Vacation Project – Research Review and Report

The purpose of this project is to give you experience in researching and writing a scientific document, and to connect the more abstract material you have covered through the year with practical applications.

Choosing one of the topics listed below, you should research and then write a report, no more than 2500 words long, which should communicate the science to another person who is scientifically literate, but with no specific knowledge of the topic. Your report should include diagrams and equations, as well as prose. Try to include simple justifications or explanations based on the physics you have covered.

The document should be word-processed, as part of the purpose is to give you experience with word processing software, specifically in putting equations and diagrams into documents. Some guidance on this is given below.

The report should be submitted by the end of Week 0 of Michaelmas term, by email to (paul.jeffreys@keble.ox.ac.uk). The Physics Tutors hope to be able to award one or more prizes for reports of sufficient merit.

Choice of Topic

Below is a list of suggested topics for you to research, together with some references to get you started. You are welcome to come up with your own idea for a topic that you would like to research, but please run the idea past me before you start.

The Physics of Water Droplets

- Mason, Phys. Education. Vol. 13, pp. 414-419 (1978)
- Bergeron, Physics World. May 2001.

The Search for Magnetic Monopoles

- Fang et.al., Science. Vol. 302. No. 5642, pp. 92-95 (2003)

Magnetic Carbon

- Coey and Sanvito, Physics World, November 2004.

Superfluidity

- Scandolo and Santoro, Physics World, December 2004.
- McClintock, Physics World, November 2000.

High Tc Superconductors

- Rice, Physics World, December 1999.

How Marconi Shaped the World we Live in Today

- Bridgman, Physics World, December 2001.
- “Propagation of radiowaves” ed. Barcley, IEE (2003)

X-Rays in 21st Century Medicine

- Gould, Physics World, August 2004.
- “X-ray trick picks out tiny tumours”, New Scientist, 22 February 2003.

The Electronic Properties of DNA

- Dekker and Ratner, Physics World, August 2001.

The Physics of Time and Clocks

- Bishop, J. Sci. Instrum. 32 289-293 (1955)

The Physics of Flying and Sailing

- Clancy JC. Aerodynamics, John Wiley (1975)
- http://www.physclips.unsw.edu.au/jw/sailing.html

Physics Improving Sports Performance

- Haake, Physics World, September 2000.
- Curtis, Physics World, August 2004.

The Transits of Venus

- Dick, Scientific American, May 2004.

Climate Information from Ice Cores

- Shepherd, Physics World, May 2006.
- http://nsidc.org/sotc/

Information Theory

- Effros et al., Scientific American, May 2007.
- “A Mathematical Theory of Communication”, Shannon, Bell System Technical Journal, Vol. 27, pp 379-423 (1948)

Power Transmission without wires

- Karalis, Physics World, Feb 2009

Accurate distance measurement with lasers

- Cundiff et al., Scientific American, October 2008

Research

As well as the references above, a good place to start researching your topic is by looking through recent years of Physics World, New Scientist and Scientific American. The web is also an excellent way to get information, but be careful about trusting the source (not everything on Wikipedia is correct!), so try and follow up anything you find with reference to reliable publications, Universities or libraries.

You may find that as you research into a topic then you come up with too much information to include. Therefore, as you gain a bit more insight into the topic, try and choose perhaps two or three key discoveries or questions to write about, and narrow your research down to these.

If you need to find a specific scientific paper then as well as the library, many publications are available on the universities electronic resources page: http://tdnet.bodley.ox.ac.uk/. You may also find that arXiv (http://arxiv.org/), an e-document service provided by Cornell University may have papers of interest. However, specialist papers are not usually the easiest way to get an understanding of field. Journalistic or review articles will usually be better.

Structure of the Report

When writing the report, think firstly what you think is the most interesting, exciting or important thing that you have found out about the topic you have been researching. This can then be the centre-piece of the report, and the other sections fit around it. The background can set this finding in its historical context; you can then outline some of the key science that the reader will need to know in order to understand this topic; then you can present the key information and follow it up with an explanation of the importance of the finding and what it may lead to in the future.

Before starting work on your own, you may find it useful to read about the preparation of scientific reports. One such account, available in the College Library is: R. Barrass "Scientists must write" (Chapman & Hall).

When you have completed the draft, review the text and ask yourself what story you are intending to convey.

Writer's Block

For many of us, writing can be hard, and we end up staring at a blank screen, wondering where to start. Two suggestions I would give to help with this are:

1. Try to just write anything to start with – don't worry if it isn't in proper sentences, or isn't in the right order. Getting your thoughts down on paper means that you can come back to them and rearrange them later. Often you find on second reading, that something that you thought wasn't very good when you wrote it, was actually okay.
2. Try and set yourself a goal of writing for 1 hour every day for a period – rather than trying to write in one long block. Stop all distractions and just try and write. Even if you are in a flow with writing, then stop at the end of the hour - you will still have the thoughts in your mind the next day you come to write, and this may make the whole writing experience more enjoyable in the long run. If you are finding it difficult to write on any one day, still keep to the hour, and just get something written – even if it is just notes.

