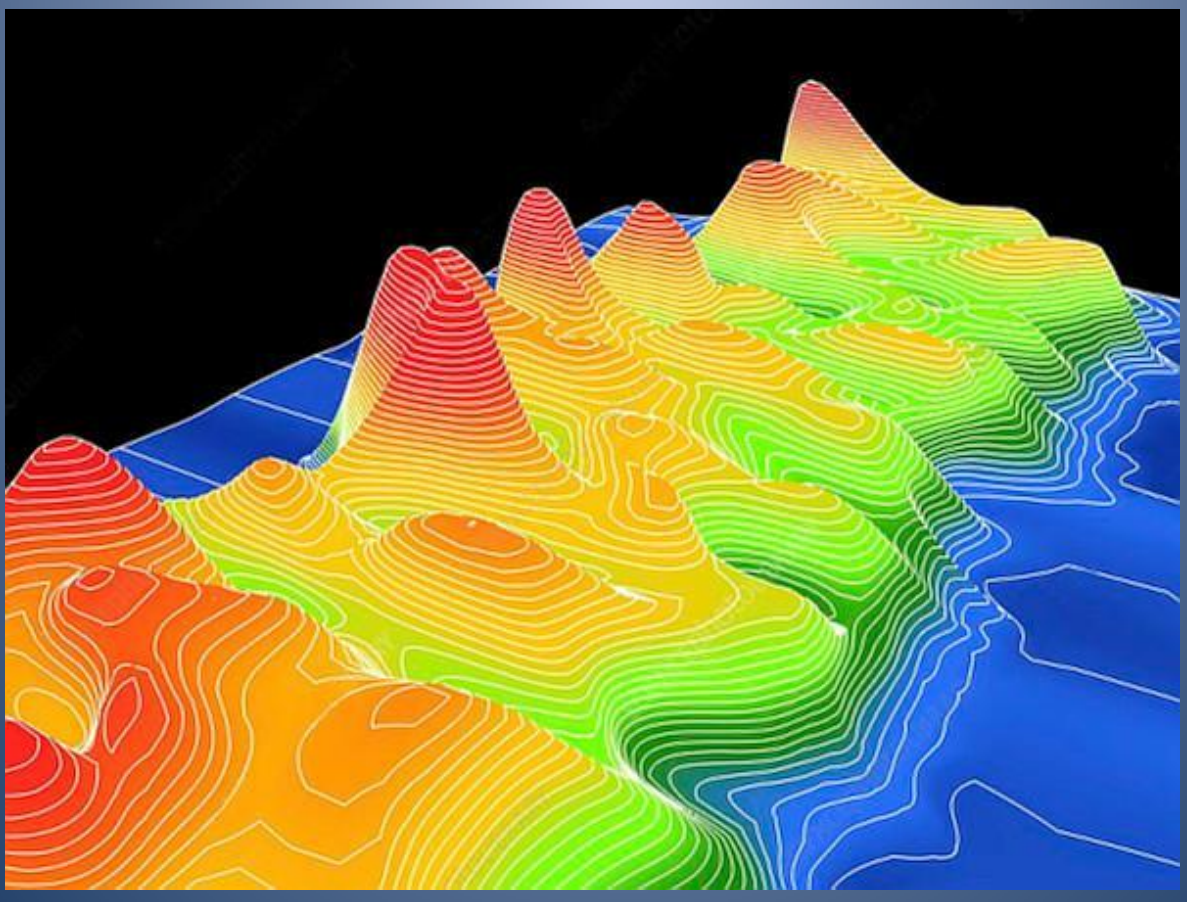
University of Glasgow | School of Physics & Astronomy

Physics 3: Computational Lab Guide

Valid for academic session 2023-24

Covers PHYS4008 & PHYS4060: The Honours Computational Physics Laboratory



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1 General Information and Introduction

This guide is intended for students enrolled on the Physics 3 Computational Laboratory Course (PHYS4008) and the December-finish version, PHYS4060.

