2014 Notes from the Marking Centre – Physics

Introduction

This document has been produced for the teachers and candidates of the Stage 6 Physics course. It contains comments on candidate responses to the 2014 Higher School Certificate examination, highlighting their strengths in particular parts of the examination and indicating where candidates need to improve.

This document should be read along with:

- the Physics Stage 6 Syllabus (PDF)
- the 2014 Higher School Certificate Physics examination (PDF)
- the marking guidelines (PDF)
- Advice for students sitting for HSC science examinations
- Advice for HSC students about examinations
- other support documents developed by the Board of Studies, Teaching and Educational Standards NSW to assist in the teaching and learning of Physics in Stage 6.

Section I

Part B

Candidates showed strength in these areas:

- recognising that superconductors need to be below their critical temperature (Q.21)
- understanding that the angle for re-entry occupies a small range (Q.22)
- knowing that a force would exist between current-carrying wires (Q.23)
- correctly substituting into the equation (Q.24 (a))
- understanding the concept of conservation of energy as applied to transformers (Q.24 (b))
- associating the power loss in the secondary coil with the correct equation for loss of power in a wire (Q.24 (b))
- describing a simple investigation to model the principle applied in an induction motor (Q.25 (a))
- explaining and relating the influence of the AC on the operation of the motor (Q.25 (b))
- equating the two equations required to determine the energy of the photon (Q.26 (a))
- identifying the role of the slingshot effect (Q.27 (a))
- identifying and applying the relevant equation (Q.27 (b))
- identifying that the gravitational potential energy of an object in a circular orbit is constant (Q.27 (c))
- showing how B field and E field could be balanced to find the velocity of an electron (Q.28 (a))
- identifying relevant equations and equating them correctly (Q.28 (b))
- understanding the difference between p and n-type semiconductors (Q.29)
- understanding that the movement of electrons and holes constituted a current (Q.29)
- explaining Galileo's analysis of projectile motion with examples (Q.30 (a))
- plotting the cannonballs at a constant horizontal displacement or lining balls *P* and *Q* at the same vertical displacement (Q.30 (b))
- understanding the transforming ability of AC and its link to low power loss in transmission (Q.31)
- listing advantages of AC over DC (Q.31).

Candidates need to improve in these areas:

- recognising that superconductors can only transmit DC (Q.21)
- understanding that the bouncing off condition only applies to spacecraft coming from 'outer space' and not to spacecraft in orbit (Q.22)
- realising that both sides of the coil that were parallel to the current-carrying wire would have an effect on the straight conductor (Q.23)
- rounding of values (Q.24 (a))
- understanding that the voltage drop across the secondary coil of the transformer was not equal to the output voltage (Q.24 (b))
- determining the power loss in the secondary coil rather than determining the change in power for the system (Q.24 (b))
- recalling the correct units for power (Q.24 (b))
- rearranging the equation (Q.24 (b))
- addressing the specifics of how the motor effect was applied in the operation of an AC motor (Q.25 (b))

- converting nanometres to metres (Q.26 (a))
- finding the *x*-intercept (Q.26 (b))
- understanding that the line is parallel to the original line (Q.26 (b))
- distinguishing between the rotational and orbital motions of planets (Q.27 (a))
- converting to appropriate units (km to m) (Q.27 (b))
- recognising that all gravitational potential energies are negative (Q.27 (c))
- showing that only B field is used to measure the radius of the electron's path (Q.28 (a))
- using appropriate annotations (Q.28 (a))
- transcribing values, especially powers, correctly (Q.28 (b))
- recognising that doping introduces extra energy levels between the conduction and valence bands (Q.29)
- recognising that energy is required to initiate the movements of electrons (Q.29)
- linking the motion of the cannonballs to Galileo's analysis (Q.30 (a))
- showing calculations (Q.30 (b))
- linking the advantages of AC over DC to a specific benefit to society (Q.31)
- expressing ideas in an organised manner (Q.31).

