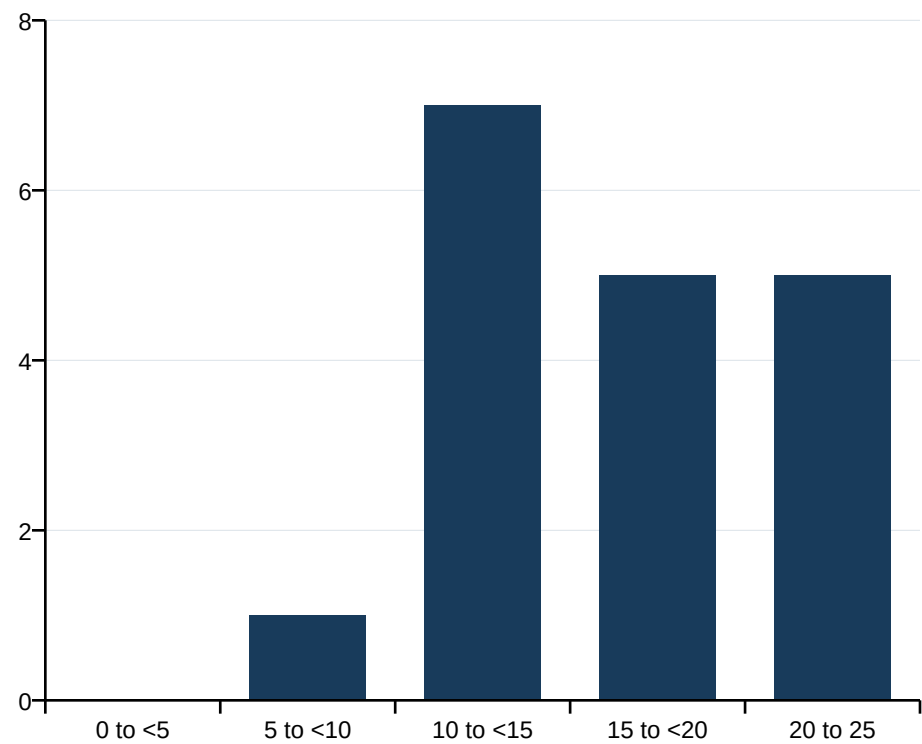
Whole exam	Points	Percent
Exams graded	18	
Mean	16.42	65.7%
Median	16.00	64.0%
Minimum	8.50	34.0%
Maximum	24.00	96.0%
Population SD	4.07	16.3%
Lower quartile	13.63	54.5%
Upper quartile	20.00	80.0%
Interquartile range	6.38	25.5%
Range	15.50	62.0%

SD is the population standard deviation. Quartiles use inclusive interpolation.

Score interval	Exams	Share
0 to <5	0	0.0%
5 to <10	1	5.6%
10 to <15	7	38.9%
15 to <20	5	27.8%
20 to 25	5	27.8%

Intervals describe the score distribution and do not define letter grades or pass/fail.

Exam score distribution (number of exams)



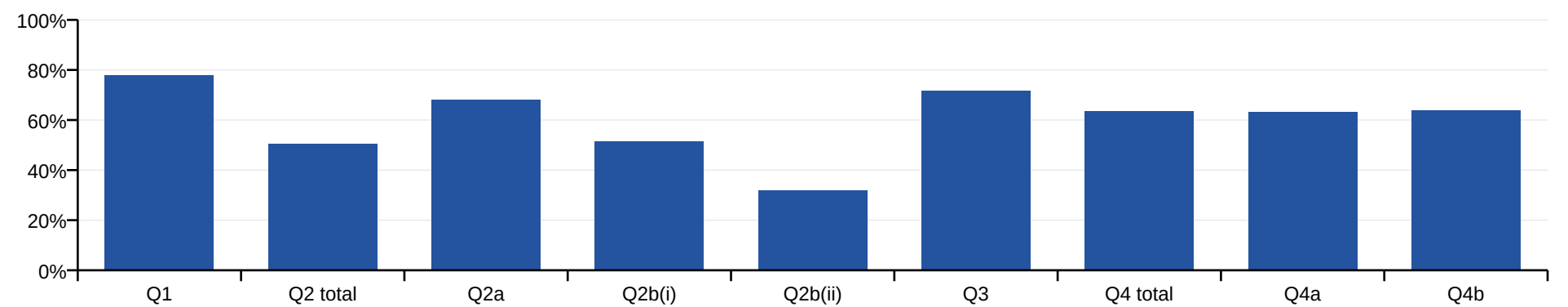
Statistics by question and subpart

Mean share of available points summarizes attainment for each part.