Lab Head:	**Prof Andy Buckley**	**Schedule:**	**Tue and Thu 11am-5pm**
SCQF Credits:	**20**	**ECTS Credits:**	**10**
Assessment:	**Laboratory (100%)**	**Co-requisites**	**PHYS4011, PHYS4004, PHYS4031, PHYS4025, PHYS4030, PHYS4029P**
Level:	**Honours**		
Typically offered:	**Semester 1**	**Prerequisites:**	**Physics 2T**

PHYS4008 runs twice a week for ten weeks in Semester 1. Induction for this lab takes place on the Tuesday of Week 1 from 1100-1200, along with PHYS4009. Support will be enhanced through other online facilities such as Padlet.

1.1 Communication

All information about the lab classes will be communicated via the P3 Computational Lab Moodle site and its forums.

You will automatically be registered for access to the relevant Moodle site. As with all other Moodle sites, the login ID and password are those you use to access all University computers, including your student email account. You must regularly check the Moodle site for new information.

1.2 Contacts

PHYS4008 Lab Head:	Prof Andy Buckley Room 481 Email: andy.buckley@glasgow.ac.uk
PHYS4009 Lab Head:	Dr Peter H. Sneddon Room 251a Tel 0141 330 5312 Email: peter.sneddon@glasgow.ac.uk
PHYS4009 Deputy Lab Head:	Dr Philip Litchfield Room 475 Tel 0141 330 5316 Email: phillip.litchfield@glasgow.ac.uk
PHYS4009 Lab Technician:	Mr Matthew Trainer Room 422a Tel 0141 330 6437 Email: matthew.trainer@glasgow.ac.uk

2 Code of professional conduct in the laboratory

Our aim is to provide a safe and enjoyable learning experience for all students in the laboratory, whether that is face-to-face or remotely. Whilst the staff will do everything we can to help with this, students also have an important role to play in ensuring that this is achieved. We would specifically like to highlight the following points:

1. The laboratory is a professional working and studying environment. We therefore *expect you to behave in a professional manner towards one another and towards the lab demonstrators and staff at all times*.

2. We value the diversity of our student body and recognise that this diversity improves the quality of our work by allowing students to bring a range of skills and viewpoints to inform and enhance their collective achievements. We therefore expect that *students will work productively and professionally together in an atmosphere of mutual respect.*

    a. With this in mind, any form of bullying and harassment – such as on the basis of any personal characteristic (including, but not limited to: nationality, race, disability, gender or gender identity, religion [or proxies for this, e.g. football team allegiance], sexuality, appearance, or age) – is unacceptable.

    b. Please avoid at all times potentially offensive "banter" with your fellow students, which may be hurtful and problematic for some, including those who witness it. Please note that claiming something was “banter” is in no way an

excuse for bullying or harassing behaviour.

3. Any reports of bullying, exclusion, or discriminatory behaviour will be taken very seriously by the School of Physics and Astronomy. If anyone wishes to report any untoward behaviour, speech or social media content from any person or group of people in the laboratory, they may do so in confidence to the laboratory head, his/her deputy, to the School Equality and Diversity officers (currently Mrs Angela Eden and Prof Stephen McVitie), or (in the case of staff) to a trade union representative. All such concerns will be treated seriously and in confidence. (This includes incidents where students or staff are the targets or the perpetrators of such behaviour).

4. Some of these points are also included in the University of Glasgow *Dignity at Work and Study Policy* and the *Code of Student Conduct* and can result in disciplinary proceedings, where appropriate.

For further information see:
https://www.gla.ac.uk/myglasgow/humanresources/equalitydiversity/policy/dignityatwork/

https://www.gla.ac.uk/myglasgow/senateoffice/policies/uniregs/regulations2021-22/feesandgeneral/studentsupportandconductmatters/reg33/).

3 Intended learning outcomes

By the end of the PHYS4008 course, students will be able to demonstrate a knowledge and broad understanding of the key principles of computational physics.

To develop critical skills in scientific computing
To gain familiarity with the Linux operating system & various software tools
To learn basic programming in C++
To practice and improve oral presentational skills
To gain experience in keeping clear and concise records
To gain experience in report writing

Computational skills, from numerical problem solving, to data analysis, and to presentation and communication, are central to success across most of modern physics. Especially in theoretical physics, it is now rare to work without computational aids. In this lab we aim to give you experience and feedback on all these aspects of your professional-skills development.

4 Lab timetable

The P3 computational lab meets on Tuesdays and Thursdays, 1100-1700. It begins in Week 2 and runs through to Week 10 of Semester 1. A one-hour induction session precedes this on the Tuesday of Week 1, 1100-1200.

