Week 3 Homework answers

1. Describe the difference between accuracy and precision

Precision:

How close your results are to each other

How repeatable they are

The number of decimal places or significant figures that an instrument can measure

Accuracy:

How close your results are to the true value of what you are measuring

2. Explain the difference between random and systematic errors. Give an example of how you can reduce each error type. Which type of error is likely to reduce the accuracy of a result?

Random Errors:

Human errors e.g. reaction time when using a stopwatch or parallax errors when reading a graduated scale

Unpredictable environmental changes e.g. wind blowing during an outdoor experiment to measure the speed of sound

Random errors can be reduced by repeating the experiment and averaging your results

Systematic Errors:

Equipment errors e.g. digital scales being incorrectly zeroed or a thermometer that consistently reads 3°C too high

Systematic errors can be reduced by replacing equipment, calibrating equipment or using multiple sets of equipment to compare readings

Systematic errors mainly affect accuracy

3. An experiment to calculate the resistance of a resistor gives a value of 3800 Ω. The manufacturer states that the true value of the resistor is 3650 Ω. Calculate the percentage difference between the experimental value and the true value.

   (3800 – 3650) /3650 x 100 = 4.1 %

4. A stopwatch measures time to an absolute uncertainty of ± 0.1s. It is used to measure the time period of a pendulum's swing.

   i) The time period for one complete swing is measured as 2s. Calculate the percentage uncertainty in the reading.

   0.1/2 x 100 = 5%

   ii) The time period for ten complete swings is measured as 20s. Calculate the percentage uncertainty in the reading.

   0.1/20 x 100 = 0.5%

5. The mass of a sphere is 500 kg ± 20 kg. Its radius is 150 cm ± 5 cm. Calculate the percentage uncertainty in its density (volume of a sphere = $4/3\pi r^3$)

   Mass: 20/500 x 100 = 4% Radius: 5/150 x 100 = 3.3%

   % uncertainty = 4 + 3.3 + 3.3 + 3.3 = 13.9%