Photo-elastic Stress Measurement Remote Access Experimental Lab

Requirements

To analyse the stresses on a Perspex component under load conditions. The laboratory exercise will be completed via remote access using a student dedicated remote desktop link from the on-line learning environment. An additional web cam link to the laboratory for communication with a supervising technician is also necessary.

Equipment

Stress Photonics - Photoelastic Stress Analysis System, Hounsfield Tensile Testing Machine, Perspex Component.

Method

Start Procedure

1. VPN into the University Network.
2. Establish Communication with the Supervising technician.
3. The test piece will already be set-up within the tensile testing machine by the supervising technician.
4. Launch the relevant Remote Desktop Link from the on-line distance learning website. Use your university user name and password to log onto the remote access computer.
5. Check with the Lab technician that the equipment is aligned, the component is under zero load conditions and all equipment is operational.
6. Launch the stress photonics application .
7. Perform the initial calibration and camera set up steps as provided in the appendices.

Data Acquisition

NB: Remember after each capture to save the acquired data for further analysis once the data acquisition for the experiment is complete.

1. Capture an image of the unloaded component.
2. Request that the lab technician increases the compressive load in offset increments of 0.5mm, acquiring and saving image data at each step. You also need to request and note the respective force applied in newtons at each step from the lab technician.
3. Repeat step 2 above until an offset value of 5mm is applied.

Data Analysis

Compile an experimental report by analysing the acquired data. Use the maximum shear stress plot options noting the maximum and minimum shear stresses for each load condition. Note also the positions of tensile and compression stress regions of the component and the effect each load condition has.

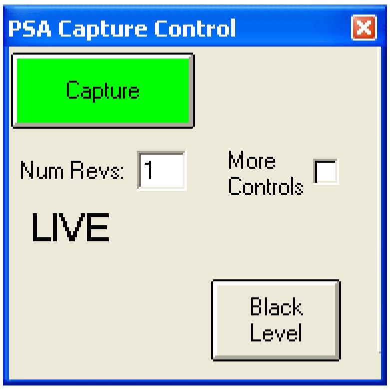
Compile an experimental report. Use the guidelines in the appendices when structuring your report.

Appendices

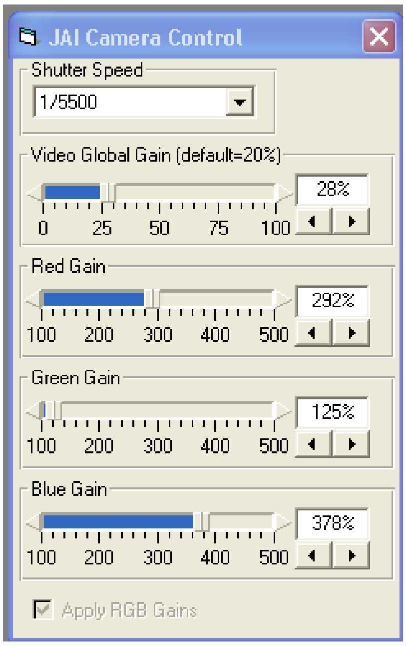
Initial Calibration Set-up.

Through communication with the Lab Technician, the camera controls Zoom and Focus should be adjusted to provide optimum image area coverage and image sharpness.

Select the GFP Control button , to enable the ‘Live Data’ and ‘PSA Capture Control’ windows:



Also select the Camera Control button , to display the camera control window:



The initial parameters to adjust are the shutter speed (exposure) and Video Global Gain controls.