The ten-week block is divided into three main work-packages, starting in weeks 2, 4, and 7 as indicated in the block timetable below. Each block ends with an assessment deadline. Week 6 is left free between work-packages 2 and 3, as a reading week. A final report on your investigations of work-package 3 is due at the start of Semester 2 (this may differ for PHYS4060; see details later).

<table>
<tr><td>Week</td><td colspan="2">1</td><td colspan="3">2</td><td colspan="2">3</td><td colspan="3">4</td><td colspan="2">5</td><td colspan="2">6</td><td colspan="2">7</td><td colspan="2">8</td><td colspan="2">9</td><td colspan="2">10</td><td colspan="2">...</td></tr>
<tr><td>Starts:</td><td colspan="2">18/9</td><td colspan="3">25/9</td><td colspan="2"></td><td colspan="3">9/10</td><td colspan="2"></td><td colspan="2">23/10</td><td colspan="2">30/10</td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2">11/1</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="5">Computing 1</td><td colspan="5">Computing 2</td><td colspan="2"></td><td colspan="6">Computing 3</td><td colspan="2">Report</td></tr>
<tr><td>Mark:</td><td>I</td><td></td><td></td><td></td><td></td><td>M</td><td></td><td></td><td></td><td>M</td><td></td><td></td><td></td><td></td><td></td><td>L</td><td></td><td></td><td></td><td></td><td>M</td><td>R</td><td></td></tr>
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5 Laboratory structure

1.1 Main laboratory exercises

In weeks 2 and 3 you will recap how to use Linux and the command-line terminal, including editing files; shell scripting; writing, compiling and running C++ programs; using plotting packages; and the basics of scientific report writing via LaTeX. In weeks 4-5 you will concentrate on an introduction to computer algebra systems, and in weeks 7-10 you have the chance to write numerical C++ programs to solve physics problems. Each session has tasks that must be completed, and you are expected to keep detailed records of your work to accompany an oral assessment. The final section is to be written up as an extended report in the style of a short physics conference paper, but aimed at being comprehensible by another student at your level.

1.2 Lecture on reading & writing scientific papers and reports

On Tuesday at 16:00 in week 8, there will be a lecture on how scientific papers are read by a (busy!) working scientist, and consequently on how one should write one for the maximum impact. Seeing as the laboratory report is in the form of a scientific paper, everything you need to know and implement in order to get the best possible assessment of your report will be covered in this session.

6 Assessment of lab records

After completion of each session in weeks 2 through 9 you will be assessed by one of the lab demonstrators. You will give an oral presentation of your progress and present your

records. As well as assessing your progress on the tasks set, your mark will take into account your organisation and presentation of your results. The marking will follow the standard version of Schedule A, setting out the descriptors for each grade on the 22-point scale. (This Schedule A document is linked from the Moodle site for the course and forms a key part of the University Regulations governing learning, teaching and assessment).

After completion of each exercise you should arrange a marking appointment with the Computational Laboratory Head and you will be assigned a marker. You will then need to book a marking time-slot with your marker on the final Thursday of each block.

Any unreasonable delays to marking caused by the student not presenting the work within this time will result in penalties according to the Policy on Late Submission of Coursework (see https://moodle.gla.ac.uk/mod/page/view.php?id=146746). In unusual cases where marking is necessarily delayed by the *marker* (e.g., the marker being unavailable on a lab day), the marking may be performed on another day by prior arrangement between the student and the marker, without any penalty to the student. **In all cases of late-marking, it is essential that prior written arrangement is made between the student and a marker before the completion of the lab time: the normal route for this is the Good Cause claim system, as discussed later.** The written records will be used by the Lab Head in ensuring that any late marking is done with good reason.

The assessment takes the form of a 30-minute interview with the marker. Before the start of the interview, you should submit your laboratory record as a PDF on Moodle in the section for the appropriate submission date. If you made your record as a Jupyter notebook or similar format, you should convert it to PDF for submission. If you did it on paper in a lab book (not recommended for this lab!), you should scan it to PDF (easily possibly with a smartphone camera).

In your interview you will be expected firstly to summarise your work orally for about 5 minutes – you should aim to summarise what the exercise was about, your main achievements, and the outcomes. Please illustrate your summary by referring your marker to key parts of your lab record. Please do not give a chronological description of your activities in the lab: this tends to not stress the key points. Do not attempt to say everything that you did – you cannot possibly fit that into 5 minutes, so pick the important points!

