

The experimental design question is worth a substantial share of the free-response section and is the one most candidates under-answer. It is not about apparatus: it is about what you measure, how you linearise it, and what the slope of your graph means. 实验设计题不考器材, 而考 “测什么、如何线性化、斜率代表什么”。

Designing the experiment

List the equipment by what it MEASURES, not by name alone: “a metre stick to measure the length of the pendulum” earns the point, “a metre stick” does not.

State the quantities you will measure directly and how you will vary the independent variable over a RANGE – a single measurement cannot give a slope.

Say that you will repeat each measurement and average, and name the error that reduces (random, not systematic).

Describe how you avoid or reduce a specific systematic error – starting the timer at the extreme of the swing, measuring to the centre of mass, zeroing the force sensor.

Linearising and graphing

Almost every design question wants a STRAIGHT-LINE graph. Rearrange the relationship so the plotted quantities give $y = mx + b$, and say what you will plot on each axis.

State explicitly what the SLOPE represents in terms of the quantity being determined – that is where the marks concentrate.

If the theory predicts a line through the origin, say so; a non-zero intercept is then evidence of a systematic error, and naming it earns credit.

Plot the data, do not connect the dots. Draw a single best-fit line and use widely separated points ON THE LINE to calculate its slope, never two raw data points.

Label both axes with quantity AND unit, and choose scales that use most of the grid.

Reasoning and justification

When asked to justify, refer to a physical principle by name (conservation of momentum, Newton’s third law) and then apply it to the specific objects in the question.

For a system question, define the system first. Whether momentum or energy is conserved depends entirely on where you draw the boundary and what forces cross it.

A comparison answer needs both sides: “greater than in case A because ...”, not “it is large”.

Do not derive a formula the question did not ask for; answer the question that was asked, in the form it was asked.