A-Level Physics

Lab Report Guide · 实验报告指南

The practical papers are marked on a fixed set of skills, and almost none of the marks are for getting the "right" answer – they are for how the measurement was taken, recorded, plotted and criticised. This is the frame those marks follow, in the order the examiner reads it. 实验卷按固定技能给分，与结果是否"正确"几乎无关。

Recording the raw data

Table headings — Every column heading needs the quantity and its unit, separated with a solidus: t/s, l/m, t^2/s^2. A missing unit in a heading loses the presentation mark for the whole table.

Consistent decimal places — Raw readings in a column all carry the same number of decimal places, set by the instrument – a metre rule reading 0.250 m, not 0.25 m. Calculated columns carry the significant figures of the least precise raw value used.

Repeats — Repeat each reading and record every repeat, then the mean. Recording only the mean throws away the evidence that repeats were taken, which is itself a mark.

Range and spread — Six values spanning as much of the possible range as the apparatus allows, reasonably spaced. Five points clustered at one end scores less than five spread points, however precise.

The graph

Axes — Label with quantity/unit, choose a scale that makes the plotted points fill at least half the grid in both directions, and avoid awkward scales such as 3 units per square. The false-origin option is available and often necessary – mark it clearly.

Plotting — Points as fine crosses or encircled dots, accurate to half a small square. Then a single smooth best-fit line, drawn with a ruler if straight, with roughly equal numbers of points either side.

Gradient — Use a triangle spanning at least half the drawn line, mark it on the graph, and show the substitution. The gradient carries a unit – derive it from the axis units, do not omit it.

Intercept — Read it directly only when the origin is shown. With a false origin, substitute a point from the line into $y = mx + c$ instead of extrapolating off the grid.

Analysis

Linearising the relationship — Rearrange the suggested relationship into $y = mx + c$ form and say explicitly what you will plot on each axis and what the gradient and intercept then represent. That statement is worth marks before any data exists.

Determining the constants — Equate the gradient and intercept to the algebraic expressions, then solve. Quote the answer to a sensible number of significant figures with its unit.

Uncertainties — An absolute uncertainty is half the smallest scale division for a single reading, or half the range for repeats. Percentage uncertainty is absolute divided by the value, times 100. When quantities are multiplied or divided, ADD the percentage uncertainties; when a quantity is raised to a power, multiply the percentage by that power.

Uncertainty in a gradient — Draw the steepest and shallowest lines that still pass through all the error bars, take their gradients, and halve the difference. Show both lines on the graph.

Evaluation – where Paper 5 marks concentrate

Identify limitations specifically — A limitation names the measurement and why it is hard: "the time for one oscillation is short compared with human reaction time", not "human error". Vague limitations score nothing.

Match each improvement to its limitation — Every improvement must address a limitation you actually stated, and must be specific enough to carry out: "time twenty oscillations and divide by twenty", "use a set square to check the rule is vertical", "use a fiducial mark at the centre of the swing".

Judge the conclusion honestly — State whether the data support the suggested relationship and cite the evidence: whether the points lie on a straight line within the error bars, and whether the intercept is zero within its uncertainty. A conclusion that ignores the scatter is incomplete.

The write-up skeleton

Aim: the relationship being tested, in symbols. Method: the quantity varied, the quantity measured, and everything kept constant, named. Safety only where genuinely relevant.

Results: one table, correctly headed, with raw and processed columns. Graph: on the grid supplied, with the gradient triangle drawn on it.

Analysis: gradient, intercept, the constants derived from them with units, and the uncertainty in each. Conclusion: does the evidence support the relationship, and within what uncertainty.

Evaluation: four limitations with four matched improvements, each pair specific to this experiment.