After your five minute summary, you will be asked some questions by the marker – some of these may be more technical and related to the details of the exercise, and some may be more related to the underlying physics. Your lab record will also be examined in further detail.

Please note, each person should make an independent record of their work, and each person's oral presentation of the work and answers to questions may differ, and reveal differing levels of understanding, so widely different results might be achieved despite the fact that all students will be working from the same source material. As stated above, plagiarism is not acceptable and will result in serious inquiries and possible sanctions.

The following areas will be examined by the marker:

Oral presentation – how you perform in the 5 minute initial summary of your work

Record-keeping and organisation – how good a laboratory record it is. Is it complete, logical, easy-to-follow, and could someone else follow this and repeat your work and reproduce your analysis?
Task completion – How well all the results are analysed, which includes numerical calculations, plotting appropriate graphs, fitting data with curves or straight lines using suitable least squares approaches, and uncertainty calculations.
Understanding and answers to questions – How good an understanding of the exercise and the underlying physics you demonstrate in your interview, especially under questioning from the demonstrator.
Conclusion – Whether you draw good conclusions together from the work, which will include comparisons to expectations, and should include some summary of the reasons for any systematic errors and random uncertainties.

This marking sheet will be completed by the marker with both marks and feedback. The latter is designed to be positive and helpful so that you can improve performance in the future. Each section will have a mark on the 22-point scale according to the verbal descriptors given based on the principles set out in Schedule A.
A final overall mark on the 22-point scale will be calculated using the weighting breakdown given below:

	Number	Percentage	Credits	Total	Total Credits
Computing Labs 1&2	2	20%	4	40%	8
Computing Lab 3	1	40%	7	40%	8
Lab report	1	20%	4	20%	4
Skills revolution	1	0%	1	0%	0
TOTAL				**100%**	**20**

The feedback sheet and mark will be directly uploaded to Moodle. If you find the feedback from your marker insufficiently helpful or specific, please speak to the Lab Head and they will address the situation as appropriate.

7 Preparation and assessment of final reports

A final laboratory report should be submitted on or before 16:00 UK time on Friday 13/01/2022 detailing the approach you took to solving the Part 3 problem at the end of week 9. Students taking PHYS4060 may want or need to submit this assessment before the end of December: please discuss this with the class head if affected.

Reports should be prepared in the style of an article for a scientific journal, and for the sake of ensuring a common, easy-to- use standard, which generates an attractive appearance with minimal work, it has been decided that this should be in the appropriate style for Journal of Physics: Conference Series (an Institute of Physics Publishing journal). Templates for the preparation of papers can be found on the course Moodle site, or at https://publishingsupport.iopscience.iop.org/questions/templates-and-guidelines-for-proceedings-papers/

There should be just one variation from the above template. All reports will be marked anonymously to ensure that any conscious or unconscious bias (whether on the basis of nationality, gender, or anything else) is avoided. For this reason, **your name should not appear on the report and in its place should be your university registration number, i.e. the numeric part of your GUID.**

Your submitted work should be a complete, self-standing report of the computational problem and how you explored and solved it, focusing on the science that is discovered or theory that is confirmed, rather than simply the mechanics of how it was done. The reports should not need to refer to the laboratory script in any way but should, where necessary, refer to scientific publications or textbooks.

It is essential that a proper logical structure is followed starting with an *Introduction*. The precise labelling and ordering of sections after this may vary but the following components are often found in papers: *Introduction, Theory, Method, Results, Analysis, Discussion.* The report must conclude with a *Conclusions* section, which is normally followed by some *References*. An *Abstract* should be provided at the start, which is a short text summary of the whole paper, including the key measurements and conclusions.

Students are advised to refer to any reputable international journal in physics for good examples of how to write a research paper – for example, there are suitable publications from Institute of Physics Publishing, and you will find many examples unpaywalled at arXiv.com.

A strict page limit will be applied, as is the case for some journals and conference proceedings. In this case the limit is **8 pages, not including references or appendices.** Any main-text material after 8 pages will not be read and you will only receive marks for the first 8 pages plus references. You can include appendices for completeness if you wish: these will not contribute to the page count, but will not be explicitly marked. Therefore the report's quality should not depend on referencing material in the appendices: if it's important, put it in the main part of the report.

