Year 12 Physics AS90252 level 2

Justify the techniques used to increase the accuracy of the measurement.

When taking measurements

1. All measurements are recorded to the initial number of significant figures read off the scale.
2. All measurements need to have a unit recorded.
3. Repeat measurements 5 times.

Every justification needs to include an explanation of why each error occurs and how that error was reduced.

Why is there an error?

- **Parallax error**
  - An object is a distance from the scale it is being read, observer is not perpendicular to the scale will read off an incorrect value.

- **Multiple measurements**
  - The scale used to measure the object is too large, there will be a large percentage error in the measurement.
  - It is difficult to accurately measure when exactly a complete oscillation starts or ends as the mass moves quite quickly, there will be a large percentage error in the measurement.

- **Zero reading**
  - The scale of the ammeter reads 0.3 A when there is no current flowing, every measurement will be 0.3 A higher than the actual value.

- **Repeated measurements**
  - Small variations in the equipment and the techniques used in measuring cause random errors, an individual reading may be quite different to the actual value.

How is the error reduced?

- By viewing an object perpendicular to the scale the error from parallax can be reduced.
- When choosing the correct scale the reading can be recorded to a higher level of accuracy (more significant figures).
- Repeating and averaging reduces the random error caused by the difficulty in judging how high the ball bounces.
- By taking multiple measurements the measurement can be taken to a higher number of significant figures.
- Lining the needle up with its reflection reduces the parallax error.
• By lining up the eye horizontally in line with the bottom of the meniscus the parallax error is reduced.
• By choosing the smaller scale I am able to take a measure to more significant figures.
• By taking repeated measurements random error that come about because of human error and the imperfections in apparatus used can be reduced and the average answer is more likely to be closer to the actual value.

Some examples

The bung rotates so quickly there is a large random error because of the difficulty in judging when to start and stop the stop watch. This error can be reduced by timing 10 revolutions; this effectively reduces the time error by 10 as only one time measurement is taken for 10 revolutions.

Situation that causes the error
How error is reduced (multiple measurements)
Rational for using technique.

When measuring the force of gravity acting on a pencil case the spring balance reads 0.2 N before the pencil case is attached. This means that every measurement taken with is balance would be 0.2 N larger than the true value. To eliminate this zero error 0.2 N is recorded and this value is subtracted of every measurement.

Situation that causes the error
Rational for using technique.
How the error is reduced (zero reading)
Explain two ways that errors can be reduced when taking the following measurements.

1. The height of a student in the Physics class.

2. The time it takes for a tennis ball to drop from the ceiling.
Explain two ways that errors can be reduced when taking the following measurements.

1. The height of a student in the Physics class.

A zero error is caused by the scale not being flush with the end of the ruler. This means that any height measured from the ground would be 6 mm shorter than the actual result. We corrected for this result by adding 6 mm to the height recorded.

A parallax error may occur when the as the highest part of the head is a distance away from the wall where the height will be measured. Two correct for this the spine of a hard book was placed against the wall and the base of the book on the top of the head. The base of the book produces a line perpendicular to the wall eliminating any possible parallax error.

2. The time it takes for a tennis ball to drop from the ceiling.

A zero error is caused by the reaction time it takes register for the student to start timing after the ball was dropped. We minimised this by counting down 3, 2, 1, GO so the timer could better anticipate when the ball was released.

Due to random human error the timer may sometimes stop the watch slightly earlier giving a shorter time or may stop the watch slightly later giving a longer result. We took 10 reading and averaged the result, this averaged result will give an answer closer to the real time.