Question / part	Available	Mean	Mean %	Median	Min.	Max.	Pop. SD	Full credit	Zero credit
Q1	7	5.44	77.8%	6.50	2.00	7.00	1.80	7	0
Q2 total	6	3.03	50.5%	3.00	1.00	5.00	1.06	0	0
Q2a	2	1.36	68.1%	1.50	0.50	2.00	0.49	5	0
Q2b(i)	2	1.03	51.4%	1.00	0.00	2.00	0.70	4	3
Q2b(ii)	2	0.64	31.9%	0.50	0.00	1.50	0.43	0	4
Q3	4	2.86	71.5%	3.00	1.00	4.00	1.13	7	0
Q4 total	8	5.08	63.5%	4.75	1.50	8.00	1.91	2	0
Q4a	3	1.89	63.0%	1.50	1.00	3.00	0.91	7	0
Q4b	5	3.19	63.9%	3.50	0.00	5.00	1.45	2	2

Full credit and zero credit are numbers of exams. Q2 and Q4 totals combine their subparts.

Mean share of available points



Grading rubric

Half-point partial credit | Valid alternative arguments accepted

Q1 | 7 points | Constancy under $u^2+v^2=2u$

Expected work and credit benchmarks

Differentiate in x and y ; use CR; get an invertible 2×2 system with determinant ± 1 ; conclude $f=0$ and constancy on the connected disc.

Benchmark: differentiated constraints 2; CR 1; correct system/elimination 1; nonzero determinant justified from constraint 2; vanishing derivative and constancy 1. Valid constant-modulus or other proofs accepted.

Common deductions / missing steps

Correct system/determinant formula but no exclusion of the zero case: typically -0.5. Incomplete matrix or invalid elimination: larger deduction. A $w=w$ requires $A-I$, not A . Dividing by a derivative that may be zero is invalid.

Q2a | 2 points | Radius of the sparse series

Expected work and credit benchmarks

$c_{n^2}=n^2$, all other $c_m=0$; $\limsup |c_m|^{1/m} = \lim (n^2)^{1/n^2} = 1$; $R=1$. Valid comparison/ratio arguments accepted.

Benchmark: correct coefficient/root or convergence setup 1; justified limit and $R=1$ 1. Partial: 0.5 for a relevant formula only; 1 for wrong root index with right strategy/answer; 1.5 for sparse-index awareness with a small coefficient or reindexing error.

Common deductions / missing steps

Using the n th root of n^2 ignores that the degree is n^2 . Reindexing does not fill the nonsquare coefficients. A formula applied to z -dependent terms does not identify the coefficient radius.

Q2b(i) | 2 points | Formal composition is well-defined

Expected work and credit benchmarks

Since h has no constant term, h^n has no terms of degree below n . At degree m only $n \leq m$ contribute, and each contribution is a finite Cauchy-product sum.

Benchmark: absence of constant term/minimum-degree idea 1; finite contributions at every degree 1. Partial: 0.5 for pointwise composition only; 1 for $h(0)=0$ /no-constant-term idea without the finite argument; 1.5 for finite-coefficient idea shown incompletely. Clearly stated applicable composition theorem: full credit.

Common deductions / missing steps

Checking $g(0)$ or function domains alone is insufficient. Powers of a sum contain mixed products. Coefficient formulas must include the correct outer a_n and degree indices.

Grading rubric (continued)

Half-point partial credit | Valid alternative arguments accepted

Q2b(ii) | 2 points | Radius of composition is at least s

Expected work and credit benchmarks

For $0 < t < s$, $B(t) = \sum |b_k| t^k < r$ unless $h=0$, which is trivial. Bound $\sum |c_m| t^m$ by $\sum |a_n| B(t)^n < \infty$, then conclude convergence for $|T| < s$.

Benchmark: inner majorant and mapping into f 's disc 1; absolute coefficient/Cauchy-product bound 0.5; strict interior convergence and radius conclusion 0.5. Limited but relevant root/radius attempts earn 0.5.