These need to be adjusted to provide an adequate image that is neither over or under-exposed. Examples of the effect of these controls are given as follows:

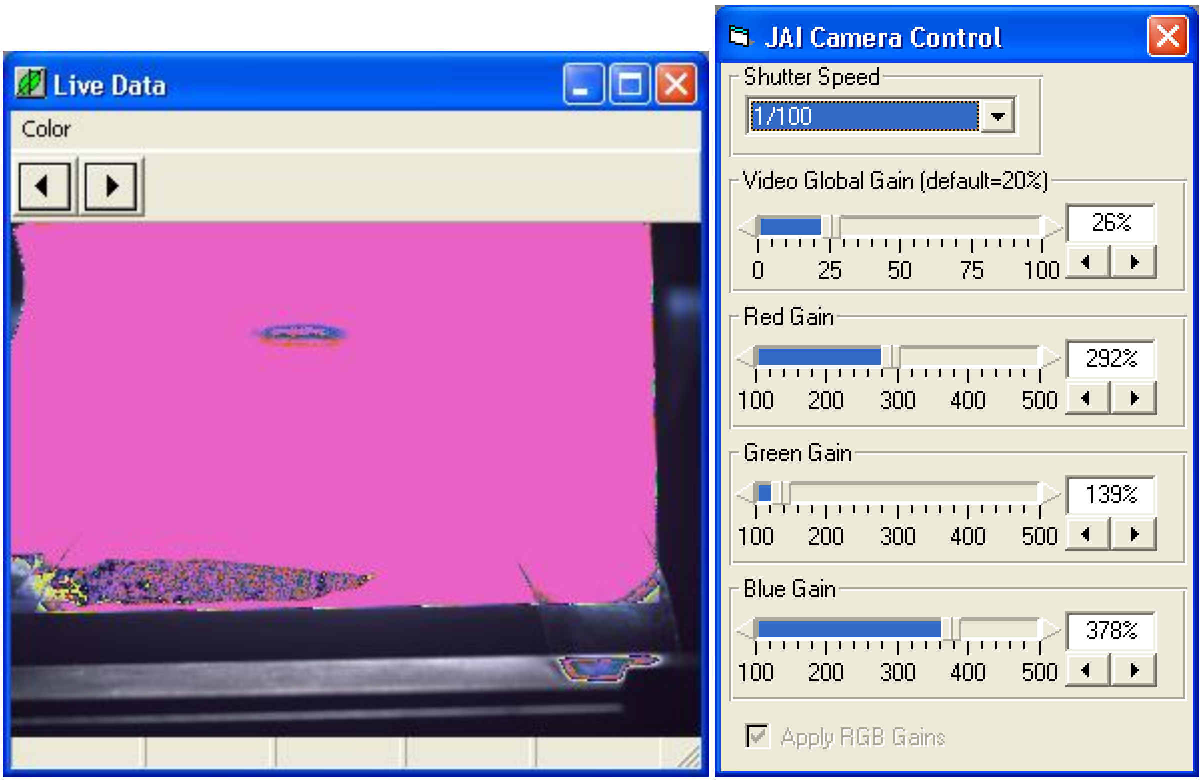


Figure 1 - Over Exposed Image by incorrect selection of Shutter Speed parameter.

