BOARD OF STUDIES
NEW SOUTH WALES

2011 HSC Physics
Marking Guidelines

Section I, Part A

Multiple-choice Answer Key

Question	Answer
1	C
2	B
3	B
4	C
5	B
6	C
7	C
8	A
9	B
10	D
11	D
12	A
13	A
14	A
15	C
16	B
17	B
18	B
19	D
20	D

Section I, Part B

Question 21 (a)

Criteria	Marks
• Correctly plots points • Draws line of best fit with similar number of points above and below the line • Correctly estimates electrical resistance	3
• Correctly plots points • Draws lines of best fit with similar numbers of points above and below the line OR • Estimates electrical resistance appropriate for their line	2
• Correctly plots points	1

Question 21 (b)

Criteria	Marks
• Gives judgement about the validity of using the data and supports this with a reason	2
• Gives judgement or reason	1

Question 22 (a)

Criteria	Marks
• Identifies the aim of the experiment	1

Question 22 (b)

Criteria	Marks
• Draws a clearly labelled diagram that indicates: – path of light – key components of apparatus – rotation of apparatus	4
• Draws a clearly labelled diagram that indicates TWO of the following: – path of light – key components of apparatus – rotation of apparatus OR • Draws a diagram that indicates: – path of light – key components of apparatus – rotation of apparatus	3
• Draws a diagram correctly identifying some components and path of light	2
• Draws a diagram correctly identifying some components	1

Question 23 (a)

Criteria	Marks
• Gives a reason for weight change of the satellite	1

Question 23 (b)

Criteria	Marks
• Selects correct equations • Correctly substitutes	2
• Selects correct equations • Incorrectly substitutes	1

Question 23 (c)

Criteria	Marks
• Identifies TWO effects and clearly relates TWO causes of these effects	4
• Identifies TWO effects and relates ONE cause	3
• Identifies TWO effects OR • Identifies ONE effect and its cause	2
• Identifies a cause or an effect	1

Question 24

Criteria	Marks
• Gives reasons why BOTH observations are correct • Outlines the relativity of simultaneity	4
• Gives reasons why ONE observation is correct • Relates this to special relativity	3
• Relates the observations to the concept of special relativity	1–2

Question 25

Criteria	Marks
• Identifies that magnet *B* will leave its tube first and supports this by identifying that the falling magnet results in a changing magnetic flux in the tube walls • Identifies that this will result in eddy currents and breaking effect for magnet *A* (Lenz's Law) • Identifies that because of the slots, there will be smaller eddy currents and no braking for magnet *B*	3–4
• Outlines the production of eddy currents and braking OR • Outlines that eddy currents will not occur in the slotted tube OR • Identifies the correct magnet	1–2

Question 26 (a)

Criteria	Marks
• Draws a correctly labelled diagram that shows the key elements of the electrical distribution system and how they are connected	3
• Draws a labelled diagram that shows some of the key elements of the electrical distribution system and how they are connected	2
• Draws a labelled diagram that shows one of the key elements of the electrical distribution system	1

Question 26 (b)

Criteria	Marks
• Demonstrates coherence and logical progression and includes correct use of scientific principles and ideas • Demonstrates thorough knowledge and understanding of the effects on the environment of the development of AC generators • Provides the cause and effect of at least one significant positive effect and one significant negative effect OR • Provides the cause and effect of at least two significant positive effects OR • Provides the cause and effect of at least two significant negative effects	5–6
• Communicates some scientific principles and ideas in a clear manner • Demonstrates sound knowledge and understanding of the effects on the environment of the development of AC generators • Describes the effects on the environment • Identifies the effects as either positive or negative	3–4
• Communicates simple ideas • Demonstrates a basic knowledge of the effects on the environment of the development of AC generators • Identifies positive AND/OR negative effects	1–2

Question 27 (a)

Criteria	Marks
• Selects correct equation • Correctly substitutes	2
• Selects correct equation • Incorrectly substitutes	1

Question 27 (b)