Section II

Question 33 – Medical Physics

Candidates showed strength in these areas:

- knowing about the use of Doppler to determine blood flow characteristics (part (a) (i))
- identifying a method of generating X-ray radiation (part (b) (i))
- comparing the use of an X-ray image to a CT scan in an investigation of the lungs (part (b) (ii))
- understanding that protons have a magnetic field and can be aligned with an external magnetic field (part (d))
- outlining features of the process involved with attaining an MRI (part (d))
- outlining a range of benefits of medical physics to society (part (e))
- outlining some applications of medical physics (part (e)).

Candidates need to improve in these areas:

- recognising the A scan, and that distance was being measured (part (a) (ii))
- recognising the difference between 'identify' and 'outline' (part (b) (i))
- using appropriate terminology (part (b) (ii))
- recognising the positron as a product of the transmutation (part (c))
- linking the description of the properties of protons to the process of MRI, involving the RF pulse (part (d))
- understanding both the positive and the negative effects of the medical applications of physics (part (e)).

Question 34 – Astrophysics

Candidates showed strength in these areas:

- identifying a reason for viewing stars through different coloured filters (part (b) (ii))
- identifying possible reasons for the change in brightness (part (c))
- identifying the type of star from its position on the H–R diagram (part (d))
- identifying features of spectra (part (d))
- outlining the evolution of stars from main sequence to red giant (part (d))
- recognising issues such as seeing and absorption which affect ground-based telescopes (part (e))
- outlining methods used to improve the resolution and sensitivity of ground-based telescopes (part (e))
- identifying interferometry, active optics and adaptive optics as technologies used to improve image quality (part (e)).

Candidates need to improve in these areas:

- knowing that parallax is evident for stars located close to Earth (part (a) (i))
- not confusing the Earth's rotation with orbit (part (a) (i))
- substituting into and manipulating the equations correctly (part (a) (ii))
- understanding the function of a blue filter (part (b) (i))
- understanding the concept of colour index (part (b) (ii))
- providing clear explanations rather than just identifying the reasons (part (c))
- explaining how the turn-off point is related to the age of a cluster and therefore the stars within the cluster (part (d))
- relating the density of a star to its evolutionary stage (part (d))
- distinguishing between active and adaptive optics (part (e))
- clearly describing how the processes of interferometry, active optics and adaptive optics improve image quality (part (e)).

Question 35 – From Quanta to Quarks

Candidates showed strength in these areas:

- substituting one of the required energy levels into the correct equation (part (a) (i))
- understanding the wave nature of electron orbits and discussing photon energy (part (a) (ii))
- explaining the weakness of the gravitational force between nucleons (part (b) (i))
- knowing about binding energy or mass defect (part (b) (ii))
- recognising that the neutron is neutral and has a relatively high mass (part (c))
- linking the neutral charge of a neutron and its large mass to its behaviour as an effective probe (part (c))
- identifying the Manhattan Project and giving both positive and negative impacts of this project on society (part (d))
- structuring their responses, giving detailed descriptions of societal impacts (part (d))
- describing the Bohr-Rutherford model (part (e))
- recalling a number of limitations of the Bohr-Rutherford model and providing a judgement as to the model's effectiveness (part (e)).

Candidates need to improve in these areas:

- distinguishing between the Balmer series and the ground state (part (a) (i))
- understanding the link between ground state stability and absorption of the photon (part (a) (ii))
- recognising other nuclear forces (part (b) (i))
- recognising the link between binding energy and mass defect during fission and fusion (part (b) (ii))
- considering both fission and fusion when interpreting the graph (part (b) (ii))
- linking the de Broglie wavelength and diffraction/interference patterns (part (c))
- demonstrating an understanding of the physics principles underpinning the Manhattan Project (part (d))
- understanding how physics had been applied to applications such as nuclear reactors (part (d))
- explaining how the experimental observation specifically supported the Bohr-Rutherford model (part (e))
- linking the movement of electrons with the hydrogen spectral lines (part (e))
- demonstrating an understanding of quantised energy states rather than repeating Bohr's postulates (part (e))
- including only relevant experiments or models of the atom (part (e)).