NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Assessment Report

Scholarship, 2006

Physics

Physics, Scholarship, 2006

Commentary

Successful candidates were very well prepared and had an excellent grasp of the physics required at this level. Many candidates, however, were not sufficiently prepared for this examination.
Out of a possible total of 48 marks only 5% (55 candidates) gained marks over 30 and only 1% (12 candidates) gained more than 35. Almost 17% of the level 3 Physics cohort for 2006 sat this examination, an unusually high percentage relative to other Scholarship subjects.

Too many candidates appeared not to give enough thought to their answers. Also, for candidates who wrote large amounts, it would have been better for them to sit and think about the question first, note if their calculations were longer than a few lines, then stop and see if they could find an easier method. Candidates who achieved showed a considered approach to problem solving and organised their thoughts before writing formulae or essays.

The following comment, from the previous year's assessment report, still applies:

> *Teachers and schools should spend time with potential candidates to determine whether the candidate has sufficient ability to attempt an examination of this standard. Evidence should be used from past national examination results and the working knowledge of the teacher. Once a candidate has decided to proceed, they need to be encouraged to extend themselves by attempting more challenging problems and spending a lot of time explaining their understanding of physics in a supportive environment. Candidates need to be nurtured and supported with appropriate stimulus material. This process should commence as early as possible in the candidate's physics education (ideally prior to Level 3 physics).*

Most candidates showed good understanding of:

- the concept of binding energy and Einstein's equation
- gravitation in relation to geosynchronous satellites
- constructive and destructive interference
- RLC circuit theory.

Many candidates had difficulty with:

- the relationship between energy and potential difference
- applications of Newton's laws
- the simple pendulum, especially in relation to the measurement of the length of the pendulum
- the necessary requirements for a geosynchronous satellite
- applying the ideas of interference
- applying Faraday's law.

The best performing candidates most commonly demonstrated the following skills and / or knowledge:

- ability to interpret an unfamiliar situation in context
- significant physical insight across a wide variety of situations
- ability to provide full but concise explanations
- coherent and structured mathematical approaches to calculations
- depth and breadth of conceptual understanding
- understanding of mechanics and how to apply Newton's laws correctly
- a good understanding of the practical implications of their answers and ability to determine if their answers made sense
- ability and understanding to provide more than a superficial response.

Candidates who did NOT achieve scholarship lacked some or all of the skills and knowledge above and in addition they:

- could not present a logical progression when deriving a relationship
- gave confused answers containing some correct material as well as material that made it clear they lacked a full understanding
- spent too much time writing and not enough time thinking
- did not understand the basic concepts.

Specific questions

The following comments relate to common problems identified in candidate responses:

Question 1

(a) Most candidates gained marks in this part of the question, but a surprising number (approximately 25%) did not attempt the question. Candidates are still generally confused about the concept of binding energy.

(b) Many candidates did not realise that they needed to equate the kinetic energy gained to electric potential energy. A large number of candidates used the capacitor energy relationship in this question. A large number used the potential difference provided as a substitute for the velocity of the electron. Over 50% of all candidates scored no marks in this question.

(c) Many candidates were unable to evaluate the Lorentz factor and make a sensible statement about whether or not the factor fell within the experimental uncertainty.

Question 2

(a) Despite a similar question in the 2005 examination, candidates were completely confused by this question (over 80% gaining no marks). Most thought that the forces would be equal on the two barges.

(b) Over 88% of candidates gained no marks in this question. Most simply stated that the force required was equal to the weight of the cleaner and the cage. As indicated in last year's report, free body force diagrams need to be used by candidates at this level. This is a simple example which can be easily solved if a free body force diagram is used. It is also very surprising that so few candidates know that a pulley can provide mechanical advantage.

(c) Over 97% of candidates gained no marks in this question. It seems that most candidates did not know that the length stated in the simple pendulum formula is from the pivot point to the centre of mass. This is quite surprising given how many candidates have attempted the internal standard at level 3 on pendulum-like systems. Many candidates insisted that the system was best modelled as a mass-spring combination!

Question 3

(a) Most candidates handled this question well. A number lost marks by not clearly stating how they fixed the mistake in the working. Candidates need practice in how to present their responses.

(b) Most candidates lost one of the marks for failing to state that an equatorial orbit is required.

(c) A large number of candidates were unable to attempt this question (approximately 50%). Those who did attempt the question generally solved the problem by substitution showing that the period was unchanged.

Question 4

(a) Most candidates were able to correctly state that interference was the reason for the sound fluctuations. A significant number argued that it was due to the

Doppler effect (or some other physical phenomenon) despite the fact that the question was titled interference.

(b) Over 80% of candidates gained no marks. Most candidates could not see how a maximum could be produced at the bench top. Many argued that there would not be a maximum at all.

(c) Over 85% of candidates gained no marks. The hint provided did not help many candidates. The idea of a virtual source equidistant below the benchtop was beyond almost all candidates. Some of the more mathematically able candidates derived equivalent (but less physically insightful) relationships. Some candidates used three pages to derive their expression. Candidates need to recognise that answers will not require this amount of algebraic manipulation.

(d) Over 95% of candidates gained no marks. Despite the significant hint in the stem of the question, only the most able candidates suggested a phase change. This was not a content-specific question. Careful reading of the question and simple analysis would draw the capable candidate to this conclusion.

Question 5

(a) Approximately 65% of candidates did not gain any marks in this question. Most candidates simply used mathematics to derive the expression. Only the most able candidates stated that the arrangement presented could be modelled as two capacitors in parallel.

(b) This question was well done. Over 20% still managed to gain no marks because they used incorrect substitution.

(c) This question was well done although a large number could not set out their working to an appropriate level. When presented with straightforward questions candidates need to ensure they gain full marks by carefully laying out their work and checking their answers.

(d) Over 75% of candidates gained no marks. Most candidates made standard statements relating to one time constant being equivalent to a 67% change in the potential difference. The question asked the candidates to explain how this circuit could be used to determine the height. Only the most able candidates could see that the potential difference reached depended on the capacitance (which is related to the height), which altered the time constant. Considering the time constant in relation to the pulse length gave the most able candidates a way to demonstrate that they could apply their understanding to a new context.

Question 6

(a) This question was generally well done.

(b) The candidates were required to apply concepts in electromagnetic induction to explain a set of observations. To answer correctly, the candidates had to critically examine their answer and ensure it was consistent with the relevant physical concepts. Many candidates who did not achieve scholarship gave an answer that was not consistent with their answer to the previous question (they failed to realise that an electromotive force is not induced when a coil passes through a uniform magnetic field, despite correctly describing Faraday's law that states that an electromotive force is only induced when a magnetic flux changes). Many candidates assumed that the loop started outside the field. The diagram and question clearly stated that this was not the situation.

(c) Many candidates used a formula "shot-gun" approach which yielded some marks. The more able candidates found this a straightforward question.

(d) Over 80% of candidates gained no marks. Only the better candidates were able to clearly demonstrate that since the kinetic energy was not changing, the heat generated must have come from the change in potential energy.