**PHYSICS ERT – NUCLEAR PHYSICS TERM 4, 2011**

**THE GENRE**

You are required to prepare your assignment in the persuasive exposition genre. In a ***persuasive exposition*** ERT you have to argue for a ‘thesis statement’ that you will generate and provide evidence to justify your claims. In Senior Physics, the evidence will consist mainly of physics principles, concepts, facts, ideas, calculations and data.

**THE FORMAT**

Present your response in a multi-modal seminar

* about 5-7 minutes in length (year 11 3-5 minutes)
* include a power point presentation of minimum 10 slides
* submit slides and script per slide (using notes section of PowerPoint)

Choose an issue, technology or use of radioactivity and research it thoroughly.

* + Formulate a ‘thesis statement’ (get this approved by teacher)
  + explain the principles of physics involved (KCU),
  + provide data and arguments (at least 3) that support your thesis statement.
  + Consider counter-arguments and limitations of your thesis statement
  + Make a recommendation (EC).

**THE STIMULUS**

While the list below is not prescriptive or exhaustive it indicates a number of topics that might be considered.

You may elect another topic that relates to Nuclear Science but this should be discussed with your teacher before the end of the first week after the assignment has been issued.

1. The use of radiation for the treatment of foods is an effective and safe way to extend the shelf life of perishable foods and address an impending crisis in food shortages in the world today.
2. The application of nuclear medical technology is an important adjunct to diagnostic medicine and provides an effective means for the monitoring and treatment of disease. While in everyday life excess radiation is a hazard, there are some diseases that are readily treatable using radiation. But which form of radiation is preferable, and why this as opposed to others. Explain the relevant physics. How does this kind of exposure work, and how does it help? What are the side effects if any (remembering that this is a physics, not biology assignment)? How do the medical bods measure exposure? How does the dosage reduce with distance and depth of penetration? What are the formulas used by the medical physicist? What are they doing with the equipment used at the cutting edge of technology and how does this reduce dangers and side effect, if at all.
3. As a source of energy, nuclear energy provides a safer alternative than current fossil fuel technology for the production of energy for large-scale consumption. Compare energy outputs and fuels.
4. The biggest problem for supporters of nuclear power generation is what to do with the wastes and how to convince the public that the wastes can be disposed of safely. How long will it remain and how should it be stored or dealt with?
5. Hiroshima! Enrico Fermi found out in 1939 that uranium could be split into two fragments to release huge amounts of energy. He said it was lucky that nuclear fission had not been discovered five years earlier. What did he mean by this and what possible consequences could have arisen?
6. Nuclear power plant accidents. Research a specific nuclear accident and describe what went wrong and what we can learn from it. E.g. Chernobyl, Fukishima, Three Mile Island You could compare Fukushima Daiichi problem to Chernobyl because the nature of the problems were fundamentally different.
7. Some of the most [serious nuclear and radiation accidents](http://en.wikipedia.org/wiki/Nuclear_and_radiation_accidents_by_death_toll) in the world have involved Soviet nuclear submarine mishaps. Notable nuclear submarine accidents include:

* [*K-19*](http://en.wikipedia.org/wiki/Soviet_submarine_K-19), 4 July 1961, the reactor almost had a meltdown and exploded, resulting in 8 deaths and more than 30 other people being over-exposed to radiation The events on board the submarine are dramatized by the film [*K-19: The Widowmaker*](http://en.wikipedia.org/wiki/K-19:_The_Widowmaker).
* [*K-219*](http://en.wikipedia.org/wiki/Soviet_submarine_K-219), 1986, the reactor almost had a meltdown. [Sergei Preminin](http://en.wikipedia.org/wiki/Sergei_Preminin) died after he manually lowered the control rods, and stopped the explosion. The submarine sank three days later.

