A-Level Further Mathematics

On this paper the method carries the marks, so almost every lost mark is a step that was done in the head and never written down. Everything below comes from Cambridge's own examiner reports. 本科按方法给分, 失分多是心算而没写出来的步骤。× 是常见做法,✓ 是能得分的做法。

Showing the method

✗ Working towards a printed answer and jumping the last two lines because the result is already there.

✓ **Show every step. A given answer means the WORKING is what is being marked.**

Raised in eight separate reports: when a result is given, the examiner must be in no doubt the solution is complete.

题目给了答案, 过程就是分数 ER 8 sessions P1

✗ Writing the answer to a proof and calling it a proof.

✓ **Show each step in order, with the reason for the ones that are not obvious.**

Named in seven reports. Credit is given for method as well as accuracy, so an unexplained leap loses both.

证明题要一步步写 ER 7 sessions P1

✗ Answering the first half of a question in depth and the second in a line.

✓ **Read for every aspect the question contains, and give each the depth it asks for.**

Examiners raise this in four reports, together with candidates missing that an exact answer was required.

每一问都要答到位 ER 4 sessions P1

✗ Expanding everything before looking for a common factor.

✓ **Take out common factors first, and keep brackets until they have to go.**

Examiners state plainly that both algebra and arithmetic are often simplified this way – and errors follow from the expansion, not the idea.

先提公因式 ER 3 sessions P1

✗ Using the same letter for two different things – r for a term and for the summation index.

✓ **Choose distinct symbols and state what each means.**

Examiners call this out as poor notation; an ambiguous symbol makes a correct argument unmarkable.

符号不要重复使用 EX P1

✗ Rounding to three significant figures partway through a long calculation.

✓ **Work to more figures than you will quote, and round only at the end.**

The rubric requires three significant figures for non-exact answers, and examiners advise a greater accuracy while working towards them.

过程多留位数, 答案给 3 位 ER 7 sessions P1

✗ Writing a moments or energy equation whose terms are not dimensionally consistent.

✓ **Check every term has the same dimensions before solving – a force times a length against**

an energy.

Examiners name dimensional inconsistency as a common reason for not receiving full credit, especially in moments and conservation-of-energy equations.

各项量纲要一致 ER 3 sessions P3

- Where the question gives a diagram, use it. Where it does not and forces or velocities are involved, draw one. Examiners call it an invaluable tool in ten separate reports.

  有力或速度就画图 ER 10 sessions P3

1 · Further Pure Mathematics 1 进阶纯数学 1

✗ Proving a result about roots without referring to the coefficients of the given equation.

✓ **Name them: for $ax^2 + bx + c = 0$, $\alpha + \beta = -b/a$ and $\alpha\beta = c/a$.**

Examiners state candidates needed to refer clearly to the coefficients of the given equation to prove the result.

要引用给定方程的系数 EX P1

✗ Solving for k and stating $k \neq 14$ without the algebra that produced it.

✓ **Simplify to the three-term quadratic on paper, then solve it.**

Examiners list incorrect algebra in reaching the quadratic, and an unsupported exclusion, as the two common errors.

要写出化简到二次式的过程 EX P1

✗ Finding eigenvectors by inspection and not checking them.

✓ **Use the vector product method, then substitute back to confirm $A\mathbf{v} = \lambda\mathbf{v}$.**

Examiners note the vector product method was most successful but that sign errors were common – the check catches them.

特征向量要代回验证 EX P1

✗ Giving every root of a trigonometric equation, including the ones the conditions exclude.

✓ **Apply the stated conditions – both b and c positive, or $\sin\theta \neq 0$ – and say which roots you discarded.**

Examiners record extra answers from candidates who did not use the given condition, and successful candidates excluding $\sin\theta = 0$ explicitly.

要用题目给的限制条件 EX P1

✗ Accepting a zero eigenvector as an answer.

✓ **A zero vector is never an eigenvector – it means an arithmetic error above.**

Examiners record candidates accepting zero eigenvectors without checking their working.

零向量不是特征向量 ER 2 sessions P1

✗ Writing $\theta = 64.3°$ without saying which angle it is.

✓ **Name it – the angle between the line and the plane – and mark it on the diagram.**

Examiners state it was not always clear which angle was being found, so a correct value could not be credited.

要说明求的是哪个角 EX P1

2 · Further Pure Mathematics 2 进阶纯数学 2

✗ Sketching $y = \tanh x$ with the curve touching or crossing its asymptote.

✓ **It approaches $y = \pm 1$ steadily and closely, and never reaches them.**

Examiners describe successful graphs as untruncated and approaching but not touching the asymptote.

渐近线只能逼近不能相交 EX P2

✗ Sketching a curve with no axes, no asymptote and no marked points.

✓ **Label the axes and every asymptote, and show the minimum, the sharp corner or the limiting behaviour.**

Examiners raise fully labelled sketches showing significant points and behaviour at limits in four separate reports.

