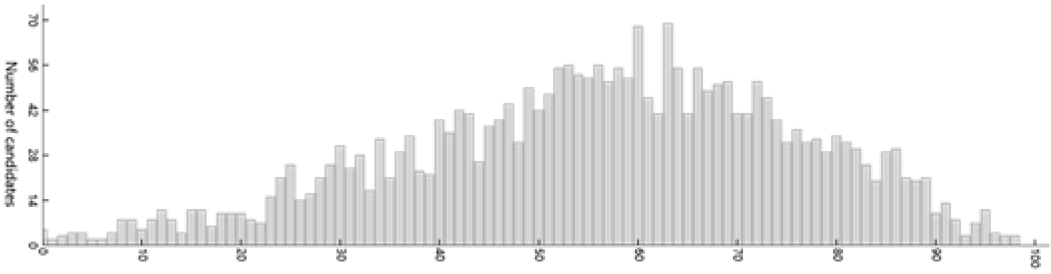
Government of **Western Australia**
School Curriculum and Standards Authority

Summary report of the 2021 ATAR course examination report:
Physics

Year	Number who sat	Number of absentees
2021	2680	43
2020	2861	40
2019	2770	58
2018	3165	35

The number of candidates sitting and the number attempting each section of the examination can differ as a result of non-attempts across sections of the examination.

Examination score distribution–Written



Summary

The paper as a whole was well received and considered a fair paper by both candidates and teachers, from the majority of feedback received. The questions in the main were accessible and covered the course well. Candidates appeared to have no trouble finishing the paper, as there were no particular sections not attempted. The mean of 55.85% was slightly down on previous years.

Attempted by 2674 candidates	Mean 55.85%	Max 98.37%	Min 0.00%

Section means were:

Section One: Short response	Mean 52.89%		
Attempted by 2670 candidates	Mean 15.87(/30)	Max 30.00	Min 0.00
Section Two: Problem-solving	Mean 58.86%		
Attempted by 2670 candidates	Mean 29.43(/50)	Max 50.00	Min 0.00
Section Three: Comprehension	Mean 52.78%		
Attempted by 2645 candidates	Mean 10.56(/20)	Max 20.00	Min 0.00

General comments

The paper as a whole was well-balanced, with each section having some parts of questions which were discriminating and challenging, while others were straightforward and accessible to the majority of candidates. The majority of contexts used were familiar to the candidates, however, the relativistic conservation of momentum and energy was a slightly different approach, in particular the use of addition of velocities in a particle collision problem. The poor ability of candidates to draw proper vector diagrams was evident, as many did not take care in ensuring that lines were straight, in correct proportions or equal if they were supposed to be. Candidates often only addressed the first point of a question and not the subsequent aspects. Legible handwriting continued to be an issue, and candidates found explanation questions more difficult to answer in a clear and logical manner.

Advice for candidates

- Pay attention to significant figures. Estimated answers must be given to two significant figures, or as specified in the question.
- Read all questions carefully and completely. Many candidates miss important information which is required for full marks. This is particularly noticeable in the Comprehension section.
- Do not force a line of best fit through the origin. If the question requires you to use two points on a line of best fit to calculate the gradient, substituting data points into the formula for calculating the gradient will attract no marks.
- Set your working out coherently for markers to follow. Start on the left and either work across or down the page. Cross out working that you do not want to include in your final answer.
- If a question is worth one mark, it will not usually involve a complicated calculation.
- Check your numerical answers against reality. For example, speeds greater than *c* and masses of 10^{23} kg for subatomic particles are clearly incorrect.

Advice for teachers

- Reinforce the concept that the net force on an object in uniform circular motion is towards the centre of the circle. This is called the centripetal force and is the vector some of all the other real forces acting on the object. Many candidates struggled with this understanding.
- It is important that candidates have a solid understanding of trigonometric ratios, as a lack of understanding places them at a disadvantage when working with components of vectors.
- Teach derivation from first principles. Many candidates rely on rote learned, short cut formulae and they struggle with unfamiliar contexts because they have not practiced derivation from first principles.
  $tan\theta = \frac{v^2}{rg}$, Tension at the bottom of a vertical circle $= mg + \frac{mv^2}{r}$, and $V_q = \frac{mv^2}{2}$ are three such examples.
- Encourage some rote learning of key Physics principles, as the ability to quickly recall key concepts is advantageous. The Laws of Conservation of Energy and Momentum, Lenz's Law, and the conditions for static equilibrium, Einstein's postulates, categories of subatomic particles, and the right hand rule for electromagnetism are all examples of this.
- Have students practise questions which require explanation, description and derivation. Do not concentrate solely on calculations.
- It is important that students are able to analyse and then explain how changing one variable in a question affects the others. Provide opportunities for candidates to practise these skills throughout the year.

Comments on specific sections and questions

Section One: Short response (53 Marks)

Section One had a low mean and this was a major contributing factor to the decrease in the overall mean for the paper from past years. Candidates struggled with a variety of questions ranging in difficulty level.

Many candidates missed key aspects in Questions 1 and 3. Electron bombardment of atoms is different to photons incident on the same atoms. The majority of candidates calculated the energies of the downward transitions of excited electrons, rather than the energies of those emitted.

Section Two: Problem-solving (93 Marks)
Apart from Questions 16 part (f) and 18, all questions were set in familiar contexts. The questions where candidates struggled the most required explanation and description.

Two topics stood out as poorly understood by candidates: vectors and trigonometric functions. Candidates were confident taking components of vectors but had trouble converting a component into the resultant vector. They did not divide by a trigonometric function.

The mean for this section was 58.85%. This could have been significantly higher had candidates given their answers to the correct number of significant figures. The instructions at the start of the paper clearly stated that estimates should be given to a maximum of two significant figures. Question 13 parts (a), (b) and (c), and Question 16 part (c) all required two significant figures. A large number of candidates knew the physics of the question but did not achieve full marks due to not following a specific instruction.

Section Three: Comprehension (38 Marks)
Historically, the comprehension section has seen many non-attempts which lowers the average. This was the case in 2021. The main problem this year appeared to be candidates not reading the entire passage, or skim reading it. Questions 20 part (c) and 21 parts (b) and (c) had sections in the text which should have been referred to in the answers to obtain full marks. Question 21 part (d) was an extremely simple derivation which required candidates to perform a one-step rearrangement of $\frac{F}{q} = \frac{V}{d}$, which was given to them in the Formulae and Data Booklet. The mean was just over 50%. Once again, many candidates confidently answered a six-mark, multi-step calculation but struggled with explanations using text available to them.