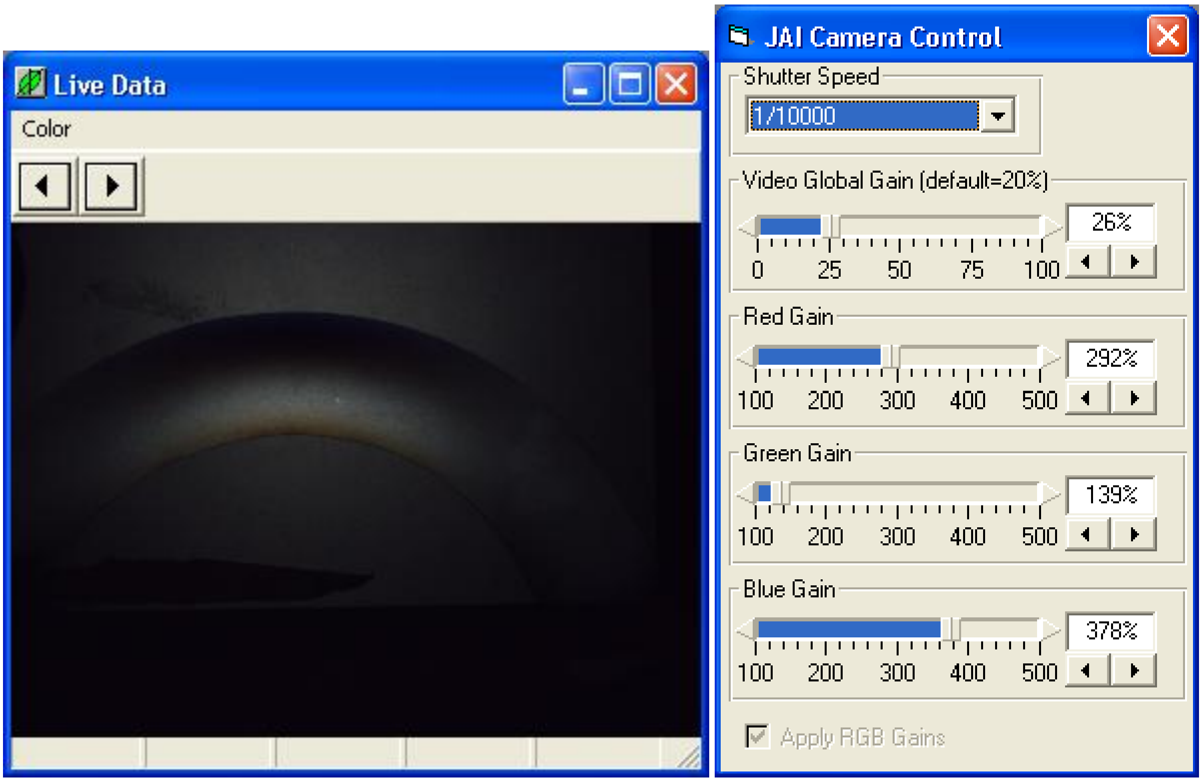


Figure 2 – Under Exposed Image by incorrect Shutter Speed parameter.

