2005 HSC Notes from the Marking Centre Physics

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2005 HSC NOTES FROM THE MARKING CENTRE PHYSICS

Introduction

This document has been produced for the teachers and candidates of the Stage 6 course in Physics. It provides comments with regard to responses to the 2005 Higher School Certificate Examination, indicating the quality of candidate responses and highlighting the relative strengths and weaknesses of the candidature in each section and each question.

This document should be read along with the relevant syllabus, the 2005 Higher School Certificate examination, the marking guidelines and other support documents which have been developed by the Board of Studies to assist in the teaching and learning of Physics.

General Comments

In 2005, 9315 candidates attempted the Physics examination. The most popular electives were From Quanta to Quarks (44%) and Astrophysics (27%).

Teachers and candidates should be aware that examiners may write questions that address the syllabus outcomes in a manner that requires candidates to respond by integrating their knowledge, understanding and skills developed through studying the course, including the Prescribed Focus Areas. This reflects the fact that the knowledge, understanding and skills developed through the study of discrete sections should accumulate to a more comprehensive understanding than may be described in each section separately. It is important to understand that the Preliminary HSC course is assumed knowledge for the HSC course.

In 2005, at least one question in Section 1 Part B focused on the mandatory skills content in Module 9.1. Candidates who had actively planned and performed practical experiences clearly demonstrated a deeper knowledge and understanding of the content described in this module. There was evidence that some candidates had a very poor knowledge of basic definitions specific to terminology associated with the course.

Overall, the candidate's responses were appropriate and indicated a level of understanding of Physics concepts appropriate for most HSC candidates. Candidates need to be reminded that the answer space provided and the marks allocated are guides to the maximum length of response required. Similarly, the key word used in the question gives an indication of the depth of the required response. Candidates should use examination time to analyse the question and plan responses carefully, working within that framework to produce clear and concise responses. This may include the use of dot points, diagrams and/or tables, and avoids internal contradictions. This is particularly so in holistic questions which need to be logical and well-structured.

Better responses indicate that candidates are following the instructions provided on the examination paper. In these responses, candidates:

- show all working for numerical questions and express their answers with the correct number of significant figures
- think carefully about the units to be used and the quantities to be substituted into formulae
- do not repeat the question as part of the response

- look at the structure of the whole question and note that in some questions the parts follow from each other ie responses in part (a) lead to the required response in part (b) etc
- use appropriate equipment, for example, pencils and a ruler to draw diagrams and graphs. (A clear plastic ruler would aid candidates to plot points that are further from the axes and rule straight lines of best fit.)

The option question is divided into a number of parts: candidates should clearly label each part of the question when writing in their answer booklets. In part (c), many candidates wrote a lot of information that was not relevant to the question. Some responses show evidence of rote learning an anticipated answer based on a single source. These did not address the syllabus content and/or outcomes being assessed and hence did not score full marks. Some candidates are responding to more than one option question: candidates are strongly advised to answer the option they have studied in class.

Section I – Core

Part A – Multiple choice

Question	Correct Response
1	A
2	D
3	B
4	D
5	C
6	B
7	A
8	C

Question	Correct Response
9	C
10	B
11	B
12	A
13	A
14	B
15	C

Part B

Specific Comments

Question 16

(a) In better responses, candidates demonstrated recognition of the required formula provided in the Formulae Sheet and provided correct substitution of values to determine the period of Io and hence the period of Ganymede. The responses included the use of Kepler's formula again to determine the orbital radius of Ganymede.
In the best responses, candidates recognised that $\frac{GM}{4\pi^2}$ was a constant and determined the radius using ratios.
Weaker responses involved substitution errors or the use of incorrect units.

(b) In better responses, candidates recognised that centripetal force and gravitational force had to be equated to derive an equation for orbital velocity and substituted the correct values and units.
The weaker responses included substitution errors or used 'r' values in kilometres rather than metres.

Question 17

(a) Better responses to this question began with a simple statement such as 'time dilation'.

(b) Better responses described a valid experiment for the statement in part (a) eg one involving two atomic clocks, one on a high speed jet and the other earth-bound.

(c) Better responses provided a clear explanation of how the nominated technological advances allowed the experiment to be successfully completed.
Weaker responses did not link parts (a), (b) and (c).

Question 18

Better responses discussed the impact on the scientific community of the result of the Michelson-Morley experiment and its implication for the existence of the aether. This shifted scientific thinking from classical theory to relativity.