Criteria	Marks
• Identifies that the magnitude of the forces on either side of the coil is equal • Correctly relates the direction of the current in the coil to the direction of the forces experienced	2
• Identifies the opposing forces on either side of the coil	1

Question 28 (a)

Criteria	Marks
• Identifies an appropriate investigation • Clearly demonstrates how the results support the hypothesis	3
• Identifies an appropriate investigation • Shows some understanding of how the results support the hypothesis	2
• Identifies an appropriate investigation	1

Question 28 (b)

Criteria	Marks
• Describes how the beam is produced, including the role of the: – filament – electrodes – collimator/focusing system	3
• Outlines how the beam is produced, including the role of TWO of the following: – filament – electrodes – collimator/focusing system	2
• Identifies the role of ONE of the following: – filament – electrodes – collimator/focusing system in the production of an electron beam	1

Question 29 (a)

Criteria	Marks
• Selects correct equations • Correctly substitutes	3
• Correctly substitutes to determine photon energy OR • Selects correct equations but makes one error in substitution or incorrectly manipulates formulae	2
• Correctly calculates frequency of the photon OR • Identifies two correct equations	1

Question 29 (b)

Criteria	Marks
• Correctly outlines TWO significant differences	2
• Correctly outlines ONE significant difference	1

Question 30 (a)

Criteria	Marks
• Identifies that higher temperature results in increased lattice vibrations • Relates increased lattice vibrations to a greater number of collisions of the electrons with the lattice and therefore higher resistance	2
• Identifies that higher temperature results in increased lattice vibrations or a greater number of collisions of the electrons with the lattice	1

Question 30 (b)

Criteria	Marks
• Clearly outlines the BCS theory, including: – formation of Cooper pairs – critical temperature – the role of the distortion of the lattice – unimpeded movement of the Cooper pairs through the lattice, resulting in zero resistance	4
• Outlines the BCS theory, including MOST of the following: – formation of Cooper pairs – critical temperature – the role of the distortion of the lattice – unimpeded movement of the Cooper pairs through the lattice, resulting in zero resistance	3
• Outlines the BCS theory, including SOME of the following: – formation of Cooper pairs – critical temperature – the role of the distortion of the lattice – unimpeded movement of the Cooper pairs through the lattice, resulting in zero resistance	1–2

Section II

Question 31 (a)

Criteria	Marks
• Identifies natural hazard and risks • Identifies appropriate instrument • Links use of instrument to reduction of risk	3
• Identifies hazard and instrument OR • Identifies hazard and describes how risk is reduced	2
• Identifies hazard	1

Question 31 (b) (i)

Criteria	Marks
• Identifies magnetic anomaly profile as indicating reversals of magnetic field and radiometric dating as techniques used to date reversals • Provides a method of how this is used to determine spreading rate	3
• Links radiometric dating to anomaly profile but fails to provide description of method	2
• Outlines radiometric dating OR • Outlines reversal of magnetic fields	1

Question 31 (b) (ii)

Criteria	Marks
• Draws correct graph with time axis labelled	2
• Draws correct graph shape	1

Question 31 (c) (i)

Criteria	Marks
• Describes a plausible investigation which includes the use of different wavelengths • Identifies items of apparatus	4
• Describes a plausible investigation but fails to include the use of a second wavelength • Identifies items of apparatus	3
• Describes investigation but fails to give details of apparatus	2
• Lists relevant apparatus	1

Question 31 (c) (ii)

Criteria	Marks
• Outlines method of observation and links observed property to state of vegetation	2
• Outlines method of observation and observed qualities without linking property to state of vegetation	1

Question 31 (d) (i)

Criteria	Marks
• Identifies at least one cause • Relates this to the effect	2
• Identifies one or more causes but fails to relate any effect	1

Question 31 (d) (ii)

Criteria	Marks
• Provides features of survey • Identifies the primary distinction between resource deposit and other surface features • Links this distinction to observed property	3
• Any TWO of the above	2
• Any ONE of the above	1

Question 31 (e)