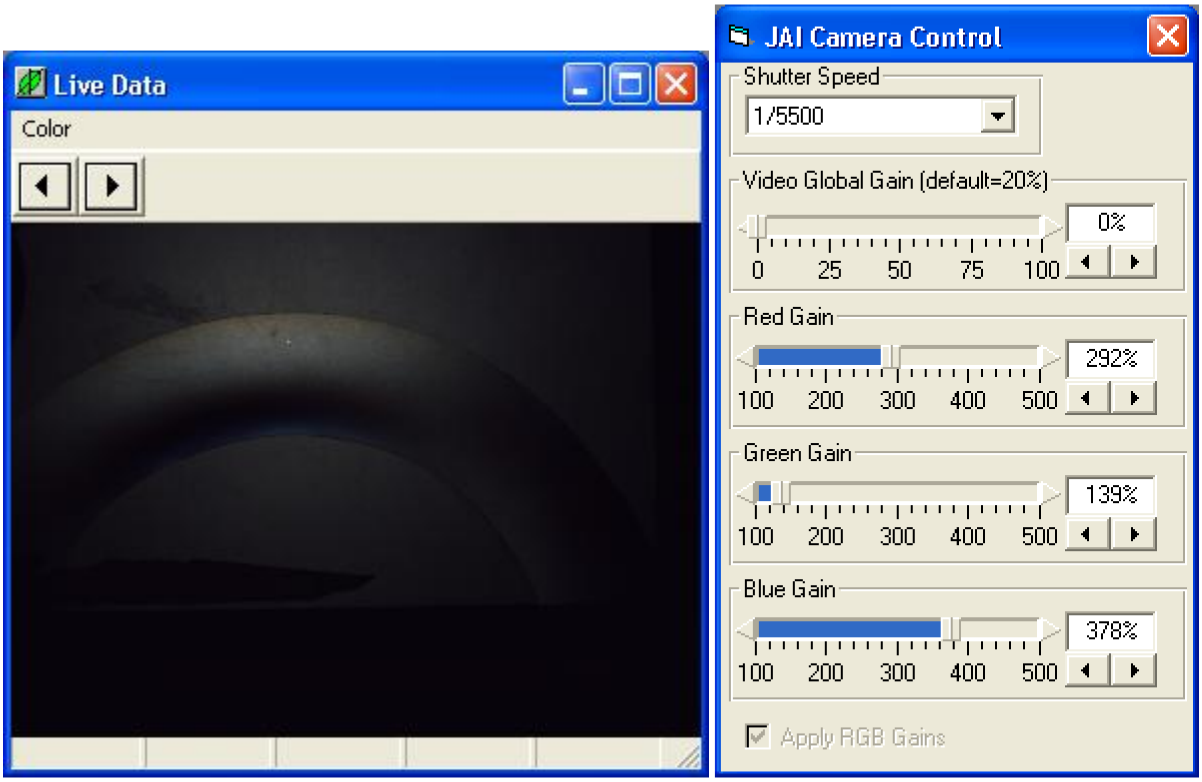


Figure 3 – Under Exposed Image by incorrect Global Video Gain adjustment.