1. How is nuclear science like alchemy? Are there any useful transmutations to make a new, more valuable substance?
2. Out in space, the use of radiation as a power source or investigative tool is of less concern that it is on our little, mostly blue, planet, especially so given the masses of radiation and cosmic rays that are already there as a result of the action of the sun. You might investigate the quantities and type of radioactive material used in spaceships, and quantify the energy they provide, as well as the period over which this energy is provided, and might compare this to what would otherwise need to be sent out into space to achieve the same result, if indeed other options are realistic. You could compare this to using solar energy, and the effect of moving further away from Sol.
3. Our growing population means we are facing an energy crisis. If it was proposed to build a nuclear power plant here in Townsville, what would you recommend and why? There are different kinds of nuclear reactors. Each has its strengths and weaknesses. You could do a comparative analysis of these and consider any that are on the drawing board at present. Which is safest? Which is cheapest? This presentation would at least cover the basics of controlled nuclear reaction, and describe not only the components of an operating plant – control rods, fuel rods, and the way in which these interact in an actual plant – but will consider critical distances and the potential hazards.
4. Some nuclear reactions are perfectly natural and utilised around the home or in industry. What are some applications of natural nuclear decay? Radiation technology is used in medical, industrial and forensic fields. Choose one and outline how it works, the risks and recommendations of this application.
5. Using the rate of decay of Carbon 14 atoms is a useful tool, but some say it is as much art as science. Why might this be? Your presentation should include equations, scientific assumptions, and limitations of the model.
6. Nuclear fusion powers the Sun. Can we reproduce and harness this energy? The attempt to extract energy from nuclear fusion is a dream for mankind because it could power the world with hydrogen extracted from water. The magic energy bullet. But it ain’t so easy. Why? Tokomak was the first fusion reactor built, and has come ahead in leaps and bounds. But is it enough?
7. There was a lot of controversy about the first run of the LHC (Large Hadron Collider) in 2009. Was there cause for concern? What other particle accelerators are available?
8. ANOTHER TOPIC DECIDED BY YOU

|  |  |
| --- | --- |
| **What is an extended response task?** | |
| The extended response task is an assessment instrument developed in response to a Physics question, circumstance or issue. It is essentially non-experimental, but may draw on primary experimental data. Research and secondary data will often be the focus. The management of the extended response task should be mostly the responsibility of the student. Supervision by the teacher may be necessary at times. The extended response task may last from two weeks to the entirety of the unit of work.  The assessable outcome of the extended response task is a written or nonwritten presentation. *Aspects of each of the three criteria should be evident in the task.*  **Written**  *Report:* In the report, the student would make some form of decision regarding the question or issue under investigation and support the decision with logical argument. The report may be in response to observations made and conclusions drawn from a case study or studies, industrial visits, or field trips.  *Assignment:* Students provide a response to a specific question or issue. The response may be supported by appropriate tables of data, diagrams and flowcharts. The assignment could be a persuasive argument or informative text.  *Article:* Students create an article that would be suitable for a scientific magazine or publication that would run stories of scientific interest. Documentation of findings should be enhanced by the use of graphics, tables and pictures.  **Nonwritten**  A nonwritten extended response task may be a spoken (e.g. debate, seminar, lesson, demonstration) or multimodal (e.g. PowerPoint, webpage, video, computer simulation) presentation. The nonwritten presentation would need to be supported by explanatory notes, references, data and diagrams. | |
| **For monitoring** | **For verification** |
| **Written**  Report: 800–1000 words (discussions, conclusions and/or recommendations)  Assignment: 800–1000 words  Article: 800–1000 words  **Nonwritten**  Oral or multimodal presentations: 3–5 minutes | **Written**  Report: 1000–1500 (discussions, conclusions and/or recommendations)  Assignment: 1000–1500 words  Article: 1000–1500 words  **Nonwritten**  Oral or multimodal presentations: 5–7 minutes |
| **What must a student do to complete an extended response task?** | |
| gather and sort information and data from a variety of sources, demonstrating appropriate referencing  process information, demonstrating an understanding of processes and phenomena  interpret, analyse and synthesise data  explain relationships between concepts, principles, theories and schema  evaluate information and justify ideas  communicate ideas. | |