Question 19

In better responses, candidates were able to describe and relate two or more of Newton's Laws of Motion in words and/or equations to the return trip of Apollo 13, ie the period after leaving the lunar orbit.
In weaker responses, candidates incorrectly applied the 'slingshot effect' to the motion of the rocket around the moon.

Question 20

The best responses made a judgement about the reliability of information gathered both from first-hand data and/or second-hand data. Many candidates understood the general principles of assessing reliability of information but had difficulty relating these principles to the identified applications of induction.

Question 21

(a) The better responses clearly identified a repulsion force existed between the two tubes and went on to explain why one moved. Responses that incorrectly identified attraction between the tubes were still able to explain why only one tube jumped. A common poorer response was to relate the brief connection of the circuit to an induced back emf and attempt to use this to explain the upward jump.

(b) The best responses calculated the mathematical relationship between weight and electromagnetic force between the two tubes. Candidates are reminded that the use of SI units is essential to express a correct value for current.

(c) Good responses indicated factors that influence forces between closely placed conductors carrying large amounts of current.

Question 22

(a) Most responses correctly identified the formula and included a correct calculation of the voltage in the high tension wires.

(b) In a majority of responses the major causes of energy losses were identified as resistance in the wires and eddy currents in the transformers.

(c) This section was generally well answered with the majority of responses indicating that superconductors have zero resistance. However, a significant number of these responses did not include an explanation of how this minimised the energy losses.

Question 23

There was a broad range of responses to this question, most indicated that the emission and absorption of black body radiation as quanta was understood to be important.

A number of responses included a graph of intensity versus wavelength (or frequency) in an attempt to describe the need for Planck's hypothesis; if done correctly this proved helpful. In some responses, the labels on the axes were often omitted or confused.

Better responses indicated why Planck's hypothesis was needed and linked this to a change in scientific thinking.

Question 24

A majority of responses identified that the BCS theory involved Cooper Pairs of electrons. Better responses drew clear diagrams and clearly labelled the sections of the diagrams. These responses indicated a clear understanding between the drop of resistance with temperature. Clearly structured answers showing point by point description of the theory and showed that candidates understood the terminology used to describe the BCS theory, for example 'phonons' are integral to the explanation.

Question 25

This question assessed Module 9.1 skills content. A large number of responses indicated difficulties in interpreting the graph and relating it to the photoelectric effect.

(a) & (b) The best responses clearly had a thin, ruled line of best fit that extended through the data points to the x-axis so that the minimum energy could accurately be determined. Poorer responses did not identify the region of greatest variation in the data and did not extend the line of best fit to the x-axis.

(c) Better responses drew a straight line of steeper gradient from the same x-intercept. Poor responses included a curved line.

(d) Better responses described the link between the increased steepness of the second line and an increase in the number of electrons released from the metal surface due to a doubling of the number of photons in the incident light. They identified that it would have the same x-intercept because the minimum energy would not change.

Question 26

(a) The best responses showed clearly on the diagram a uniform electric field between both plates.

(b) The best responses correctly identified and substituted into the correct electric field equation showing the conversion of centimetres into metres.

(c) Better responses clearly identified the balance between the downward weight force and the upward force of the electric field and clearly stated that the charge was positive.
Weaker responses indicated confusion between electric and magnetic fields.

Question 27

(a) The better responses derived an expression for the momentum of a proton in the bubble chamber by equating the centripetal force to the magnetic force.

(b) The best responses included correct substitution into the expression found by equating centripetal force and magnetic force.

(c) The better responses were those that recognised that the mass obtained in part (b) was a relativistic mass and substituted accordingly into the Lorenz transformation.

Section II – Options

Question 28

(a) (i) The majority of responses named the correct equipment.

(ii) Poorer responses confused emitted Infra Red with reflected Infra Red.

(b) (i) Better responses used the value for the speed of sound from the Data Sheet to calculate the correct distance.

(ii) Good responses named a geophysical technique and explained how to use the equipment and data.

(c) Better responses identified the technologies that lead to the acceptance of the principle of plate tectonics and made a judgement based on the evidence they presented.

(d) (i) Better responses correctly identified the gravitational attraction and related it to the deflection of the plumb-bob.

(ii) This part of the question was generally well done.

(iii) A majority of candidates demonstrated an understanding of using a pendulum to find variations in 'g' and how this related to the shape of the earth.

Question 29

(a) Many responses demonstrated a sound knowledge of the process of obtaining an image of parts of the body using a radioactive isotope. In better responses there was a link to the specified procedure and a justification the choice of radioisotope in terms of the effect of the radiation produced and the appropriateness of the half-life.

