Notes from the PD on SACs
Formats: Analysing (Pages 1 - 2) and Comparing (Page 3 – 5)

'Analysing' Format: Summary of comments on the Units 3 and 4 Areas of Study

Unit 3 AOS 3: Generating Electricity

Discussed marking approaches: Tended to use rubrics, although some use a combination of rubrics and a marking scheme. Valuable to ensure that students have rubric ahead of the assessment. One teacher includes rubric in assessment to remind students of assessment criteria.

Task format:

Teachers have used a range of data sets. The key to a successful task is to use a rich data set so that can get students to graph, ask questions about trends, conclusions that can be drawn from data, outliers, sources of uncertainty and judgements of repeatability and reproducibility. It was noted that data does not need to be from a real system.

Need to follow up with VCAA regarding the expectations and meaning of data analysis. Some audit feedback seemed to discourage questions about the data collection process, despite the fact of the influence on data collection upon the analysis of data.

There would seem to be a useful role for Vicphysics to collect data sets that might be able to be used for such tasks.

Unit 4 Area of Study 1

The consensus was that the PE effect was the simplest way to deal with this SAC. One teacher was going to the Synchrotron and was hoping to use that data for the SAC. (They changed their mind and might look at the data collected at the synchrotron this year to use next year).

Summary of the outcomes.

- Use data from PhET or similar. Teacher to select the data, so that it included outliers.
- Focus of the task was to plot the data from the data set. (plotting data)
- Have the students plot the data for one metal, including specified uncertainties. Students would either be given averaged values or would be expected to generate their own averages.
- Some were going to give the students blank graph paper, and other were going to provide more information. Quite a few liked the idea of providing the axis with the upper limit in place, in an attempt to get all the graphs to the same scale, in order to minimise the work-load in marking the plotting of the points (with varying scales). T hose with smaller classes were prepared to tolerate this extra workload in correction.
- The line of best fit, was assumed to be linear (addressing assumptions), and should not be extrapolated below the horizontal axis (limitations).
- The gradient was to be identified, and using uncertainties, a maximum and minimum value could possibly be obtained.
- Students would need to identify the threshold frequency and the work function from the graph, (possibly with uncertainties).
- The students were then to plot the data for a second metal, on the same axis, looking to see that the gradient remains the same (trend)
- Possibly one point for a third metal could be given, and the students required to identify the threshold frequency and the work function for the third metal from the graph (links to theory).

- The students would complete the task by writing a suitable conclusion (conclusion).
- The use of measurement terminology would have been specifically assessed by questions throughout the task. Some were going to use multiple choice for this.
- In the teaching and learning sequence students would have been exposed to PhET and have analysed a similar set of data. So effectively, this is a direct assessment task that has come from work completed in class.
- The majority sensed that a marking scheme was the simplest assessment format.
- Participants left this session with a similar set of ideas of how this could be quite easily implemented this year, but with some concern on how to make it different next year. For next year, it seems that most want to use the same data in a different task.

'Comparing' Format: Summary of comments on the Units 3 and 4 Areas of Study

Unit 3: Motion in 2D and Fields

There were only five in this combined group, four used the format in Motion, one in Fields.

Topics for tasks:

1. Projectile motion from two approaches: conservation of energy and kinematic equations, (two schools)
2. Luna Park: Twin Dragon ride, compare energy and force approaches
3. Determining 'g' by different means
4. DC Motors, compare and contrast improved performance with data on loops and current.

Assessing comparisons: How was this done?:

1. How well they approached and solved problems. Compared explaining differences in results
2. Summarised in tables
3. Compared experimental values with theory
4. Compared two graphs.

Assessing evaluations:

4. Need to compare practice to theory and explain any difference encountered

Information provided:

1. More theoretical. Collection of data in the lab data was discussed, then SAC was done using the data.
2. Students given ride data.
3. They were told what data collection task were, not what they would be uwd for until the day of the SAC.
4. Ran prac for turns, used secondary data for current.

Authentication issues: None

Discriminate students:

1. Large range from really high to really low. Range was moderate, students struggle with written explanations.
2. Small number had difficulty with language.
3. Good spread with high median.
4. Didn't discriminate, number skills good, but literacy results clumped.