Word processing

Most people today use Microsoft Word, or a similar word processor for documents, and this is sufficient for any kind of scientific writing. However many scientists, particularly those who particularly like programming, use a package called LaTeX. You can download it for Windows/Mac/Linux from http://www.latex-project.org or buy it from OUCS. It takes some time to get used to, so following a tutorial before you start is a really good idea. It has a very powerful equation editor – which is why many people with lots of equations in their document like it.

Equation editors

As mentioned above, LaTeX has an inbuilt equation editor, and tutorials online to help you to use it. Microsoft Word also has an equation editor (not always installed by default on a machine, so you may need to get the CD's out to install). Look for it under Insert>Object>Microsoft Equation. The user interface takes some time to get used to, and again there are tutorials online that can help. You can also purchase other equation editors for Mac or Windows, such as MathType (available from OUCS).

Images and diagrams

Images and diagrams are an excellent way of communicating information in a concise way to the reader. If you scan images in from publications, make sure you put a reference to the publication. Similarly, images from the web should be credited where at all possible. If you scan in images, you usually want to scan them at a resolution of 300 dpi, and usually in greyscale or colour (rather than B&W) for best reproduction. If you have the option, save the images in the TIF file format rather than JPEG or GIF, which will reduce their quality.

If you want to draw your own diagrams, there are a number of commercial packages that you can use – from simply generating a graph in Excel to a drawing package such as Adobe Illustrator. A free package called 'InkScape' is also available (http://www.inkscape.org) for Mac/Windows/Linux which allows quite complex graphics to be drawn, and things like labels to be added to scanned images. Export the images from these programs as TIF again, if you have the option to, as this will preserve the quality in the final document. If you are using latex, then you will need your diagrams to be in EPS format.

References

The report must contain a list of references to the sources of the material you have used.

For printed material use the form:

Title, Author, Publisher/Journal, Page, Date/Year of

publication For web material use

Author (if appropriate), http://www.xxx.yyy.zzz

There should be no need to use specialist referencing packages for this report.

Vacation Essay Mark Scheme

1	30%	Choice of topic and research	Is the topic well chosen, i.e. not too broad or too narrow? Is it relevant and interesting to a broad physics audience? Has the student sufficiently well researched the topic? Is the topic presented comprehensively and does it give appropriate weight to important results and not miss out anything of major importance.
2	25%	Structure	Is the essay appropriately structured (i.e. like a review paper)? Does it follow a logical trajectory to get to the point?
3	10%	Style	Is the essay easily readable and clear? Has the student put effort into making it interesting to read?
4	15%	Figures	Are figures used appropriately to support the main points made in the essay? Are the figures explained well and easy to read?
5	10%	Equations	Are equations used well to explain the main physical mechanisms? Are the equations defined well and do they “fit” with the text of the essay? Do the equations help understanding of the essay?
6	10%	References	Has a thorough review of the existing literature been carried out? Have the most important references been appropriately cited? Is the correct form used?

I look forward to reading your reports.

Professor Paul W Jeffreys

(paul.jeffreys@keble.ox.ac.uk)

Preparation for Oral Presentation and Wider Reading

You should use this vacation to read widely and to refresh your interest in physics and its applications. A wide choice of books exists in the College library and elsewhere. You will have to give an Oral Presentation in Hilary Term next year. The Long Vacation is a good time to start reading up a topic. It can be whatever you like but should not be the same as your research report (see above). Ideally it will be something that interests you, and has a significant Physics content that is not too far beyond the material you will have covered in the course by next Hilary term. You will need to check your choice of topic with me later.

Here is a list of books for you to consider

- Feynman Lectures on Computation, edited by A.J.G Hey and R.W. Allen (Addison-Wesley, 1996)
- A Pais Inward Bound (OUP)
- R P Feyman et al Lectures on Physics (Addison-Wesley)
- R B Leighton Principles of Modern Physics (McGraw Hill)
- E F Taylor & J A Wheeler Spacetime Physics (Freeman)
- F Close The Cosmic Onion (Heinemann)
- S Weinberg The First Three Minutes (Flamingo)
- E Mendoza (Ed) A random walk in science (lOP)
- Scientific American Reprint The Physics of Music (Freeman)
- J Gribbin In Search of the Big Bang (Heinemann)
- M J Usher Information Technology for Information Technologists (Macmillan)
- M S Longair High Energy Astrophysics (CUP)
- Paul Davies (Ed) The New Physics (CUP)
- I Stewart Does God play dice? (The mathematics of chaos) (B. Blackwell)
- G Smoot & K Davidson Wrinkles in Time (Little Brown)
- K S Thorne Black Holes and Time Warps (Papermac)