(b) (i) Candidates were required to select the appropriate equation and substitute correctly into it to determine the percentage of an incident ray reflected at a boundary. The majority of candidates were able satisfy both these requirements and the question was generally well answered.

(ii) Better responses focused on and identified several of the actual physical principles involved, and used the cited principles to make a clear comparison between the two imaging technologies.

(c) Better responses showed a thorough understanding of how ultrasound scans were obtained and addressed the 'advances in technology' leading to the improvements in scans.
Weaker responses either only identified advances in technology or identified or outlined issues.
Better responses addressed both parts of this question.

(d) (i) Better responses correctly stated that the superconducting magnet assembly produced a very strong magnetic field which aligned the protons in the body and also stated the function of the radio frequency coils as pulsing RF waves into the body in order to resonate with aligned protons which subsequently re-emit radio waves to again be detected by the radio frequency coils.

(ii) Better responses correctly identified that the gadolinium affects the relaxation time of tissue A more than tissue B and consequently enhances clarity or definition of the resultant scan. The majority of responses correctly suggested that improvement of the image was the reason for the introduction of the gadolinium.

(iii) Better responses identified that the most significant advantage of MRI over CAT is its ability to distinguish between soft tissues and also referenced this technique to the brain and to the abnormality shown in the MRI brain scan image They also identified that MRI is a safer technique and that MRI is capable of discerning function as opposed to mere structure.

Question 30

(a) (i) The better responses used correct terminology.

(ii) The best responses provided information about the motion of both stars. For the star Dromus many candidates wrote only about density rather than rotation. Weaker responses incorrectly stated Dromus was orbiting another star.

(b) (i) Good responses involved the halving of the measurement from the graph when substituting. Many candidates were confused by the two dimensional angular displacement.

(ii) The best responses correctly calculated the apparent magnitude using the brightness ratio formula. Good responses involved correct substitution into the distance modulus formula using log to the base 10 (log) and not the natural log (ln).

(c) The better responses provided characteristics and features of a number of technological advances and of the evolution of stars. These responses clearly related the technological advances to putting new data onto the H-R diagram, and how this leads to an understanding of the evolution of stars.
In weaker responses the technologies were merely identified or outlined

(d) (i) The better responses provided relevant information in point form.

(ii) This question was generally well answered, providing reasons for the causes of A, B and C. Most candidates identified the system as an eclipsing binary system. Weaker responses explained the shape of the binary curve due to differences in mass or size of the stars, not brightness.

(iii) Better responses showed full working for calculations. This included stating the correct formula and giving a data summary, as well as converting the information into the correct units.

Question 31

(a) Most responses indicated some knowledge of cloud chamber observations.

(b) Better responses showed an understanding of radioactive decay equations. They were able to link Pauli's ideas to the work of Fermi. Weaker responses were unable to identify Fermi's ideas on beta decay.

(c) The best responses often included diagrams and/or tables.

The better responses were well balanced answers providing features and characteristics of two or more nuclear technologies developed from the Manhattan project and making a judgement about the significance of their impact on society.

(d) This question was generally well answered by a majority of candidates.

In parts (i) and (ii) the majority of responses identified the correct equations and made the correct substitutions.

(iii) In better responses candidates demonstrated an understanding that only standing waves of integral wavelength supported Bohr's postulate by not losing energy.

Question 32

(a) (i) Most candidates were able to provide the required responses.

(ii) Better responses gave a circuit, a truth-table and a description.

(b) (i) Many responses displayed just a basic op-amp. Few responses gave calculations of resistances or labelled their design of the circuit.

(ii) Most responses identified correctly negative output. Few responses gave correct scaling and identified clipping.

(c) Better responses addressed the key issues of both 'digital images' and 'last ten years', citing relevant examples.

(d) (i) A majority of responses provided appropriate examples to distinguish between the two transducers.

(ii) Few responses identified the key steps of calculating the total current through the resistor.

(iii) This part was generally well answered.

