

Physics IA Evaluation Checklist

Read your Evaluation section. If you cannot check a box, you need to rewrite that part.

Phase 1: The Basics

- ☐ **Past tense, paragraphs:** I have written in the past tense, in paragraphs.
- ☐ **No strengths:** I have removed all mention of "what went well" or strengths of the method.
- ☐ **No mistakes:** I have removed all mention of carelessness, "human error" or using equipment wrongly. Where I meant reaction time, an inconsistent release or reading at an angle, I said that instead.
- ☐ **No recap:** I did not repeat the Conclusion. I referred to the discrepancy in one clause and went straight to its cause.
- ☐ **No extensions:** I did not propose a different investigation. Every suggestion improves the method of answering *this* research question.
- ☐ **Nothing generic:** None of my sentences could be pasted unchanged into a report on a different experiment. Each weakness names the apparatus or step, the quantity it affected, the direction or size of the effect, and the feature of my data that shows it.

Phase 2: Evidence

- ☐ **Every point has evidence:** each weakness or limitation I discuss is backed by one of: a feature of my graph or data (scatter, a shift in a known direction, curvature, a repeat that disagrees); a qualitative observation I recorded under my data table; or a physical effect that must have been present and whose direction matches the shift I saw.
- ☐ **No speculation:** I have removed anything of the form "the temperature might have changed" that I did not record or that my data do not show.
- ☐ **Shift vs scatter:** For an ever-present effect such as friction, I discussed its average as a systematic error and, only if I had evidence that it varied between trials, that variation separately as a random error.

Phase 3: Classification

- ☐ **Weakness vs limitation:** I labelled each error source correctly.
 - ☐ **Weakness:** something in the method that affected the data I collected (control of a variable, precision of a measurement technique, variation between repeats).
 - ☐ **Limitation:** something in the overall approach that bounds what my conclusion can claim even with perfect measurements (the range of the independent variable covered, a model assumption, a looked-up value, a single object used to represent all objects of its kind, such as one spring or one brand of ball).
- ☐ **Both levels:** I evaluated the overall approach (the model I chose to test, what I measured versus looked up, the range of the independent variable I covered, the order of trials), not just individual procedural steps.
- ☐ **Random vs systematic:** I said which type of error each one produced.
 - ☐ Random (scatter, larger uncertainty bars, lower precision) from a weakness whose effect differed from trial to trial.
 - ☐ Systematic (a shift in one direction, lower accuracy) from a consistent weakness or from a limitation of the model.

- ☐ **Terminology:** I used "limitation of the methodology" for a flawed model assumption, and "weakness" for instrument or technique precision.

Phase 4: Read the Graph

Tick every line that describes your linearised graph (scatter and a shift can both be present). The sub-box under Curvature applies only if you made that claim.

- ☐ **Scatter or large bars** → I linked it to a specific weakness in control or precision, and I named the single measurement that contributed most to my percentage uncertainty.
- ☐ **Shift (straight line, wrong intercept or gradient)** → I linked it to a consistent weakness or a model limitation, and the cause I named produces the direction I observed. If the shift was many widths of my max/min range, I identified which assumption of the model is at fault, treated it as a limitation of the methodology, and did not write the gap off as apparatus error.
- ☐ **Curvature (model "not a valid description")** → I chose between the three causes (a term missing from the model that grows with the independent variable; a variable drifting in step with the independent variable because trials ran in order; an instrument used past its linear range), and said which fits my data and why.
 - ☐ **Drift or instrument-range claims:** If I claimed drift or an instrument past its range, I gave the evidence (a setting repeated at the end that came out different; the instrument's specification or my calibration).
- ☐ **Nothing visible** → My result agreed with theory within uncertainty, so I identified the systematic effects that must have been present, estimated their size and showed they were smaller than my uncertainty.

Phase 5: Relative Impact (the 5–6 band)

- ☐ **Biggest first:** I identified the one or two issues that account for most of the discrepancy (or, if the discrepancy was negligible, most of my uncertainty), discussed them first and spent most of my words on them.
- ☐ **Sized:** I estimated how big an effect the main cause would have and compared it with the discrepancy I observed (e.g. "a y-intercept of -0.20 m s^{-2} means a resistive force of $0.75 \text{ kg} \times 0.20 \text{ m s}^{-2} = 0.15 \text{ N}$, consistent with the nudge the cart needed to start"; "a 13% shallower gradient needs a string angle of about 30° , more than I saw, so the angle explains only part of it"), and ruled out causes that are too small (e.g. "0.2 s reaction time on 14.1 s is 2.8% in T^2 , smaller than the 9% error").
- ☐ **Minor ones dismissed with a reason:** Each minor issue got one sentence saying that it is minor and why.

Phase 6: Discussion of Each Issue (three steps)

- ☐ **Identify and classify:** weakness or limitation; random or systematic.
- ☐ **How and how much:** For random error, how it produced the scatter or bar size and what share of my percentage uncertainty it accounts for. For systematic error, the physics of the direction ("...so the measured period was consistently lower because...") and an estimate of the size of the shift compared with the shift I saw.
- ☐ **Improve:** a realistic improvement that fixes the source.

Phase 7: Scope

- ☐ **Range justified:** I said why I chose the range of the independent variable I did and what it allows me to claim.
- ☐ **Range as limitation:** If the range was too narrow to distinguish the relationship from a nearby alternative, or covered only part of the range the model is expected to apply to, I identified that as a limitation and said what range would have been needed, and what it would have tested (e.g. "lengths from 0.40 m to 0.60 m only: over a range that short a straight line fits almost any smooth curve, so lengths from 0.20 m to 1.00 m would be needed to confirm the relationship").

Phase 8: Improvements

- ☐ **Feasible:** realistic for a school laboratory.
- ☐ **Targeted:** each improvement fixes the source of a specific weakness or limitation I identified.
 - ☐ Bad: "Be more careful." (Lame.)
 - ☐ Good: "Use a photogate to remove reaction time from the timing."
- ☐ **Explained:** I said what each improvement would achieve: reduce the random or systematic error I identified, or, for a scope limitation, widen what I could claim.
- ☐ **Approach-level improvements considered:** where my biggest issue was a limitation, I suggested measuring what I looked up or neglected; putting the neglected term into the model and re-deriving what it predicts (an analysis improvement, possible with my existing data); widening the range; or randomising the order of trials / repeating the first setting at the end.
- ☐ **Matched to error type:** I did not offer "more repeats" or a more precise instrument as the fix for a systematic shift.
- ☐ **Refined model:** If I proposed a more general model and it is within the course, I re-derived the expected gradient and/or intercept from it (a 6/6 Evaluation does this). If it goes beyond the course, I cited a reliable source, made clear which parts of the argument are mine, and, where I could not complete the derivation, stated what the neglected factor would change (gradient, intercept or shape of the line), in which direction and why.