NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Assessment Report

Scholarship, 2007

Physics

COMMENTARY

Successful candidates were well prepared and had a solid grasp of the physics required at this level. Many candidates, however, were not sufficiently prepared for the examination. The average mark improved from the previous year but out of a possible total of 48 marks only 4% (46 candidates) gained marks over 30 and only six candidates gained more than 35 marks. Approximately 16% of the level 3 Physics cohort for 2007 sat this examination – a high percentage relative to other Scholarship subjects.

Too many candidates gave insufficient thought to their answers. As in 2006, for candidates who wrote large amounts, it would have been better for them to have thought more carefully about each question before providing their responses.

Candidates who gained scholarship showed a considered approach to problem solving and organised their thoughts before writing formulae or explanations. Scholarship responses demonstrated a sound understanding of underlying physical concepts. Candidates who had received considerable exposure to various physical situations throughout their course work were able to demonstrate maturity of thought sufficient to achieve success in scholarship.

In 2007 most candidates showed good understanding of:

- simple mathematical application of standing waves
- mathematical estimation relating to global warming
- applying Einstein's relationship
- using the Doppler effect relationship in a kinematics context
- the resonance condition for LCR circuits.

Many candidates had difficulty with:

- applications of Newton's laws in familiar and unfamiliar contexts
- understanding the implications of conservation of angular momentum
- applying conservation of energy in a familiar context
- understanding electromagnetic induction
- dimensional analysis
- understanding the behaviour of capacitors.

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
- concise mathematical expression and treatment of concepts.

Candidates who did <u>not</u> achieve scholarship lacked some or all of discussed the skills and knowledge above and in addition they:

- gave confused answers containing some correct material as well as material that made it clear they lacked a full understanding
- were satisfied with single idea answers expressed at length
- spent too much time writing and not enough time thinking
- did not understand the basic concepts.
- were unable to discuss or explain ideas using physical principles.

In Question One:

(a) Most candidates correctly stated that the centre of the star was a node. Very few candidates could provide a physical reason why this must be so.
(b) The concepts underpinning the formation of standing waves in tubes were not well understood by candidates.
(c) Many candidates did not set out an appropriate solution – they needed to show clearly their thinking when asked to derive a relationship.
(d) Most candidates responded well although many did not substitute correctly.

In Question Two:

(a) Candidates generally demonstrated a good ability to estimate the sea rise that could be caused by global warming. The better candidate responses demonstrated an understanding that the floating ice would not contribute to a rise in sea levels. These candidates were also able to make sound assumptions based on sensible physical insight.
(b) Most candidates found this question difficult – most were unable to link the ideas of conservation of angular momentum, rotational inertia and period. A number of candidates stated that rotational kinetic energy was conserved – this is incorrect. Many stated incorrectly that if the angular velocity decreased, so did the period. Some did not understand the concept of density and stated that when ice melts it gets more massive because water is denser than ice.
(c) (i) Most candidates responded well but many were still very confused about the basic underlying concepts of mass deficit and binding energy.
(c) (ii) This part of the question was answered well by most candidates.

In Question Three:

(a) Poor presentation of ideas was evident in the responses. The most able candidates provided elegant and simple solutions to this difficult problem.
(b) Most candidates responded well to this part of the question.
(c) Most candidates spent at least one page restating the resonance condition for LCR circuits multiple times. The most successful candidates answered the question in terms of the underlying physical responses of the three components. Many

candidates did not read this question carefully enough to provide an effective response.

In Question Four:

(a) The concept of a centre seeking force was not well understood. Many candidates stated quite clearly that the force due to gravity was balanced by the centripetal force. It appears that most candidates fundamentally believe that there is a special force known as centripetal force rather than a force, such as the force due to gravity, providing the necessary centre seeking force for circular motion to occur. Also the concept of a reaction force appears to be unknown to most candidates.

(b) Most candidates stated that the minimum height required was less than the diameter of the circle. Scholarship candidates must look more critically at the responses they are providing.

(c) (i) Most candidates responded well to this question.
(ii) Many candidates did not provide any physical reason why the mass did not affect the height. This is surprising given the emphasis in the curriculum on this particular idea.
(iii) A challenging question that was well done by only the most successful candidates.

In Question Five:

(a) Most candidates provided a partially correct response to this question. Most did not realise that the solution they provided depended on a suitable velocity of the puck.

(b) (i) This question was specifically designed to allow candidates to show their understanding of the underlying physical concepts of mechanics but few stated that the centre of mass velocity will remain unchanged. The better responses from candidates correctly calculated the minimum velocity required for the successful mission. Many stated that at 600 m s^{-1} the mission would not succeed but virtually no candidate considered the fact that the centre of mass of the system must continue forward. No candidates considered the facts that considerable forces and accelerations were involved and how they might impact on the success of the mission.
(ii) Many candidates who had correctly stated there was a minimum velocity of approximately 150 m s^{-1} required in the previous question then stated that the mission could be successful using a velocity of 10 m s^{-1}. Many candidates were unable to handle the percentages used in the question to correctly calculate the relevant momenta. Very few discussed energy in relation to the collision.

In Question Six:

(a) Many candidates tried unsuccessfully to use the concept of back emf in this context. Very few candidates discussed the force experienced by electrons moving through a magnetic field and the subsequent potential difference produced. This then leads to a current in the circuit.

(b) Many candidates were unable to derive the appropriate relationship.

(c) The better responses showed that candidates clearly understood the fact that when the potential difference induced across the roller was the same as that across the capacitor no current could exist. This then leads to the constant velocity of the roller.

(d) The most successful candidates attempted to show that their relationships were dimensionally correct in the second part of the question. Many candidates appeared to memorise the units of quantities and did not understand how to use dimensional analysis to check the validity of their derived relationships.

(e) Some candidates realised that charging up the capacitor would still lead to a constant (but different) velocity. Few candidates considered that there were many different possible scenarios in relation to the initial state of the roller and that of the capacitor. The most successful candidates provided some insightful responses to this question.