Unit 3: Electricity Generation

Which option?: Two solutions to a problem was the common choice

Topics:

1. Power transmission by high voltage AC and DC.
2. Power supply to a property by PV panel or an AC generator.

Power transmission comments:

- Useful resources on High Voltage AC and DC: Sun Cable project in NT to link to Singapore and Tasmania-Victoria link. Also High Voltage DC is used in Victoria and elsewhere, interconnecting different transmission systems.
- Students did some google research beforehand and came in with one page of notes.
- Possibility of explaining the skin effect as an example of Electromagnetic Induction.

- Some students valued the task, but others preferred a focus on exam-style questions.

Power supply comments:

- Difficult to structure a question on advantages and disadvantages that students did not write the opposite of one for the other. Instead flesh out the evaluation of the two solutions.
- Consider asking about cost of materials, environmental considerations, e.g. benefits and requirements. Question to select an option and justify.

Comparing takes the task to a higher level.
Most used a marking scheme, rubrics seemed too subjective and time consuming.

Unit 4: Area of Study 1

Note that VCAA instructions are:
The source materials for the SAC task could be:

- two different opinions about the merit of a new discovery, invention or proposal in response to a physics-related issue reported in the public domain
- two different explanations of a physics phenomenon
- two different theories proposed by physicists to explain natural phenomena
- two different interpretations and / or conclusions drawn from students' experimental data
- two different equations, or algebraic methods, for measuring and calculating variables
- outline of an alternative experimental method from that which was used in class activities
- data related to an investigation produced by two students (de-identified and manipulated by the teacher so that the two data sets have not been seem by any students in the class).

Which option? Teachers in the groups chose 'Explanations of a physics phenomenon'

Topics:

1. Particle and Wave models of Light
2. Classical and relativistic descriptions of motion
3. Classical and quantum descriptions of matter.

Other ideas that came up in discussion were:

4. Example of two different opinions: Ether hypothesis versus special relativity to explain the observed invariance of the equations for electromagnetism
5. Compare diffraction and interference patterns. Does this fit the description of the task?
6. Compare diffraction of light and electrons and the technologies that are used and their specific purposes, microscopy, etc,
7. Comparing quantum technologies, e.g. devices, screen technologies, link to careers
8. Comparing the contributions/models of two scientists, eg Bohr vs Einstein
9. Compare spectra from different atoms or arrangements of electrons
10. Reflection, refraction and diffraction of light: comparing explanations of the phenomena using a wave and particle model
11. Photoelectric effect: comparing explanations of the phenomenon using a wave and particle model
12. Number of muons observed at surface of earth: classical versus special relativity explanation
13. Colour in the natural world: absorption versus diffraction
14. Imaging: particle versus wave model

Aspects to compare:

Key is to find examples that are sufficiently rich so that can construct a 50 min task that elucidates achievement in the outcome.

Topic 1:

- Experimental evidence, both what is explained and what isn't explained.
- Historical approach
- Evaluation of each models.
- Ideas around wave model vs particle model provide lots of opportunity for comparison
- Compare theoretical predictions with experimental results, eg: wave model theory with photoelectric effect results
- Look at Young's double slit for waves and particles, look at single slit diffraction for waves and particles
- Use examples from experiments in the stem of questions, eg: how does this relate to the wave and/or particle model? Compare this to the predictions of the wave/particle model, what important information does this provide around wave and/or particle model, …
- Compare changing frequency with intensity in photoelectric effect, more specific comparison
- Delve into wave model in more depth, eg: compare mechanical waves with EM waves, check study design to ensure only focusing on currently assessable topics

Topic 2:

- Problem done with two different descriptions.
- Analyse a situation using classical and special relativity
- Extended response question on muons or particle accelerators
- Compare muons in the lab with muons moving through space

Topic 3:

- Evidence for quantum explanation
- Innovative thinking, quantum idea was a challenge
- Neither is a complete solution

Reading material:

- Possibly an analysis of articles, or Youtube videos and students critique them, evaluate populist presentations
- Historical background

Other comments

- In comparing two explanations, ask which is the better?
- Need to compare, not just include two different things

Criteria for comparing and evaluating:

- Get students to think about the historical origins of these ideas.
- Identify similarities and differences, not just differences
- Focus on comparison, not two separate things with a final compare question

Assessing:

- Rubrics could be more use than marking scheme as open-ended questions could be used effectively
- Use a detailed rubric to assess
    - Allows for open ended questions
    - Could just ask students to 'compare wave model with particle model' and follow the rubric provided
    - Do research into a particular aspect of wave/particle model and allow students to have summary notes to bring into SAC