Physics

2005 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
Section I Part A			
1	1	9.2.2.2.1	H9
2	1	9.2.2.2.11	H7
3	1	9.2.2.2.3	H9, H13
4	1	9.2.2.2.10	H9
5	1	9.2.2.2.1	H6
6	1	9.3.2.3.2	H9
7	1	9.3.2.3.1	H9, H14.3 (c)
8	1	9.3.4.3.1	H7, H12.3 (c)
9	1	9.3.2.2.7, 9.3.2.3.4	H7
10	1	9.3.4.3.3	H7
11	1	9.4.1.3.2	H10
12	1	9.4.2.2.3	H10
13	1	9.4.3.2.6	H10
14	1	9.4.2.2.6, 9.4.2.3.4	H7, H12.4 (b)
15	1	9.4.3.2.3, 9.3.1.2.5	H9
Section I Part B			
16	5	9.2.2.2.10, 9.2.2.3.5	H6, H12, H13
17	6	9.2.4.3.4, 9.2.4.2.10	H2, H6, H14
18	4	9.2.4.1	H1, H2, H6, H8, H14
19	4	9.2.3.2.3, 9.2.3.2.2	H6, H9, H14
20	6	9.3.2.3.3, 9.3.2.3.4	H7, H9, H12
21	6	9.3.1.2.2, 9.3.1.3.1, 9.3.3.2.4	H4, H9, H12, H13
22	5	9.3.4.3.2, 9.3.4.2.3, 9.3.3.2.4, 9.4.4.2.5	H4, H7, H9, H12

Question	Marks	Content	Syllabus outcomes
23	3	9.4.2.2.3, 9.4.2.2.4	H1, H10, H14
24	4	9.4.4.2.6	H9, H13, H14
25	6	9.4.2.2.5, 9.4.2.2.6	H7, H10, H12, H13, H14
26	5	9.4.1.3.3, 9.4.1.2.7	H9, H12, H13
27	6	9.4.1.2.5, 9.2.4.3.5, 9.2.2.3.4	H6, H9, H12, H13
Section II **Question 28 — Geophysics**			
28 (a) (i)	2	9.5.2.3.1	H7, H11
28 (a) (ii)	2	9.5.2.2.1	H7, H14
28 (b) (i)	2	9.5.3.3.2	H8, H12
28 (b) (ii)	4	9.5.1.2.2, 9.5.3.2.4	H8, H14
28 (c)	7	9.5.1, 9.5.4.1	H3, H14
28 (d) (i)	2	9.5.2.2.4	H6, H9, H14
28 (d) (ii)	3	9.5.2.2.4	H6, H9, H14
28 (d) (iii)	3	9.5.2.3.2	H6, H9, H14
Section II **Question 29 — Medical Physics**			
29 (a) (i)	2	9.6.3.3.2	H10, H12, H14
29 (a) (ii)	2	9.6.3.2.1	H10, H12, H14
29 (b) (i)	2	9.6.1.3.5	H8, H12, H13
29 (b) (ii)	4	9.6.2.2.1, 9.6.2.2.5	H8, H10
29 (c)	7	9.6.1	H3, H5, H14
29 (d) (i)	2	9.6.4.3.3	H7, H8, H9
29 (d) (ii)	2	9.6.4.2.7	H14
29 (d) (iii)	4	9.6.4.3.4	H9, H10, H14
Section II **Question 30 — Astrophysics**			
30 (a) (i)	2	9.7.3.1, 9.7.3.2.3, 9.7.3.2.4, 9.7.3.2.5	H7, H8, H14
30 (a) (ii)	2	9.7.3.1, 9.7.3.2.3, 9.7.3.2.4, 9.7.3.2.5	H7, H8, H13, H14

Question	Marks	Content	Syllabus outcomes
30 (b) (i)	2	9.7.2.2.1	H6, H13
30 (b) (ii)	4	9.7.4.1	H8, H12, H13
30 (c)	7	9.7.6	H3, H7, H14
30 (d) (i)	2	9.7.5.1, 9.7.5.2, 9.7.5.4	H6, H7, H14
30 (d) (ii)	3	9.7.5.1, 9.7.5.2, 9.7.5.4	H6, H7, H14
30 (d) (iii)	3	9.7.5.1, 9.7.5.2, 9.7.5.4	H6, H7, H12
Section II **Question 31 — From Quanta to Quarks**			
31 (a) (i)	2	9.8.3.3.1	H7, H10, H14
31 (a) (ii)	2	9.8.3.3.1	H7, H10, H14
31 (b) (i)	1	9.8.3.2.4	H10
31 (b) (ii)	2	9.8.3.2.4	H10
31 (b) (iii)	3	9.8.3.2.6	H6, H7, H10, H14
31 (c)	7	9.8.4	H3, H14
31 (d) (i)	2	9.8.1.2.3, 9.8.1.3.3	H7, H8, H10, H12
31 (d) (ii)	3	9.8.2.2.1, 9.8.2.2.4, 9.8.2.3.1	H7, H8, H10, H12
31 (d) (iii)	3	9.8.2.2.1, 9.8.2.2.4, 9.8.2.3.1	H7, H8, H10, H14
Section II **Question 32 — The Age of Silicon**			
32 (a) (i)	2	9.9.5.2.1, 9.9.5.3.1, 9.9.5.3.2	H13
32 (a) (ii)	2	9.9.5.2.2	H13, H14
32 (b) (i)	4	9.9.6.2.5, 9.9.6.3.3, 9.9.6.3.1, 9.9.6.3.2	H13
32 (b) (ii)	2	9.9.6.3.1, 9.9.6.3.2	H13, H14
32 (c)	7	9.9.1.2.3, 9.9.1.3.1, 9.9.7.1	H3, H7
32 (d) (i)	2	9.9.2.2.6, 9.9.3.2.1	H7, H14
32 (d) (ii)	3	9.9.3.2.2, 9.9.2.2.5, 9.9.2.3.3	H12, H14
32 (d) (iii)	3	9.9.3.2.2, 9.9.2.3.3, 9.9.5.2.1	H12, H14

