Physics

Environmental Radiation

-Radon Gas

[HIGHER]

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Advice to students

Overview of the unit and activities

What is involved in the Researching Physics unit?

Studying physics involves learning physics facts and concepts. It also involves developing particular skills. These include research skills, which may involve you in doing investigative experiments or researching information, perhaps from the internet. The aim of this unit is to help you develop these physics skills. You will learn some physics facts, probably in some depth, but it is the development of skills that is the focus of the unit.

What physics content will I be learning?

The context for your work is the monitoring of ionising natural radiation as opposed to pre-prepared known sources of radiation. This builds on your previous experience learning experiences of ionising radiation its measurement and dangers.

What activities will I be doing?

There are three types of activity in the unit.

Undertaking literature-based research is a hugely important skill. In this unit, this is best carried out as web-based research. It is easy to simply look up a single fact on the internet, but undertaking a more structured project is more complex. Sifting through what is often a large amount of data is demanding. Keeping track of what you are trying to find out is one of the most difficult parts of this type of research, and summarising what you have found, without merely cutting and pasting someone else's work, is also challenging. In this material, there is an activity that describes how best to

carry out web-based research. There are also several research briefs that can be used in preparation for your investigation.

Investigative practical work can be fun and challenging. Planning and designing experiments is often the hardest part of this work. Actually carrying out the experiment may be straightforward. This material includes a number of activities that develop the skills required to do investigative practical work. There are also several investigation briefs that you can use to help you plan and carry out an investigation. The experiments you are likely to carry out in your investigation are not the kind where you can simply look up the results beforehand. There may be no right or wrong answers. What you find is what you find, and your way of doing the experiment may not be similar to others in your class.

Scientific communication is hugely important. It does not matter how interesting or groundbreaking your work is, if you cannot communicate your results then you have not completed your work. Information from your web research and data from your practical work will contribute to an assignment that you will complete under supervised conditions. This assignment is assessed externally by the SQA. You can pass this unit without completing the assignment, but you cannot get an overall course award in Higher Physics without doing so.

Organising your work and carrying out the activities

How will I organise my work?

Some of the work you carry out in this unit will be in preparation for your research into one or more aspects of earthquakes. When you carry out the research activities themselves, it is likely that you will be responsible for organising your work.

You are required to produce a report on the results of a piece of web-based research, and you may produce a report of your practical investigation that you may submit as your assignment for SQA assessment. You are strongly advised not to produce these “as you go along”. Rather, it is very good practice to maintain a diary, or record of work. This should record all your experimental results, ideas, problems you met, references and all the other day to day observations and data that you want recorded. The record of work is your record and as such it should be in a format that suits you. However, experience shows that students who organise their work for ease of reference are likely to be able to extract the information more easily and the resulting reports are likely to be easier to produce.

Will I do the same work as everyone else in my class?

This material includes a number of web-based research and practical investigation briefs. It is likely that students within the same class will be allocated different activities, depending on resources available and other classroom management issues.

What about teamwork?

It is probable that you will undertake some of the work as part of a group. Sometimes, within your team, you will be undertaking the same task and other times you will each focus on a different part of the task. In either case, it is important that discussion takes place. Agree the part that each member of the team will play and ensure that there is time to share the results of the work.

Assessment issues

What do I have to do to pass this unit?

As you work on this unit, you will carry out activities that develop your skills in undertaking research in physics.

Two of the activities contribute to the unit assessment. To be awarded the unit, you need to demonstrate that your work is of at least the required standard in each of the two types of activity.

The two types of activity are:

- undertaking web based research
- carrying out investigative practical work – you need to take an active part in planning and carrying out an investigation

Do I need evidence?

For the web-based research and scientific communication, you should ensure that you retain evidence that your work is of the required standard. Each year SQA will ask to see the evidence from a number of candidates. This process is easiest to manage if your evidence is stored in an e-portfolio. You can store text-based work, together with pictures, web pages, and any other material that you wish to present as evidence. If you do not use an e-portfolio, you should ensure that your evidence can be easily accessed.

What about assessment in the Higher Physics exam?

The Higher unit Researching Physics is available as a free-standing unit. It is also a required unit for a course award in Higher Physics. There will not be any questions in the Higher Physics course assessment that specifically relate to the topic of this unit. However, there will be questions in the course assessment that relate to the skills that you have developed in the unit. The following are the skills that may be assessed in the course assessment:

- selecting information from texts, tables, charts, graphs and diagrams
- presenting information in a variety of forms
- processing information
- planning and designing an experiment
- evaluating experimental procedures
- drawing conclusions and making predictions based on evidence provided.

Web-based research briefs

Research activity 1: Sources of environmental radiation

Research brief

In this research activity you will find out some background information about environmental sources of radiation and their measurement their effect on health and how this can be mitigated.

In carrying out your research you should answer at least two of the following focus questions in detail:

- What is a suitable instrument for radiation measurement and how does it work?
- What foodstuffs or organic materials are sources of above background levels of radiation and what isotope(s) are responsible for the increased radiation?
- What mineral sources cause high levels of background radiation and where are they found?
- What is the source of radiation dangers for both space and air travelers and how is this exposure different to ground based exposure?