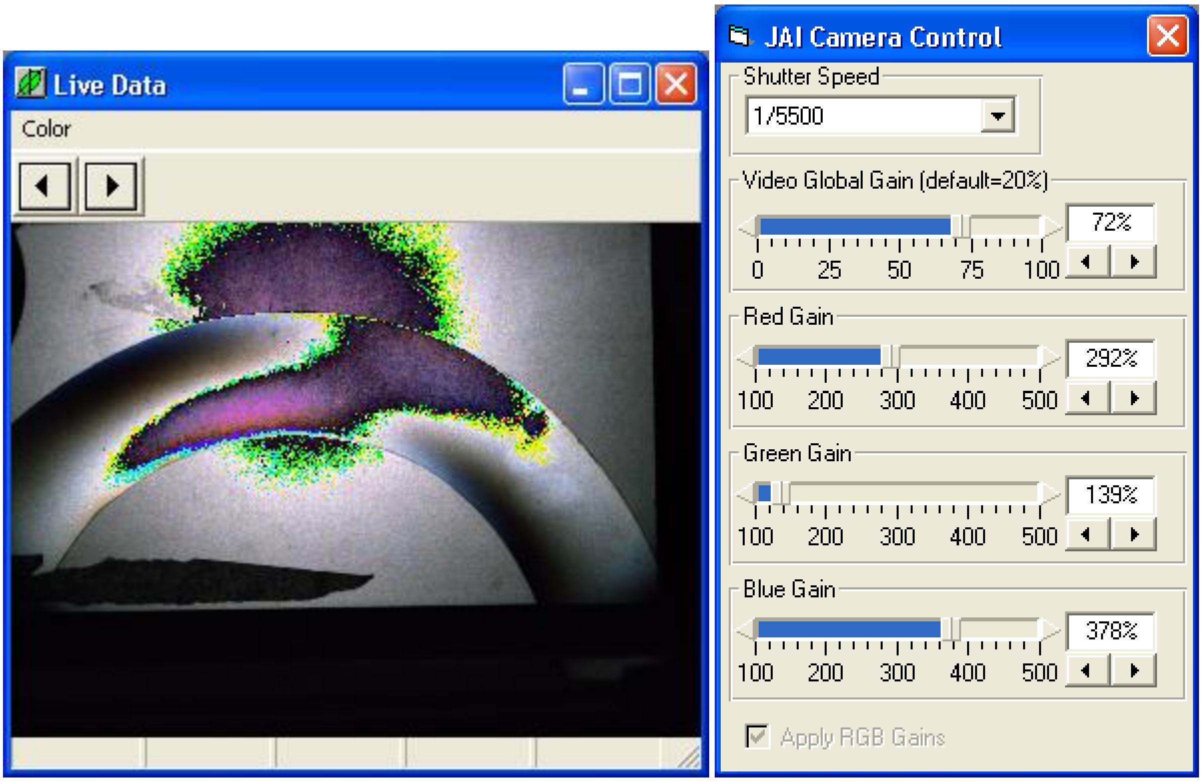
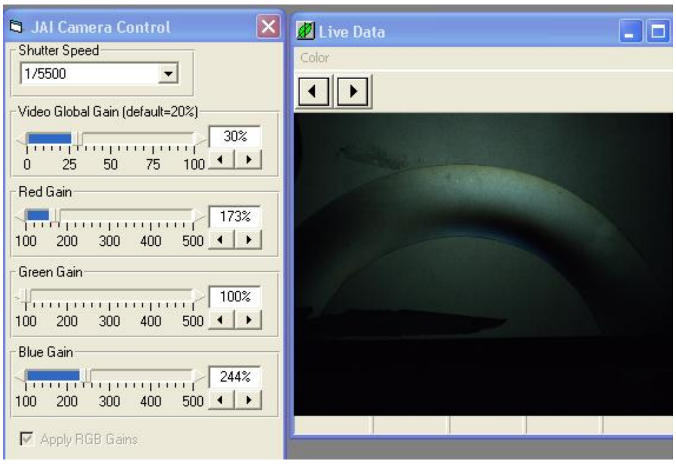
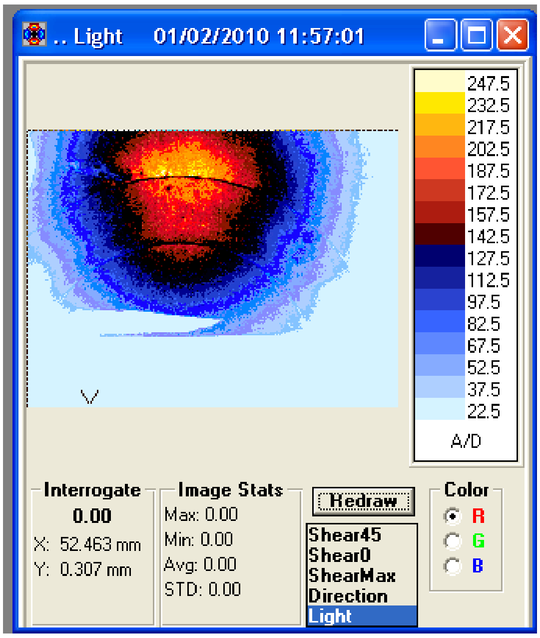


Figure 4 – Image with over exposed areas due to too high a Video Gain Setting selection.

Assume the following settings, although the optimum may differ somewhat from the screenshots provided.