Common deductions / missing steps

Typically -0.5 for ordering complex expressions/omitting absolute outer coefficients, and -0.5 for assuming convergence at radius r . Minimum of the separate radii is not a general composition bound. A composite coefficient is not merely $a_n h(z)^n$.

Q3 | 4 points | Zero product implies a zero factor

Expected work and credit benchmarks

If f is not identically zero, it is nonzero on a small disc; g is zero there and the identity theorem gives $g=0$ throughout U . Alternatively first nonzero Taylor coefficients give a unique nonzero product coefficient.

Benchmark: choose nonzero-factor/contradiction strategy 1; local nonzero region or first-index setup 1; force open zeros/unique coefficient 1; identity-theorem/global conclusion 1. Correct proof under a nonzero constant-coefficient assumption but missing the general case: typically 3.

Common deductions / missing steps

A single zero does not force local or global vanishing. A sum of products equal to zero does not force each product to be zero. Arbitrary nonzero coefficients may cancel; use the first nonzero indices. Applying the identity theorem just to fg repeats the hypothesis.

Q4a | 3 points | Conjugate integral around the unit circle

Expected work and credit benchmarks

$z = e^{it}$, $0 \leq t \leq 2\pi$; $\text{conjugate}(z) = e^{-it}$; $dz = i e^{it} dt$; integrand i ; result $2\pi i$.

Benchmark: correct contour/conjugate parametrization 1; differential, orientation and setup 1; simplification/evaluation 1. Partial credit also recognizes a correct general contour formula or geometry when later steps fail.

Common deductions / missing steps

Dropping dz or replacing the contour with an area integral loses setup/evaluation credit. Continuity alone does not justify Goursat; conjugation is not holomorphic. Reversing orientation, duplicating a derivative or leaving the integral unevaluated costs the corresponding credit.

Grading rubric (continued)

Half-point partial credit | Valid alternative arguments accepted

Q4b | 5 points | Goursat with one continuous exceptional point

Expected work and credit benchmarks Isolate a in a small interior rectangle; use Goursat on surrounding rectangles; cancel shared edges; bound the remaining integral by uniform M times shrinking perimeter; conclude the original integral is zero. Benchmark: isolate/shrink 1; Goursat on holomorphic pieces 1; exact boundary relation 1; uniform ML bound 1; valid limiting conclusion 1. Equivalent nested-rectangle and continuity-oscillation arguments accepted.	Common deductions / missing steps Minor perimeter scaling or missing absolute values: typically -0.5 each. A bound must be uniform, e.g. compact R. $f'(a)$ is not assumed. In maximal-subrectangle arguments the factor 4^n must be controlled; bare boundedness alone is insufficient. A singleton is not a replacement contour.
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Policy	Application
Total and part allocation	25 points: Q1 7; Q2a 2; Q2b(i) 2; Q2b(ii) 2; Q3 4; Q4a 3; Q4b 5. The two Q2b subparts share its 4 points equally.
Partial credit	Scores use half-point increments. Meaningful correct setup, a valid strategy, and useful intermediate steps receive credit even if the proof is unfinished. The benchmark allocations guide a holistic assessment; equivalent work earns equivalent credit.
Alternative methods and class results	Valid alternative proofs receive full credit. Clearly stated class results may be used when their hypotheses are checked, as permitted by the exam directions.
Deductions	Minor algebra, indexing or notation omissions usually cost 0.5 point. A missing central implication costs more according to the work completed. A single underlying error is not repeatedly penalized for every consequence.
Blank and crossed-out work	Blank answers receive zero. The final uncrossed argument is graded, with credit for useful surviving work. Handwritten continuations were included.
Interpretation	Raw scores are reported without a curve, letter-grade boundaries or a pass threshold. Statistics describe the 18 scanned exams only.
Editing	In the Excel workbook, blue score cells in Grades are editable; totals, percentages and statistics are formulas. Feedback text and PDF covers reflect this saved grading and must be revised separately if scores are changed.
Source	Answer key: MidtermExam1-solutions.tex in 2026-Midterm Exam. Answers: Scanned Exams/Individual Exams, codes listed in Grades. Remarks cite original printed pages; KHVBB2 and KUWGGK9 include handwritten back pages.