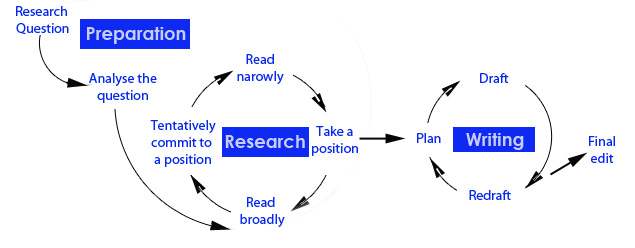
**THE RESEARCH & WRITING PROCESS**

There are two phases to preparing your ERT: The *Research Phase*, and the *Writing Phase*.

**1. RESEARCH PHASE**

The following flow chart and schematics give a suggested approach to the completion of the task.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Read the stimulus (background information) in the task sheet**  and search for and collect information to help you understand the physics involved.  Transfer this information to your note/log book. | | | | | | | |
| 🡻 | | | | | | | |
| **Develop a Research Question based on the task stimulus.** | | | | | | | |
| 🡻 | | | | | | | |
| **Conduct a preliminary literature/internet search to analyse the Research Question.**  (you may need to make some assumptions about quantities or do calculations). | | | | | | | |
| 🡻 | | | | | | | |
| **Develop a position (thesis) statement based on your Research Question.**  Ensure that it significant (not trivial), that it is about a real-world issue in the stimulus, that it has a narrow focus, that it allows you to bring scientific evidence (physics facts, concepts and data) to make your argument. Discuss this with your teacher. | | | | | | | |
| 🡻 | | | | | | | |
| **Deconstruct the focus area and the thesis.**  Read more narrowly to identify, interpret and analyse underlying science concepts/ideas. | | | | | | | |
| 🡻 | | | | | | | |
| Concept A | -------------- | Concept B | -------------- | -------------- | Concept C | -------------- | Concept D |
| 🡻 | | | | | | | |
| **Draw a concept map explain relationships between underlying physics concepts/ideas**  (rank order from general to specific; organise them logically, link with arrows and use linking words). | | | | | | | |
| 🡻 | | | | | | | |
| **Plan your arguments.** State how the identified physics concepts/ideas are linked to your thesis statement and to each other. You need to be a little discriminating in deciding how, and to what extent, the identified concepts tie into your thesis. | | | | | | | |



**2. WRITING PHASE – PLAN, DRAFT & EDIT YOUR Presentation**

**Introductory paragraph** (1-2 pages; 200 – 250 words)

The introductory paragraphs should include a topic sentence which includes the thesis or a specific purpose statement, followed by a brief overview of the essay. This is where you establish the intention of your writing and inform the reader of what the paper is about. You should state why the issue is personally relevant to you , and say why it is relevant to society. Next, you should present definitions of the words and terms that may not be familiar to your audience. You should briefly present the arguments you will be using. The last sentence of this paragraph should also include a transitional sentence that moves the reader to the first paragraph of the body of the essay. In summary, the introduction should contain:

* Thesis (topic, focus) statement and overview
* Personal relevance
* Social relevance
* Definitions (of words, and technical terms)
* Scientific explanations (valid and accurate)
* Closing statement and link to next section

**Body paragraphs** (3-5 pages; 600 – 800 words)

These should consist of the arguments; and the limitations or counter-arguments. The best number of arguments is three. Arguments and support should be logically linked and sequenced in a way that makes it easy and interesting to follow the author's train of thought.

**Argument 1 – the first idea that supports the argument for your thesis.**

This paragraph should clearly set out the first and most important argument (premise).

* The first sentence should contain a link to the transitional sentence from the previous paragraph.
* Use only one idea/concept per paragraph. If you change ideas, start a new paragraph.
* It should then include the data (facts, statistics, principles, examples, real-life experiences) and the relevant theory (concepts, laws, formulas, quantities, units) that support the premise. All of the evidence (data and theory) should be specific, relevant and explanations are given that show how each piece of evidence supports and convinces of the author's position. Be careful that if you cite scientific theories or mathematical calculations in support of your thesis, you must explain why and how they relate.
* It should then draw a clear connection to the thesis statement; and most importantly – it should be plausible.
* The closing sentence ideally should not only sum up the paragraph, but also provide a link to the next argument, in order to provide fluency of expression and cohesion in the argument.