Criteria	Marks
• Identifies types of waves • Provides a detailed description of wave properties and Earth structure • Links wave properties to deductions regarding Earth structure in a logical and coherent way	6
• Identifies wave properties and relates these to observation • Describes structure of Earth but does not link	4–5
• Provides limited information about each of wave properties and Earth's structure OR • Provides detailed information about only one	2–3
• Provides limited information about one only of wave properties and Earth structure	1

Question 32 (a) (i)

Criteria	Marks
• Correctly identifies the type of scan AND the information that can be obtained from it	2
• Correctly identifies the type of scan OR the information that can be obtained from it	1

Question 32 (a) (ii)

Criteria	Marks
• Identifies that the proportion of ultrasound reflected is determined by the difference in acoustic impedance of the tissues at the boundary • Relates this to the specific scan	2
• Makes a correct, relevant statement about the reflection of ultrasound at a boundary	1

Question 32 (a) (iii)

Criteria	Marks
• Substitutes correctly into both equations to determine the percentage of ultrasound reflected	3
• Uses the two equations correctly but makes an error in substitution	2
• Uses one formula correctly in an attempt to calculate the percentage reflected	1

Question 32 (b) (i)

Criteria	Marks
• States that the production of X-rays involves the conversion of kinetic energy of electrons with the target during the collision • Outlines the TWO ways this occurs	3
• States that the production of X-rays involves the conversion of kinetic energy of electrons • Outlines ONE way this occurs	2
• States that the production of X-rays involves the conversion of kinetic energy of electrons	1

Question 32 (b) (ii)

Criteria	Marks
• Outlines THREE relevant similarities and/or differences between the information provided by the two scans	3
• Outlines TWO relevant similarities and/or differences between the information provided by the two scans	2
• Outlines ONE relevant similarity or difference between the information provided by the two scans	1

Question 32 (c)

Criteria	Marks
• Identifies that a tumour is a region with a greater water (hydrogen nuclei) content than normal tissue. • MRI scans measure hydrogen (proton) density AND therefore an MRI scan is effective in detecting the increased water content of brain tumours	3
• Identifies that a tumour is a region of different water content to the surrounding tissue • MRI scans measure hydrogen density	2
• Identifies that a tumour is a region of different water content OR • MRI scans measure hydrogen density OR • Relevant information about MRI	1

Question 32 (d)

Criteria	Marks
• Outlines the structure of coherent and incoherent optical fibre bundles • Identifies that an incoherent bundle transmits light to illuminate the internal organ • Identifies that a coherent bundle transmits the image of the organ to the observer	3
• Outlines the structure and/or function of coherent bundles • Outlines the structure and/or function of incoherent bundles	2
• Outlines the structure and/or function of coherent bundles OR • Outlines the structure and/or function of incoherent bundles	1

Question 32 (e)

Criteria	Marks
• Demonstrates a thorough understanding of the properties of radioactive isotopes • Describes the use of radioactive isotopes in two scanning techniques • Outlines at least two scanning techniques that use radioactive isotopes to produce an image • Correctly uses scientific principles and ideas to support the given statement • Demonstrates coherence and logical progression	5–6
• Demonstrates a sound understanding of the relevant properties of radioactive isotopes AND EITHER • Identifies TWO relevant scanning techniques OR • Outlines one relevant scanning technique	3–4
• Demonstrates a basic understanding of radioactive isotopes • Identifies at least one relevant scanning technique	1–2

Question 33 (a) (i)

Criteria	Marks
• Provides correct diagram as part of correct definition	2
• Provides correct definition without diagram OR • Provides diagram with incomplete definition	1

Question 33 (a) (ii)

Criteria	Marks
• Relates a reason to sensitivity and a reason to resolution and links the reasons to relevant observations	3
• Relates a reason to sensitivity and a reason to resolution OR • Distinguishes between sensitivity and resolution	2
• Relates a reason to sensitivity or resolution OR • Outlines sensitivity or resolution	1

Question 33 (a) (iii)

Criteria	Marks
• Describes features of a new technology that allow resolution to be improved	2
• Identifies a new technology related to resolution	1

Question 33 (b) (i)