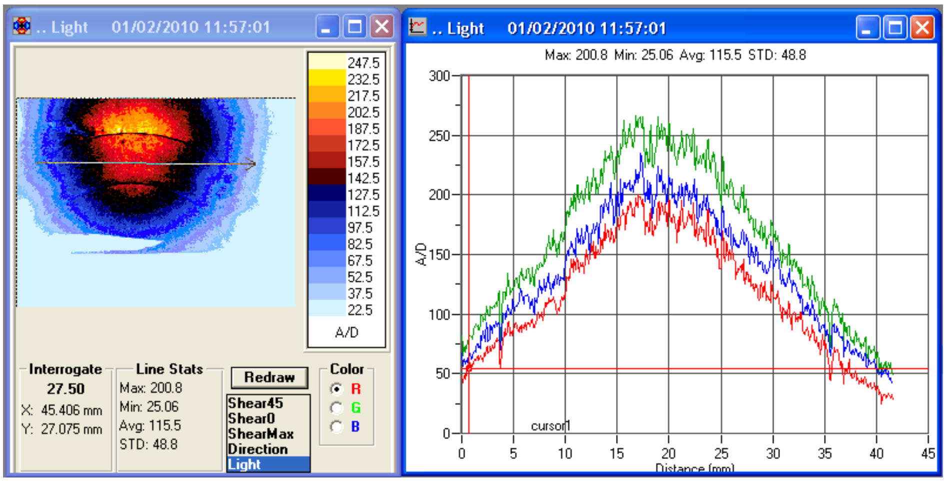


Capture an image using the PSA Capture Control.

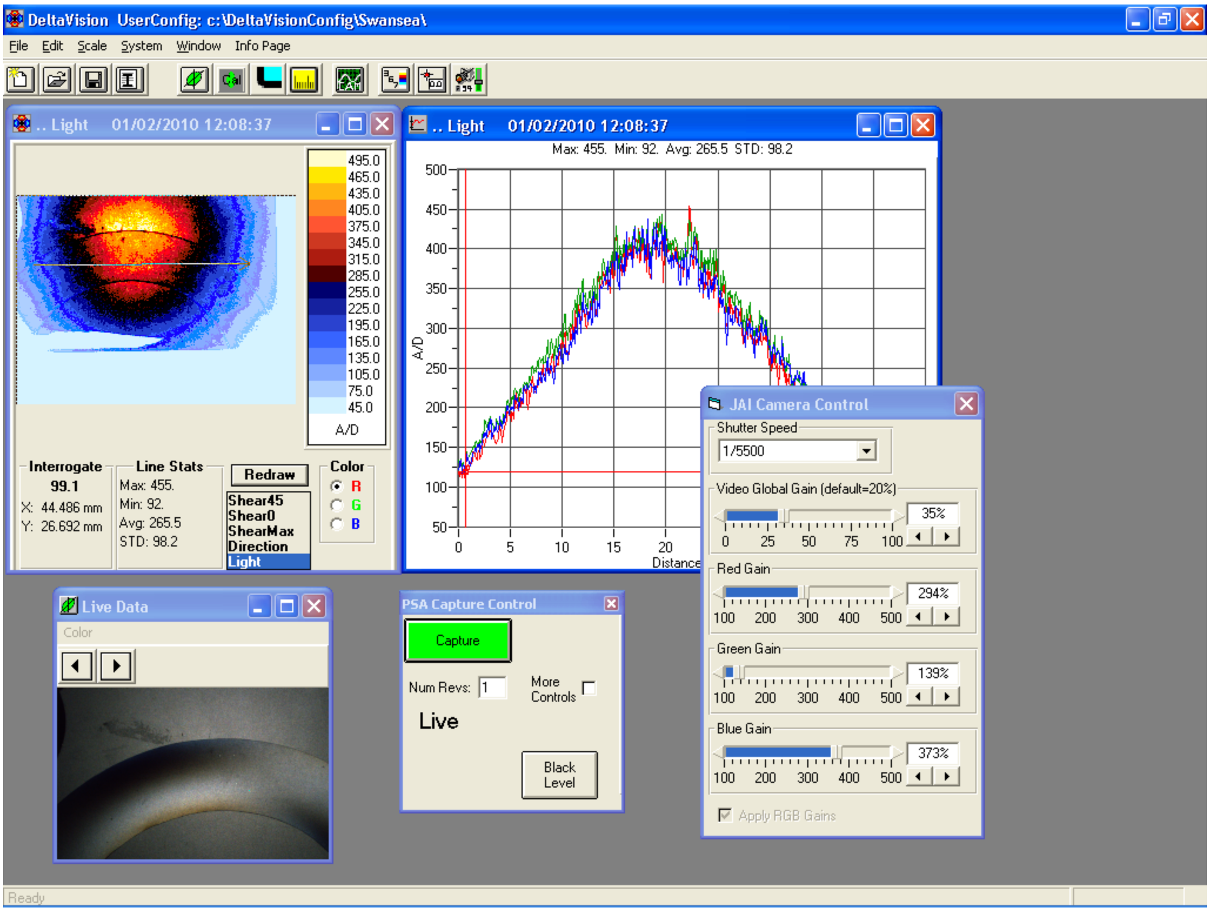


The image obtained is displayed above. Note that the data presented can be selected fro the list. In this instance we are looking at the light distribution. We need to compare the different wavelengths of light (red, green and blue) to ensure that these are evenly distributed.