Notes and suggestions:

- You need not put in every result or a complete table of all data, but can choose to put in only part of the results to illustrate the main progress made in your experiment.
- You should put in the mathematical derivations and error analysis that are essential, but this can be in abbreviated form, with only selected steps and not every detail shown, as long as the working and derivation is clear.
- Graphs and figures should be appropriately sized so that the contents are clearly legible, even if printed in black and white. Text in figures should be large enough to be legible (preferably ≥ 10 point size).
- You will not be penalized if the report is shorter than the allowed 8 pages, but will be marked on the content that you have provided.

All reports are marked by academic demonstrators in the absence of the student. Students should note the marking criteria to which they are assessed since this will help them in the preparation (see lab induction for tips on writing a lab report). As for all other assessed work,

the assessment will be carried out against the 22-point scale, using the verbal descriptors provided in the standard version of Schedule A.

The reports have to be submitted electronically as a PDF file of up to 16 MB file size on the course Moodle site. Please note that all files should be named in the following format:

*RegistrationNumber*_CompLab_REPORT.pdf

e.g. 1234567_P3CompLab_Report.pdf. **Do not include your name in the filename!** Note that the surname letter has been removed from the end of the GUID, as in the in-text authorship identifier. Just using the numeric part of your GUID ensures we have no chance of accidentally identifying you during marking.

8 Attendance, good cause, and other issues

8.1 Progress and lab completion

You should monitor the rate at which you are working, to ensure completing the exercises in time. It should be possible to complete the exercises in around half the allotted time, but if you require more (due to, for example, a need to recap a lot of material from P2T) then it is up to you to spend time on the exercises outside the scheduled lab sessions.

If you fall behind with your work due to absence, please refer to the section above on Attendance and Adverse Circumstances. If you are attending the lab regularly but are still falling behind with your work you should discuss the reasons with the demonstrators and/or the Lab Head. The earlier this is done, the more chance to resolve the issues.

Students who fail to attend regularly, who fail to carry out the required lab work, or fail to present sufficient work for assessment may receive no credit, as set out below. An additional Catch Up week is available to allow for students in exceptional circumstances to complete the lab work.

8.2 Penalties for late submission

Deadlines for handing in work are indicated on the timetable. Work handed in late without good cause will be subject to the standard penalty (2 grade points per working day). In exceptional circumstances, a deadline extension may be granted by the Lab Head. **This must be agreed in writing with the lab head prior to the deadline.**

To quote from the policy:

> *"The University has agreed to introduce consistency in the penalties applied to penalties on students for late submission of coursework, and this has been warmly supported by the SRC. Following consultation, the following formula has been agreed: Work should be penalised at the rate of 2 Schedule A 'aggregation points' for each working day (or part day) by which it was submitted after the published deadline. This formula may be applied to a maximum of five working days; work submitted more than five days late should be awarded Grade H."*

In the context of the current lab, this means that for each working day after the deadline for the submission of the work for assessment (which is defined here as either arrangement with

a marker for an oral assessment on your lab record in your lab book, or the fixed deadline for the submission of laboratory reports at the end of the semester), you will receive a deduction of 2 grade points on the 22 point scale from your assessed mark.

8.3 Plagiarism

Plagiarism is defined as the submission or presentation of work, in any form, which is not one's own, without acknowledgement of the sources. The University's degrees and other academic awards are given in recognition of the candidate's personal achievement. All suspected cases of plagiarism will be handled in accordance with the University Plagiarism Statement, which can be found at http://senate.gla.ac.uk/academic/plagiarism.html .
In the context of this lab, the above policy is not intended to stop you discussing your laboratory work with other students – in fact we encourage this. You must not, however, directly copy anyone else's lab records or report.

8.4 AI assistance

Use of artificial intelligence “large language model” tools such as ChatGPT has exploded in the last year, and computational project work is particularly susceptible. The University policy is currently to treat using such tools as misconduct. For this lab I would add the more practical point that in the interviews (and code annotations) we are interested primarily in your *understanding* of why to use a certain method, or structure code a certain way — just copying in answers from an AI assistant will not help you to explain why you did it that way when asked. And it’s that understanding that will act as a foundation for you to imagine and build more sophisticated scientific computing solutions in future: using an AI now means you will fail to build elements of that foundation. Please also note that AI tools often generate strange or subtly wrong code: it is often easy to identify. Message received?