**Argument 2 – the second idea that supports the argument for your thesis.**

Same structure as Argument 1 but with further evidence supporting your thesis.

**Argument 3 – the third idea that supports the argument for your thesis.**

Same structure as Argument 1 but with the final evidence supporting your thesis.

**Counter-arguments**

Here you can qualify the limitations of your arguments in terms of the quality of the data you used, the supporting formulas or theory, and the logical process you have adopted. You can lump them all together in a “Counter-arguments” or “Limitations”section or you can address them in each of your three arguments.

You could examine the background material presented to you in the stimulus or that you have located elsewhere. You could examine the *authority* on which the claims in the evidence have been made. Not all of the following will apply:

* Is the theory presented correctly without mistakes;
* Are the formulas, units, quantities, and symbols correct and appropriate;
* Have scientific terms been used in an everyday sense to change the meaning;
* Does the theory apply to a limited range of situations or is it able to be generalised more broadly;
* If you are quoting or responding to the claim of a scientist, is it in the scientist’s field of expertise?
* Is the cited expert really an expert?
* How recent is the source?
* How authoritative is the expert? Are they recognised by colleagues as an outstanding expert?
* If several scientists disagree on the topic, have you consulted several experts as well?
* Is supporting evidence available, and is the statement by the scientist in accordance with this evidence?
* Is the expert’s statement clear and intelligible, and correctly interpreted?
* Does the scientist have a vested interest in the research? That is, does the scientist work for a company or institution with a financial interest in the research; if so, you may have to question the scientist’s personal reliability (is he/she honest, unbiased, and conscientious?). This has been a problem in the asbestos, cigarette, swine flu, mobile phone, vaccination, nuclear and oil industries.

**Concluding paragraph/s** (1 page; up to 200 words)

These paragraphs are the summary paragraphs. Each sentence should sum up the main idea or point of the individual paragraphs in the essay. The conclusion should be very strong and clear and follow logically from information collected and judgments made and must not introduce new information. Ideally, it would contain four critical points:

1. A restatement of the thesis statement, using some of the original language or language that "echoes" the original language. (The restatement, however, need not be a duplicate of the thesis statement.)
2. A summary of the main points from the body of the essay and how they link to this thesis.
3. A statement about the limitations of the arguments.
4. A final statement that signals the discussion has come to an end. This final statement may state the implications of the thesis. It is sometimes where you can offer a solution to the reader. Your last few sentences should leave a lasting and strong impression on the reader.

**Documentation**

You will need to present a Reference List and a Bibliography.

**REFERENCES & FOOTNOTES**

References are used to acknowledge the source of comments, quotations, diagrams, photos and so on. *Footnotes* or *endnotes* are used to provide additional interesting and relevant material to elaborate the point but that is incidental to your argument.

**BIBLIOGRAPHY**

A bibliography is a list of sources consulted during your research. It is different to a Reference List in that you can cite sources that were read but not quoted. Bibliographies and Reference Lists are usually treated as proof that you have consulted more than just one source or format (not just the internet, but books and journals for example). You don’t need to cite every source you consulted; you should be discriminating. A *focused* bibliography will have a few, very specific, highly relevant, recent, authoritative sources in different formats; a *broad* bibliography will have a broad range of sources and demonstrates a wide examination of the sources. Sources should be listed alphabetically according to the referencing style advised in the task sheet. You should use consistent, accepted conventions of in-text citations and referencing. Use about seven references for a 1500 word assignment.

**Annotated Bibliography**

An *annotated bibliography* (should you choose to provide one) is your list of cited sources (as in the *Bibliography* above), each followed by a brief paragraph that discusses aspects of the source. An annotated bibliography is useful for documenting your research in a specific area, exploring varying viewpoints, and summarizing main points from different sources.

