E4 Accuracy, Percentage Difference and Reliability

$^{7}/_{9}$

You will be penalized for an inappropriate number of significant figures (e.g. giving an uncertainty to 3 sf) and you must include the relevant unit.
Data (accepted values):

$g = 9.81$ m s^{-2}
$\epsilon_0 = 8.85 \times 10^{-12}$ F m^{-1}
$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}

E4.1 In an experiment, you obtain the result that $g = (9.89 \pm 0.06)$ m s^{-2}.

a) What is the percentage difference of your experiment compared to the accepted value? [Note - sometimes this is referred to as the percentage error.

b) Does the accepted value lie within your error bars?

c) Without calculation, will the percentage difference in (a) be greater or less than the percentage uncertainty on your result?

E4.2 Your classmate obtains the result that $g = 7.4$ m s^{-2}, and states that his relative uncertainty was 35%. Work out the upper and lower bounds on his value, and state whether the accepted value lies within his error bars.

E4.3 You do an experiment and work out that the percentage difference between your result and the accepted value is smaller than your relative uncertainty. Does the accepted value lie within your error bars?

E4.4 You measure the resistance of a component as 35.7 mΩ $\pm$ 300 μΩ. You are told that the percentage difference between your answer and the true value is 0.6%. Work out your percentage uncertainty and hence state whether the accepted value lies within your error bars.

E4.5 You obtain a measurement that $G = 6.95 \times 10^{-11}$ N m^2 kg^{-2}, with a relative uncertainty of 5%. Determine whether or not your experiment is consistent with the accepted value of G.

E4.6 You obtain the following results for the time period of a pendulum: $(561, 563, 569, 562, 565)$ ns. None of these results are anomalous. You are then told that the accepted value is 560.5 ns. Does this lie within your error bars?

E4.7 You conduct an experiment to measure the value of ϵ_0. You work out that the total uncertainty in your experiment is 11%, and that the accepted value of ϵ_0 only just lies within your error bars. You tell your friend all this information, and ask him to work out what result you got. What two possible answers should he give you?