List of Limitations and improvements of Physics Lab experiments

1. For measurement of vertical height

Limitations	Improvements
1. Two readings (of d and l) not enough/only two readings/ too few readings.	Take more readings and plot a graph/ more values of k (and compare).
2. Difficult to measure h with reason/parallax error in h	Detailed use of set square or pointer to improve parallax/
3. Rule may not be vertical (when measuring h)	Detailed use of set square (table level)

2. For Oscillation experiments

Limitations	Improvements
1. Difficult to judge when oscillation is complete	1.Use video (+ playback) + timer/use clock on video /2.Use (fiducial) marker/pointer at centre of oscillation
2. Oscillations die away quickly/too few oscillations/ damped	

3. Deflection of meter rule when mass is placed on it (S11_Q32_Q33)

Limitations	Improvements
1. d is very small.	1. Use larger mass/use larger x value. 2. Use thinner rule
2. Difficult to measure h (with reason).	Use vernier caliper/travelling microscope
3. Difficult to measure x (with reason)/difficult to judge position of mass.	Hang masses below rule
4. ruler slips on support/supports slip on block	glue support to block

4. Penetration of wooden rod in sand (S11 Q35)

Limitations	Improvements
1. Explain difficulty in getting measurement of depth accurately with finger/position of finger and line may not be in line.	Put mark on rod/use a clip/ measure rod out of sand with scale or ruler/scale marked on ruler/draw mark all the way round.
2. Rod falls sideways/not entering sand vertically.	Practical method to keep rod vertical e.g. guide for rod.
3. Cannot see if mass is directly above rod.	Ensure centralisation of mass e.g. guide for mass.
4. Depth/x very small	Increase height/mass

5. Attractive force between two magnets (S10 Q32)

Limitations	Improvements
1. Maximum force reached without warning	video with playback in slow motion
2. Zero error on newton meter when used horizontally	Adjust zero / practical vertical arrangement.
3. Friction with bench.	Method of reducing friction.
4. Difficult to measure force due to weak magnets	More sensitive newton meter

6. Terminal speed of glass ball in oil (S10 Q33)

Limitations	Improvements
1. Time too short/reaction time large compared to measured time/parallax error in judging start/stop.	Increase x/lengthen tube/smaller balls/video with timer (playback) in slow motion
2. Difficult to see glass balls.	Use coloured balls/shine light through.
3. Terminal velocity not reached (by the first marker).	video with timer (playback) in slow motion
4. Balls not all the same diameter/ size /shape /mass	Use micrometer screwgauge/top pan balance

7. For Electricity expe. With resistance wire (W10 Q33)

Limitations	Improvements
1. Voltmeter scale not sensitive enough/not precise enough/only reads to 0.1 or 0.05 V.	Use digital voltmeter/use a voltmeter that reads to 0.01 V.
2. Contact resistance/ fluctuating ammeter or voltmeter readings.	Method of cleaning contacts e.g. sand clips. Tighten clips
3. Difficult to make *I* the same (for both experiments).	Method to obtain continuous variation in the current e.g. (slide wire) potentiometer/potential divider
4. Wires kinked/Wires not straight/Difficult to keep wire straight	tape to ruler, hang weights off end, clamp wire.

8. Water flow through a hole in a container (W10 Q34)

Limitations	Improvements
1. Difficult to see water level/meniscus problems/refraction problems.	Use coloured water/liquid
2. Labels get wet/ink runs	Use waterproof labels/ink
3. Difficult to judge when to start/stop timing	Use video, with timing method
4. Bottle deforms when measuring d	Use vernier callipers to measure d.

9. Equilibrium of a rule (W10 Q35)

Limitations	Improvements
1. Difficult to balance with reason e.g. unstable or effect of fans/draughts/a.c	Drill hole higher up/switch off fans/a.c./close windows.
2. Difficult to judge when wooden strip horizontal/parallel	use a spirit level or metre rule(s) to measure height of both ends
3. Difficult keeping x constant/ weights move.	Method of fixing cotton loop to rule e.g. tape, glue
4. Difficult to measure θ because hard to judge vertical/movement of hand	Use a plumb line/clamped ruler/clamp protractor.
5. Friction at pulley/between nail and wooden strip.	Use lubricant/method of reducing friction.

10. Angle of tilt of bottle (S09 Q31)

Limitations	Improvements
1. Parallax error in measuring h/θ .	Get eye level/ 'eye level' perpendicular (to protractor lines, ruler or meniscus).
2. Difficult to measure height owing to refraction/shape of bottle	Add dye/use ruler with a zero at the start
3. Difficulty in deciding the toppling point	Move by increments/hold with newtonmeter and tilt until F = 0
4. Difficulty in measuring θ owing to container not perfectly right angled (curved) at the bottom	Make bottom square with plasticine

11. Rsistance of wire coil on cylinder (W08 Q31)

Limitations	Improvements
1. Tube not circular/tube not rigid.	Repeated measurements of d in different directions.
2. Coils not circular (helix inferred)/different turns have different lengths	Measure the length in one turn by wrapping string, then unwrapping and measuring
3. Difficult to judge whole number of turns when positioning contacts/large contact area	Mark lateral line on tube to give positions for contacts
4. Contact resistance/ fluctuating or changing readings	Measure lead resistance and subtract from R/clean the contacts/use shorter leads.

12. Rebound height of a ball (S07 Q32)

Limitations	Improvements
1. Hard to judge rebound height	Use video and play back slowly/position sensor
2. Parallax (error in measuring h)	drop many times to refine value of h /ensure measurement taken at eye level
3. Difficult to release without applying a force	Mechanical method of release
4. Inconsistent bounce	Use flat surface/turn off fans

limitations in an experiment. The checklist could include the following questions.

· Apart from the variables being measured, was there any other factor that might have affected the results?
· Which measurements were difficult to make?
· What were the largest sources of error?
· Were there any systematic errors?
· Was enough data collected?
· Was the range and distribution of the data points appropriate?
· Was a graph of the data plotted?