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2005 HSC Physics
Marking Guidelines

Section I, Part B

Question 16 (a)

Outcomes assessed: H12, H6, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly substitutes into relevant formula	2
• Rearranges Kepler's Law of Periods into a ratio of periods OR • Uses the equation from the data sheet and substitutes incorrectly	1

Question 16 (b)

Outcomes assessed: H12, H6, H13

MARKING GUIDELINES

Criteria	Marks
• Correct substitution	3
• Manipulates the equations correctly	2
• Identifies relevant equation	1

Question 17 (a)

Outcomes assessed: H2, H6, H14

MARKING GUIDELINES

Criteria	Marks
• Correctly states one prediction	1

Question 17 (b)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Identifies and provides features and characteristics of the correct experiment	2
• Identifies the correct experiment	1

Question 17 (c)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Names and describes two advances and relates them to the experiment	3
• Names two advances OR • Names and describes one advance and relates it to the experiment	2
• Names one advance	1

Question 18

Outcomes assessed: H1, H2, H6, H8, H14

MARKING GUIDELINES

Criteria	Marks
• Makes a judgement of the impact of the result based on evidence provided	3–4
• Relates the results to Einstein's Special Theory of Relativity	2
• States the result of the Michelson and Morley experiment	1

Question 19

Outcomes assessed: H6, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Presents a logical, coherent argument to support Jim Lovell's statement, for the period after the rocket burn including correct, relevant description of Newton's laws	4
• Describes and explains the relevance of Newton's laws to the solution of the astronaut's problem for the period after the rocket burn	3
• Correctly identifies and relates one of Newton's laws to the situation for the periods either before or after the rocket burn OR • States two of Newton's laws	2
• Correctly states one of Newton's laws	1

Question 20

Outcomes assessed: H7, H9, H12

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of the methods used to assess reliability of information from first hand data or secondary sources • Identifies at least two sources of information • Links methods of assessing the sources of information identified • Describes two applications of induction	5–6
• Outlines methods of assessing reliability of information from first hand or secondary sources • Identifies at least one source of reliable information • Outlines two applications of induction	3–4
• States one method of assessing reliability of information • States one application of induction	1–2

Question 21 (a)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Indicates that there is a repulsive force between the rods AND • Provides reason why the conductor jumps upwards	2
• Provides either of the points above	1

Question 21 (b)

Outcomes assessed: H12, H9, H13

MARKING GUIDELINES

Criteria	Marks
• Correct substitution into correct equations	3
• Correctly relates the two equations	2
• Identifies that magnetic and gravitational force are necessary	1

Question 21 (c)

Outcomes assessed: H4, H9

MARKING GUIDELINES

Criteria	Marks
• Identifies any correct implication	1

Answers could include:

Cables must be far enough apart.
Cables can be designed to minimise the effect of the force.