1. Ensure Light is selected
2. With the mouse draw a line as in the following (hold down the mouse at line start and release at line end)
3. Compare the 3 wavelengths in the displayed graph.



We can see here that there is a discrepancy between the 3 wavelengths of light. Using the camera control panel, we can adjust the individual gains of the 3 components, iteratively to bring these components together. In this case we need to adjust the blue and red gains to bring them in line with the green component.



Remember to redraw the cross section on the image to produce a new light graph after each adjustment and image capture.

Structure of an Experimental Report

The convention, when writing a scientific report, is to adopt a rather formalised structure. The table below describes what sections a typical report should have and a brief description of what each section should contain. Whether the experiment is largely theoretical or more biased towards data analysis, you should still comply as closely as possible with the structure set out in the following table. The table also gives a typical breakdown of the marks allocated to each section (if the experiment is for assessment). Since no two experiments or investigations are the same, the relative weights of each section might well vary from one experiment to another. As with any open-ended piece of work, some flexibility in the marking scheme is usually required, to take account of each student's approach. Remember, there is no hard and fast rule about the relative importance of different sections for different experiments, so the marks in the table below are just a typical breakdown for a typical experiment.

A typical length would be 7 to 10 pages for the main body of the report.

Section of Report	**Typical mark**
Date, title and general presentation and organisation of the report.	*~5 marks*
Abstract - This should be three or four sentences, summarising what you did, how you did it, what the results (and uncertainties) were and what your conclusions were. In practice, **you will write this last**, so leave about half a page at the beginning of your write-up in which to put an abstract later.	*~5 marks*
Apparatus - List the apparatus with a diagram where necessary. Describe in particular anything different or additional to that in the script.	*~10 marks*
Introduction/Method/Procedure - Explain very briefly what the experiment is about. Record what you did - particularly if it differs from the script. Include problems and disasters.	*~10 marks*
Measurements and Graphs of Raw measurements - Record **all** raw measurements (good, bad or indifferent) as and when you obtained them. If the raw data or calculations are voluminous, they could be summarised here and included in their entirety in an appendix. It is often worthwhile to plot a graph of your measurements as you go. This can save time since it indicates quickly if you need to repeat readings or if you need more.	*~20 mark*
Calculations and error estimates - Describe the calculations or other processing of your results. Explain what equations you used and include a sample calculation, even if you use a spreadsheet programme to carry out the calculations. Discuss the sources of error in your measurements and use these to estimate the uncertainties (or experimental error) on your final results. Include any graphs used in your analysis.	*~10 marks*
Results and Discussion - Discuss the interpretation of your results. The questions in the experimental script usually lead you through what is required, so you should record your responses to these questions as you come to them. Clearly state your results with estimated errors and units. This is where you should compare your results with accepted values from reference books or other sources.	*~25 marks*
Conclusion and bibliography - Write a conclusion drawing the results together, discussing their physical implications, the validity of the theory and the methods, and scope for improvement of the experiment. Remember to list the books, articles or web pages that you used for reference in a bibliography at the end.	*~15 marks*
Appendix - Most reports will not require appendix as tables of data, calculations and graphs of results should normally be included in the main body of the report to create a coherent whole. Only relegate large volumes of data to the appendix if absolutely necessary. **Don't forget** to go back and write the abstract.	*N/A*