Answer the questions by carrying out research. This is probably best undertaken using web-based research. You are advised to have completed an activity in which you consider the issues of undertaking web-based research. This may have been done during your work on other units in Higher Physics.

You may work individually or as part of a team.

Produce a report of your findings. This may be hand-written, printed or electronic and saved in an e-portfolio. The report per question should typically take up no more than one side of A4 per question. You should provide a record of at least two sources of information for each question answered. (Bibliography)

You should spend approximately 2 hours on this activity.

If you work as part of a team that produces one report, you should include a short statement at the end of the report that indicates which part of the work you were responsible for.

Other things to consider when undertaking web-based research

Stay focused

Make sure that you remain focused as you carry out your research. It is very easy to get side-tracked. Make sure you have clear questions that you wish to answer. Keep reminding yourself of what you are trying to find out as you surf. Interesting, but not relevant, sites can be visited later.

Don't write your report as you go along

Your task is to find suitable sites that may contain the information you require. Sites that seem to be promising can be bookmarked so that they can be returned to later. Tables, graphs and pictures can be copied into a folder. It is likely that some will be used and some will not. It is important to make a selection later, not just as you stumble across the site.

It may help to include an introduction at the start of your report and it is often best if this is written last. The introduction can act as a summary of the findings and is best written when the information has been collected.

Cut and paste – don't!

The finished report should be easy to read. Avoid simply cutting and pasting large chunks of text. Try to summarise the information you find and, where possible, use your own words to state what you have found. Tables and charts can be very useful but often contain too much data. If information is provided in a table, consider extracting the data you require and making your own table and graph.

Referencing

It is important that the information you include in your report is referenced. As a general rule, someone else should be able to easily find where you got your information from. Make sure that your report includes a clear indication of where you have sourced your data.

Web-based research briefs

Research Activity : Air Borne Radiation – Radon Gas

Research brief

In this research activity you will find out some background information about Radon, its daughter products and their measurement their effect on health and how this can be mitigated.

In carrying out your research you should answer at least two of the following focus questions in detail:

- What is Radon, how does Radon get into a building and how can this be prevented?
- What is the mechanism whereby Radon becomes a health risk.
- What are the measuring systems and apparatus to determine Radon levels and what is the UK unit of measurement and action level?
- If you bought a Radon test kit in the UK how would you use it and how would it be treated to show the levels of Radon gas?
- What is the decay series for Radon222 and how does this explain the presence of Radon daughter products in the air we breath.

Answer the questions by carrying out research. This is probably best undertaken using web-based research. You are advised to have completed an activity in which you consider the issues of undertaking web-based research. This may have been done during your work on other units in Higher Physics.

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Practical investigation briefs

Practical Activity 1: Investigating background radiation and the radiation levels of commonly found materials. (Foodstuffs, building materials etc)

Investigation brief

Determine the background radiation. Determine the excess radiation (if any) in common materials including those known to be mildly radioactive.

The analysis should take account of planning, apparatus, data handling and uncertainties. A short evaluation is also required.

Guide to producing a scientific report of an experiment

Write in the past tense using the impersonal passive voice e.g. “the tubing was connected to the vacuum pump”. Use the following structure as a guide

Title

Procedure

- The aim of the experiment
- a labelled diagram and or a description of the apparatus used
- how the independent variable was altered
- how measurements were taken or observations made

Readings/Results

You should analyse / present your readings / results using as appropriate:

- a table with suitable headings and units
- a table with ascending or descending independent variable
- a table showing appropriate computations (this can be in the same table as above)
- a graph with independent and dependent variables plotted on horizontal and vertical axes respectively
- a graph with suitable scales and axes labelled with quantity and units
- a graph with data correctly plotted with a line or a curve of best fit.

Uncertainties

You should consider the numerical uncertainties which include:

- uncertainties in individual readings
- mean value and approximate random uncertainties in the mean
- uncertainties expressed in absolute or percentage form

Conclusion

- overall pattern to observations
- trends in analysed information or results
- connection between variables
- measurement of a physical variable

Evaluation

A few brief sentences:

- possible sources of error
- control of variables
- possible improvements
- limitations of equipment

Practical investigation briefs

Practical Activity 2a: Investigating the radiation found on dust particles in the air using a charged balloon.

Investigation brief

Determine the background radiation. Determine the radiation level on the balloon prior to the dust acquisition process. Determine the radiation level on the balloon after charging up the balloon electrostatically by rubbing and using it as an air-borne dust capture device around the lab. If time permits, determine the half-life of the radiation.

The analysis should take account of planning, apparatus, data handling and uncertainties. A short evaluation is also required.

Practical investigation briefs

Practical Activity 2b: Investigating the radiation found on dust particles in the air using a pump and filter.

Investigation brief

Determine the background radiation. Determine the level of radiation on the filter. Pump some air for an agreed length of time and re-measure the radiation level. If time permits, determine the half-life of any radiation excess found.