草图要标轴、渐近线和关键点 ER 4 sessions P2

✗ Completing the square carelessly before an inverse-hyperbolic integration.

✓ **Complete the square in full, then match it to the standard form before choosing the formula.**

Examiners note candidates completing the square incorrectly or applying the wrong formula at exactly this step.

配方后再选公式 EX P2

✗ Evaluating a limit as $N \to \infty$ without substituting the limits first.

✓ **Write the integrated expression $-\ln(\cosh x)$ – then substitute 0 and N, then take the limit.**

Examiners describe this order as what showed enough detail to justify the given answer.

先代入上下限再取极限 EX P2

✗ Substituting into the arc-length formula before simplifying the expression under the root.

✓ **Simplify $1 + (\mathrm{d}y/\mathrm{d}x)^2$ fully first – it usually becomes a perfect square.**

Examiners note that the candidates who simplified before substituting were the ones who completed the integration.

先化简根号内再代入 ER 4 sessions P2

✗ Applying a reduction formula and not evaluating the base case.

✓ **Evaluate it: $\cosh 0 = 1$, $I_0 = \ldots$, then work up.**

Examiners record a few candidates failing to evaluate cosh(0), which made every term after it wrong.

递推公式要算出初始项 ER 2 sessions P2

✗ Comparing coefficients for a particular solution and slipping on the arithmetic.

✓ **Set the comparison out line by line and check each coefficient separately.**

Examiners record inaccuracies exactly here, in questions candidates otherwise completed to a high standard.

系数比较要逐项核对 EX P2

3 · Further Mechanics 进阶力学

✗ Finding the kinetic energy after an oblique collision from the component along the line of centres only.

✓ **Include the perpendicular component too – it is unchanged, but it still carries energy.**

Named as a common error: the perpendicular component of A's velocity was omitted from its kinetic energy.

斜碰要算两个分速度 EX P3

✗ Resolving for a particle on a cone without a normal reaction in the equation.

✓ **Put every contact force on the diagram first, then resolve.**

Examiners record the omitted normal reaction, which makes the horizontal equation simplify to something plausible and wrong.

别漏掉支持力 EX P3

✗ Using the constant-acceleration formulae where the acceleration varies.

✓ **Set up and solve the differential equation instead.**

Examiners record candidates attempting *suvat* even though the acceleration was not constant.

变加速要用微分方程 ER 2 sessions P3

■ Draw the forces before writing any equation. Ten reports name the diagram as what stops a term being left out.

先画受力图再列方程 ER 10 sessions P3

4 · Further Probability & Statistics 进阶概率与统计

✗ Running a hypothesis test and going straight to the conclusion.

✓ **State explicitly whether there is sufficient evidence to reject H_0, THEN write the conclusion in context.**

Examiners strongly encourage this two-step ending in six separate reports; the decision and the conclusion are separately credited.

先判断是否拒绝, 再写结论 ER 6 sessions P4

✗ Writing H_0: the mean is 20.

✓ **Say whose mean: H_0: the POPULATION mean $\mu = 20$.**

Examiners record hypotheses not specifying the population, or using the vague word 'average', as a common error.

假设要写总体均值 μ EX P4

✗ Writing a chi-squared hypothesis that omits a word from the variable – 'the number is independent of type'.

✓ **State the full variable the table describes, including the word the question uses.**

Examiners name the omission of a single word as a common error in specifying the hypotheses.

假设中的变量要写全 EX P4

✗ Reporting a chi-squared result with no expected frequencies shown.

✓ **Show the expected-frequency table and at least two of the calculations behind it.**

Examiners state the expected frequencies needed to be seen, with at least two correct expressions.

要写出期望频数 EX P4

✗ Deriving s_x^2 when the question already gave the unbiased estimate.

✓ **Read the question: if the unbiased estimate is stated, use it.**

Examiners record errors in the denominator of the test statistic from candidates who did not realise this.

题目给了无偏估计就直接用 EX P4

✗ Integrating a probability density function and forgetting the constant.

✓ **Find the constant from $F(\infty) = 1$, and state $F(x) = 0$ below the range and $F(x) = 1$ above it.**

Examiners name the omitted constant, and the missing pieces outside the range, as the common error in two separate sessions.

累积分布要写全三段 ER 2 sessions P4

✗ Concluding that a test PROVES the claim.

✓ **Say there is sufficient, or insufficient, evidence to reject H_0 at this significance level.**

Examiners state that a test never proves anything, and that too assertive a conclusion is a common error.

检验只提供证据, 不能证明 ER 2 sessions P4

✗ Taking the critical value from the row next to the right one, or reading a z-value from a t-table question.

✓ **Check the distribution, the degrees of freedom and the tail before reading the table.**

Named as the most common mistake in that part: an adjacent tabular value, or the wrong distribution entirely.

查表先确认分布与自由度 EX P4