8.5 Appeals

When your assessment interview is complete, you should have a clear understanding of why you achieved the grade you did, either through the written feedback you are given, or the verbal feedback. If you think your work has been incorrectly assessed, and are unsatisfied with your grade, then you can appeal directly to the Computational Lab Head. They will listen to both the students and the original markers before deciding the final mark.

The main bases for any appeal are as follows:

- The markers did not follow the marking procedure set out in this document correctly;
- The feedback provided did not match the marks awarded;
- Comments were made or the interview was conducted in a way which is inconsistent with the Code of Professional Conduct.

The Computational Lab Head may seek opinions from other markers, or ask a different marker to reassess the work. **Any appeal must be made by email immediately following the assessment**. The lab head will respond to your request for an appeal as soon as possible thereafter.

8.6 Submission of work for moderation and examiners meetings

The moderated marks and lab records will be presented to the external examiner at the Honours Examiners Meeting; these will be retained until six months after a student finally graduates. This is to allow the material to be considered in any appeal processes following decisions about the award of degrees.

8.7 Minimum requirements for the award of credit

In order to receive credit for a Module, the University Calendar states that at least 75% of the required coursework must be submitted for assessment. In this context, it is important to note that even if you are late in submitting work, it is still worth submitting it, since a submitted piece of work still counts towards the credit requirements for the module.
Of course, if you are unable to submit work with good reason (e.g. illness, family circumstances etc.) and inform the lab head in good time, then you will be provided with an extended deadline to complete the work, if feasible. Alternatively, you will be credited with the full number of credits and assessed purely based on the work you were able to submit over the module. It is therefore important that you submit any absence reports promptly into MyCampus and upload all supporting evidence. It is also helpful if you alert the lab head about any such absences by a separate email.

8.8 Attendance and absence from the lab class

Students are expected to take part in all Computational Laboratory sessions. This is a course requirement. These attendance records will form part of the performance assessment. Students with longer absences, or absences immediately prior to any of the deadlines for the submission of work, should discuss their individual situations with the Lab Head. If you miss a lab day with good cause, or if you miss an assessment deadline, or if you believe your assessment performance has been affected by adverse circumstances, you should submit a Good Cause Claim via MyCampus. If you are uncertain whether your circumstances count as “Good Cause”, contact the lab head who will advise you.

8.9 How to submit a Good Cause Claim

Submission of a Good Cause Claim is the mechanism that allows your circumstances to be considered by the Board of Examiners. Please note all Good Cause Claims must be submitted within **one week** of the date of the affected assessment. These can be logged for missed sessions, or sessions where you were present, but believe your ability to perform was hindered. In the latter case, students should note that the University’s Code of Assessment allows grades to be awarded only on the basis of demonstrated work. So, if you feel that some piece of assessed work has been affected by adverse circumstances, and if staff agree, then the only course of action available is for the grade for that piece of work to be set aside (in the case of continuously assessed work and Class Tests) or to allow a resit (in the case of Degree Exams) – marks cannot be adjusted.

To submit a Good Cause Claim on MyCampus:

1. Go to the ‘Student Centre’ and select *My Good Cause* from the Academics menu.

2. Select the relevant course(s).

3. Complete the report in MyCampus (there is provision for particularly sensitive information to be provided separately, outwith the system, but a claim report must still be entered into MyCampus).

4. Add supporting evidence by uploading documents. (Scanners are available on level 3 of the University Library.) It is the responsibility of the student to keep all original documentation and submit it to the lab head on request.

If you encounter any difficulties with this process please contact the lab head immediately to let them know you have a problem with your Good Cause Claim.

What will happen to your Good Cause Claim

The Lab Head will ensure that your claim is considered and this will be in accordance with the section of the Code of Assessment that covers incomplete assessment and good cause (paragraphs 16.45 to 16.53). The outcome of your claim will be posted into the Approval Information section on your Good Cause Claim in MyCampus. If it is accepted that your assessment was affected by good cause, the work in question will be set aside.

See also the Senate Office Absence Policy:
http://www.gla.ac.uk/services/senateoffice/policies/studentsupport/absencepolicy/