Question 22 (a)

Outcomes assessed: H9, H12

MARKING GUIDELINES

Criteria	Marks
• Identifies formula and substitutes correctly	1

Question 22 (b)

Outcomes assessed: H4, H7, H9

MARKING GUIDELINES

Criteria	Marks
• Identifies eddy current loss in transformer AND • Identifies resistive losses in transmission line	2
• Identifies eddy current loss in transformer OR • Identifies resistive losses in transmission line	1

Question 22 (c)

Outcomes assessed: H7, H9

MARKING GUIDELINES

Criteria	Marks
• Links superconductivity to zero resistance in eliminating power loss	2
• Identifies what superconductivity means	1

Question 23

Outcomes assessed: H1, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Describes black body radiation and clearly relates this to the resultant change in the direction of scientific thinking	3
• Outlines black body radiation and relates this correctly to the change in direction of scientific thinking	2
• Outlines the correct change in direction of scientific thinking OR • Outlines black body radiation	1

Question 24

Outcomes assessed: H9, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides at least two diagrams with text showing understanding of BCS theory in terms of electron pairs • Correctly identifies role of phonon	4
• Provides two diagrams with text showing understanding of BCS theory in terms of electron pairs	3
• Provides at least one diagram with relevant text showing distortion of lattice	2
• Provides a single labelled diagram of lattice or text to show understanding of concept	1

Question 25 (a)

Outcomes assessed: H7, H10, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Correctly draws line	1

Question 25 (b)

Outcomes assessed: H7, H10, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides correct answer	1

Question 25 (c)

Outcomes assessed: H7, H10, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Must cross x axis at 1.6 eV (or where the first line crossed the axis) • Slope greater than in part (a) but not negative	2
• Must cross x axis at 1.6 eV (or where the first line crossed the axis) OR • Slope greater than in part (a) but not negative	1

Question 25 (d)

Outcomes assessed: H7, H10, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Correctly relates two aspects of their new graph to intensity, number of electrons and minimum energy required (work function)	2
• Correctly relates one aspect of their new graph to intensity, number of electrons or minimum energy required (work function)	1

Question 26 (a)

Outcomes assessed: H9, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly draws electric field lines indicating direction	1

Question 26 (b)

Outcomes assessed: H13

MARKING GUIDELINES

Criteria	Marks
• Correctly substitutes in equation	1

Question 26 (c)

Outcomes assessed: H9, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly relates electrostatic force to weight force, correctly substitutes and correctly identifies sign	3
• Any two of the above	2
• Any one of the above	1

Question 27 (a)

Outcomes assessed: H6, H9, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Equates the centripetal force to the magnetic force	2
• Identifies one appropriate equation	1

Question 27 (b)

Outcomes assessed: H6, H9, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly calculates mass	2
• States the relationship OR • Uses mass dilation formula	1

Question 27 (c)

Outcomes assessed: H6, H9, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Correct substitution in the equation	2
• Correctly identifies the Lorenz transformation	1

Section II

Question 28 (a) (i)

Outcomes assessed: H7, H11

MARKING GUIDELINES

Criteria	Marks
• Identifies both appropriate pieces of equipment used	2
• Identifies an appropriate piece of equipment	1

Question 28 (a) (ii)

Outcomes assessed: H7, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of at least two applications of remote sensing of surface types	2
• States one application	1

Question 28 (b) (i)

Outcomes assessed: H8, H12

MARKING GUIDELINES

Criteria	Marks
• Correct calculation of distance	2
• Statement of speed of sound OR • Extra travel time to Tennant Creek	1

Question 28 (b) (ii)

Outcomes assessed: H8, H14

MARKING GUIDELINES

Criteria	Marks
• Outlines structure and function of equipment • Indicates how data is analysed	4
• Outlines structure AND function of equipment	3
• Outlines structure OR function of equipment	2
• States one technique	1

Question 28 (c)

Outcomes assessed: H3, H14

MARKING GUIDELINES

Criteria	Marks
• Describes current technologies used in measuring Earth's changing magnetic field • Describes principle of plate tectonics • Makes a judgement about the effectiveness of these technologies in providing supporting evidence	6–7
• Describes current technologies used in measuring Earth's changing magnetic field • Describes principle of plate tectonics	4–5
• Outlines a difference between the earth's magnetic field now and in the past • Outlines one area of magnetic evidence for continental drift	2–3
• States a feature of the earth's magnetic field that changes over time	1

Question 28 (d) (i)

Outcomes assessed: H6, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Describes the effects of extra continental mass on the pendulum	2
• Identifies increased gravitational attraction	1

Question 28 (d) (ii)

Outcomes assessed: H6, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Explains how the lower density and less deflection explain the possibility of the continents floating	3
• Outlines why the lower density crust extending deeper deflects the pendulum less	2
• States lower density crust extending deeper	1

Question 28 (d) (iii)

Outcomes assessed: H6, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of variation of period of pendulum across the world • Describes the shape of the earth as a consequence	2–3
• States variation of period of pendulum OR • Describes the shape of the earth	1

Question 29 (a) (i)

