

“Every measurement is subject to uncertainty”

1. Put a tick in the correct box in the table to match the descriptions with the three main types of uncertainty.

Description	Reading	Random	Systematic
This arises from using measuring apparatus which is not working properly			
This should be quoted as ± 1 in the least significant digit when using a digital measuring device			
This arises from having to judge where the pointer is on an analogue scale			
This will normally produce results which are all too big or all too small			
This should be quoted as \pm half of the smallest scale division when using an analogue measuring device			
This arises from factors which cannot be controlled by the experimenter			
This is equally likely to give results which are too big as results which are too small			
This arises from faulty experimental technique			

2. When you are carrying out an experiment in Physics, it is important to repeat your measurements a number of times.

Score out the statements below that **do not** describe good reasons for repeating your measurements.

- a) Repeated measurements can show up where mistakes have been made.
- b) Repeated measurements can eliminate a systematic uncertainty.
- c) Repeated measurements can be averaged to reduce random uncertainties.
- d) The more often you repeat measurements, the smaller your approximate random uncertainty will be.
- e) The mean of a set of repeated measurements is the best estimate of the true value of the measured quantity.

3. A Sixth Year pupil is trying to measure the speed of sound. She gets the following results.

326 m/s 351 m/s 339 m/s 347 m/s 333 m/s 334 m/s 342 m/s

a) Calculate the mean of her values.

b) Calculate the approximate random uncertainty in her mean value.

c) State the final result of her experiment and comment on how it compares with the accepted value of 340 m/s.

4. Score out the false statements about absolute and percentage uncertainties.

a) An absolute uncertainty is just a number that tells you about the accuracy of a measurement.

b) An absolute uncertainty should always be rounded to the same number of decimal places as the measurement it describes.

c) To calculate a percentage uncertainty, you divide the measurement by its absolute uncertainty and multiply by 100.

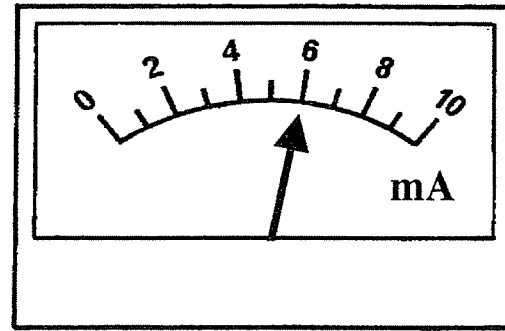
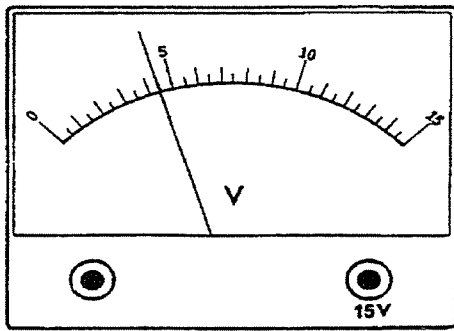
d) Percentage uncertainties are useful for comparing the accuracy of different measurements.

e) The percentage uncertainty in the result of a calculation should be taken as the greatest percentage uncertainty in the measurements used in the calculation.

5. After doing any calculation required, state the absolute and percentage uncertainties in the experimental results described in question 3.

absolute uncertainty = _____ percentage uncertainty = _____

6. The meters below show the voltage and current in a circuit to measure the power of an LED.



a) State the value of the voltage and its absolute uncertainty.

b) Calculate the percentage uncertainty in the voltage.

c) State the value of the current and its absolute uncertainty.

d) Calculate the percentage uncertainty in the current.

e) Calculate the power of the LED and state the percentage uncertainty in it.

f) Calculate the absolute uncertainty in the power of the LED.

7. In an experiment to measure the electrical energy used by a heater, a pupil measures the following quantities.

voltage supplied to heater = 12.0 ± 0.2 V

current drawn by heater = 3.0 ± 0.1 A

time heater switched on for = 100.00 ± 0.01 s

$$E = Pt = ItV$$

The formula to be used in the calculation is shown above on the right of the data.

Calculate the energy used and the absolute uncertainty in it.