There are two parts to every entry in an annotated bibliography: the citation and the annotation. The first is the *Citation* which includes the bibliographic information of the source (as above). Secondly, there is the *Annotation* which is a brief paragraph following the citation. Its purpose is to:

* describe the content of the source
* describe the usefulness of the source
* describe the intended audience
* evaluate the credibility of the source

Your annotation should cover only main points and themes. That is, it should describe how useful it was for understanding the research problem and justifying the thesis statement.

| **Criterion** | **A** | **B** | **C** | **D** | **E** |
| --- | --- | --- | --- | --- | --- |
| *Knowledge and conceptual understanding* | The student work has the following characteristics:  reproduction and interpretation of complex and challenging concepts, theories and principles | The student work has the following characteristics:  reproduction and interpretation of complex or challenging concepts, theories and principles | The student work has the following characteristics:  reproduction of concepts, theories and principles | The student work has the following characteristics:  reproduction of simple ideas and concepts | The student work has the following characteristics:  reproduction of isolated facts |
| comparison and explanation of complex concepts, processes and phenomena | comparison and explanation of concepts, processes and phenomena | explanation of simple processes and phenomena | description of simple processes and phenomena | recognition of isolated simple phenomena |
| linking and application of algorithms, concepts, principles, theories and schema to find solutions in complex and challenging situations. | linking and application of algorithms, concepts, principles, theories and schema to find solutions in complex or challenging situations. | application of algorithms, principles, theories and schema to find solutions in simple situations. | application of algorithms, principles, theories and schema. | application of simple given algorithms. |
| *Investigative processes* | ~~The student work has the following characteristics:~~   * ~~formulation of justified significant questions/hypotheses which inform effective and efficient design, refinement and management of investigations~~ | ~~The student work has the following characteristics:~~   * ~~formulation of justified questions/hypotheses which inform design and management of investigations~~ | ~~The student work has the following characteristics:~~  ~~formulation of questions and hypotheses to select and manage investigations~~ | ~~The student work has the following characteristics:~~  ~~implementation of given investigations~~ | ~~The student work has the following characteristics:~~  ~~guided use of given procedures~~ |
| ~~assessment of risk, safe selection and adaptation of equipment, and appropriate application of technology to gather, record and process valid data~~ | ~~assessment of risk, safe selection of equipment, and appropriate application of technology to gather, record and process data~~ | ~~assessment of risk, safe selection of equipment, and appropriate application of technology to gather and record data~~ | ~~safe use of equipment and technology to gather and record data~~ | ~~safe directed use of equipment to gather data~~ |
| systematic analysis of primary and secondary data to identify relationships between patterns, trends, errors and anomalies. | analysis of primary and secondary data to identify patterns, trends, errors and anomalies. | analysis of primary and secondary data to identify obvious patterns, trends, errors and anomalies. | identification of obvious patterns and errors. | recording of data. |
| *Evaluating and concluding* | The student work has the following characteristics:   * analysis and evaluation of complex scientific interrelationships | The student work has the following characteristics:   * analysis of complex scientific interrelationships | The student work has the following characteristics:   * description of scientific interrelationships | The student work has the following characteristics:   * identification of simple scientific interrelationships | The student work has the following characteristics:   * identification of obvious scientific interrelationships |
| * exploration of scenarios and possible outcomes with justification of conclusions/ recommendations | * explanation of scenarios and possible outcomes with discussion of conclusions/ recommendations | * description of scenarios and possible outcomes with statements of conclusion/ recommendation | * identification of scenarios or possible outcomes | * statements about outcomes |
| * discriminating selection, use and presentation of scientific data and ideas to make meaning accessible to intended audiences through innovative use of range of formats. | * selection, use and presentation of scientific data and ideas to make meaning accessible to intended audiences in range of formats. | * selection, use and presentation of scientific data and ideas to make meaning accessible in range of formats. | * presentation of scientific data or ideas in range of formats. | * presentation of scientific data or ideas. |