Outcomes assessed: H10, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Clearly shows relationship between injection of radioactive isotopes into bloodstream making blocked and cleared arteries visible and how the decay products of radioactivity are detected	2
• Outlines how radioactive decay products are detected using sensors OR • States blocked artery in 'before' scan has been cleared and is visible in 'after' scan	1

Question 29 (a) (ii)

Outcomes assessed: H10, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies the radioisotope and provides one reason for the choice	2
• Correctly identifies the radioisotope OR • Provides one justification for incorrect choice	1

Question 29 (b) (i)

Outcomes assessed: H8, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Substitutes correctly into equation (with or without conversion to a percentage)	2
• Correctly identifies the equation which needs to be used	1

Question 29 (b) (ii)

Outcomes assessed: H8, H10

MARKING GUIDELINES

Criteria	Marks
• States more than one physics principle in each and compares	3–4
• States one physics principle in each and compares	2
• States one physics principle in either x-ray or endoscope	1

Question 29 (c)

Outcomes assessed: H3, H5, H14

MARKING GUIDELINES

Criteria	Marks
• Describes technological advances in ultrasound imaging • Identifies current issues and provides arguments for and/or against the use of this technology (discusses current issue)	6–7
• Describes two or more technological advances and discusses one issue OR • Describes one technological advance and discusses two or more current issues	4–5
• Outlines one technological advance in ultrasound imaging • Outlines one current issue	2–3
• Identifies one current issue OR • Makes a correct statement about ultrasound technology	1

Question 29 (d) (i)

Outcomes assessed: H7, H8, H9

MARKING GUIDELINES

Criteria	Marks
• States the purpose of the superconducting magnetic assembly • States the purpose of the RF coils	2
• States the purpose of the superconducting magnetic assembly OR • States the purpose of the RF coils	1

Question 29 (d) (ii)

Outcomes assessed: H14

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies why gadolinium has been introduced AND • Correctly describes the effect it has had	2
• Correctly identifies why gadolinium has been introduced OR • Correctly identifies what effect gadolinium has had	1

Question 29 (d) (iii)

Outcomes assessed: H9, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies at least two advantages of MRI over CAT scans, particularly in reference to the brain	3–4
• Identifies two advantages of MRI	2
• Identifies one advantage of MRI over CAT	1

Question 30 (a) (i)

Outcomes assessed: H7, H8, H14

MARKING GUIDELINES

Criteria	Marks
• States two differences	2
• States one difference	1

Question 30 (a) (ii)

Outcomes assessed: H7, H8, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies motion of both stars	2
• Identifies motion of one star	1

Question 30 (b) (i)

Outcomes assessed: H6, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly substitutes into appropriate formula	2
• Correctly measures from diagram	1

Question 30 (b) (ii)

Outcomes assessed: H8, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Calculates a value for the ratio of apparent brightness	4
• Correctly identifies formula to obtain ratio of apparent brightness from two apparent magnitudes	3
• Calculates two values for apparent magnitudes OR • Substitutes absolute magnitudes into formula	2
• Correctly identifies formula to convert absolute magnitude to apparent magnitude OR • Correctly identifies formula to obtain ratio	1

Question 30 (c)

Outcomes assessed: H3, H7, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of astrophysical data collection technology • Identifies evolution of stars • Explains link between improved technology and data collection and stellar evolution	7
• Describes astrophysical data collection techniques • Identifies an idea of stellar evolution	5–6
• Describes at least two astrophysical data collection techniques	3–4
• Identifies astrophysical data collection techniques	1–2

Question 30 (d) (i)

Outcomes assessed: H6, H7, H14

MARKING GUIDELINES

Criteria	Marks
• Relates period of variable to absolute magnitude • Relates apparent magnitude to absolute magnitude to calculate distance	2
• One of the above	1

Question 30 (d) (ii)

Outcomes assessed: H6, H7, H14

MARKING GUIDELINES

Criteria	Marks
• Gives reasons for the cause of each of the features *A*, *B* and *C*	3
• Gives reasons for the cause of two of the features *A*, *B* and *C*	2
• Correctly identifies that brighter star of pair is eclipsed at *A* OR • Correctly identifies that dimmer star of pair is eclipsed at *B* OR • Gives a reason for *C* OR • Recognise the eclipsing	1

Question 30 (d) (iii)

Outcomes assessed: H6, H7, H12

MARKING GUIDELINES

Criteria	Marks
• Substitutes correctly and evaluates	3
• Obtains period of rotation from graph	2
• Correctly identifies the appropriate formula	1

Question 31 (a) (i)

Outcomes assessed: H7, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Relates observed features of the tracks to properties of α-particle	2
• Makes a correct statement about alpha particles	1

Question 31 (a) (ii)

Outcomes assessed: H7, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies β or γ radiation AND • Identifies features and characteristics of correct tracks to highlight differences	2
• Identifies β or γ radiation	1

Question 31 (b) (i)

Outcomes assessed: H10

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies mass number	1

Question 31 (b) (ii)

Outcomes assessed: H10

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies nuclide and mass number	2
• Correctly names nuclide OR • Correctly states mass number	1

Question 31 (b) (iii)

Outcomes assessed: H6, H7, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of Pauli's contribution • Outlines Fermi's explanation of beta decay	3
• Outlines Pauli's contribution OR • Outlines Fermi's explanation	2
• States KE not conserved OR • States Pauli's suggested particle	1

Question 31 (c)

Outcomes assessed: H3, H14

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of at least two technologies stemming from the Manhattan Project • Makes a judgement about the significance of the technologies supported by relevant arguments	6–7
• Provides features and characteristics of at least one technology stemming from the Manhattan Project • Outlines the significance of technology	4–5
• Outlines a technology stemming from the Manhattan Project • Identifies the significance of a technology	2–3
• Identifies a technology stemming from the Manhattan Project	1

Question 31 (d) (i)

Outcomes assessed: H7, H8, H10, H12

MARKING GUIDELINES

Criteria	Marks
• Correct substitution in correct formula	2
• Identifies correct formula	1

Question 31 (d) (ii)

Outcomes assessed: H7, H8, H10, H12

MARKING GUIDELINES

Criteria	Marks
• States de Broglie's hypothesis • Correct substitution in correct formula	3
• States de Broglie's hypothesis AND • Identifies correct formula OR • Correct substitution in correct formula	2
• States de Broglie's hypothesis OR • Identifies correct formula	1

Question 31 (d) (iii)

Outcomes assessed: H7, H8, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of de Broglie's hypothesis and gives reasons why it supports the postulates of Bohr's Theory	3
• Outlines de Broglie and Bohr's ideas	2
• Identifies the postulates of either de Broglie or Bohr	1

Question 32 (a) (i)

Outcomes assessed: H13

MARKING GUIDELINES

Criteria	Marks
• Correctly evaluates $\overline{AandB}$	2
• Correctly evaluates *AandB*	1

Question 32 (a) (ii)

Outcomes assessed: H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of a 'half-adder' AND • Draws correct circuit diagram with logic gates	2
• Constructs a truth able for the 'half adder' OR • Outlines term 'half adder' OR • Draws a circuit diagram	1

Question 32 (b) (i)

Outcomes assessed: H13

MARKING GUIDELINES

Criteria	Marks
• Draws correct diagram • Provides features and characteristics of open-loop and closed-loop gain • Calculates correct values for R_1, R_2	4
• Draws correct diagram • Outline of open-loop OR closed-loop gain • Correct values for R_1, R_2	2–3
• Draws basic circuit for inverting amplifier	1

Question 32 (b) (ii)

Outcomes assessed: H13, H14

MARKING GUIDELINES

Criteria	Marks
• Indicates on diagram that output is triangular wave truncated at –15 V	2
• States that output is amplified truncated wave OR • Draws appropriate diagram	1

Question 32 (c)

Outcomes assessed: H3, H7

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of advances in at least two semi conductor technologies and links the advances in technology to new applications	7
• Describes a number of changes in technology and describes applications and makes some attempt to link them	6
• Outlines a number of changes in technology applications	4–5
• Identifies technology changes AND/OR • Identifies applications	1–3

Question 32 (d) (i)

Outcomes assessed: H7, H14

MARKING GUIDELINES

Criteria	Marks
• Distinguishes difference between input and output transducers, giving examples of each	2
• Provides examples of one input and one output transducer	1

Question 32 (d) (ii)

Outcomes assessed: H14, H12

MARKING GUIDELINES

Criteria	Marks
• Correct calculation of R	3
• Identification of currents through both resistors, using correct calculation	2
• Correct use of V = IR	1

Question 32 (d) (iii)

Outcomes assessed: H12, H14

MARKING GUIDELINES

Criteria	Marks
• Correctly calculates voltage at input of inverter and hence calculates 1 or 0 output	3
• Correct use of V = IR to calculate voltages at input of inverter OR • Correct use of not gate	2
• Correct identification of LDR resistances from table OR • Indicates input voltage required for G to give output of 1 or 0	1