Criteria	Marks
• Correctly identifies the key process in both stars • Provides a similarity between them and a characteristic of the differences between them	3
• Identifies the two processes and relates them to the correct star OR • Identifies characteristics of the differences between the processes OR • Correctly identifies the process in one star and one feature or characteristic	2
• Identifies a difference between the processes	1

Question 33 (b) (ii)

Criteria	Marks
• Correct substitution into the correct formula	2
• Incorrect substitution into correct formula	1

Question 33 (b) (iii)

Criteria	Marks
• Correctly identifies brighter star and correct substitution into correct formula	2
• Correct substitution into correct formula OR • Correctly identifies equation and which star is brighter	1

Question 33 (c)

Criteria	Marks
• Distinguishes between an intrinsic and extrinsic variable • Names a Cepheid as an intrinsic variable star and names a type of extrinsic variable star • Links the properties of the stars to the type of variable	3–4
• Distinguishes between an intrinsic and extrinsic variable AND EITHER • Names a Cepheid as an intrinsic variable star and names a type of extrinsic variable star OR • Links the properties of the stars to the type of variable OR • Names an intrinsic or extrinsic variable star and links its properties to the type of variable	2
• Distinguishes between intrinsic and extrinsic variables OR • Gives a definition of an intrinsic OR extrinsic variable OR • Names a Cepheid as an intrinsic variable and names another type of variable star	1

Question 33 (d)

Criteria	Marks
• Shows extensive knowledge of the type of information obtained by spectroscopy and photometry • Shows limitations of using spectroscopy by itself • Gives examples of when spectroscopy and photometry combined lead to a much greater understanding of stars • Shows a coherent and logical progression	6–7
• Describes the information obtained by spectroscopy and the type of information that can be found by photometry	4–5
• Identifies some information found by spectroscopy and some information that is found by photometry	3
• Identifies some information about stars that can be found from spectroscopy or photometry	1–2

Question 34 (a)

Criteria	Marks
• Names a radioisotope that is used in agriculture • Describes its use	2
• Names a radioisotope OR • Identifies a use	1

Question 34 (b) (i)

Criteria	Marks
• Describes the relationship between neutrons, their exposure to a moderator and the number of control rods in the reactor vessel and the resulting rate of reaction	4
• Outlines any TWO of the above factors AND describes their relationship to the reaction rate OR • Outlines all THREE factors	3
• Outlines ONE factor and its relationship to the reaction rate OR • Outlines TWO factors	2
• Outlines ONE factor	1

Question 34 (b) (ii)

Criteria	Marks
• States that the mass of products is less than the mass of reactants • States the relationship to $E = mc^2$	2
• States either one of the above	1

Question 34 (c)

Criteria	Marks
• Completes the table correctly	3
• Completes 2/3 or more of the table correctly	2
• Completes between 1/3 and 2/3 correctly	1

Question 34 (d)

Criteria	Marks
• Selects correct formula • Correct substitution	2
• Selects correct formula	1

Question 34 (e)

Criteria	Marks
• Correctly states the number of up and down quarks and leptons	2
• Correctly calculates the number of TWO of the above three amounts	1

Question 34 (f)

Criteria	Marks
• Clearly and accurately outlines the important contributions made by Heisenberg and Pauli	4
• Clearly and accurately outlines ONE contribution and identifies another	3
• Accurately outlines two contributions	2
• Outlines one contribution	1

Question 34 (g)

Criteria	Marks
• Clearly describes and justifies examples of mathematical models that have been validated by experimental evidence which relate to Bohr and/or de Broglie	5–6
• Describe Bohr's and de Broglie's models	3–4
• Describes one mathematical model and/or one example of experimental evidence	2–3
• Demonstrates some knowledge of models of the atom	1

Question 35 (a)

Criteria	Marks
• Constructs a valid truth table for the situation • Correctly enters all elements in the table	3
• Constructs a valid truth table for the situation • Correctly enters the majority of the elements in the table	2
• Constructs a valid truth table for the situation OR • Shows some understanding of the correct elements in the table	1

Question 35 (b)

Criteria	Marks
• Explains that no feedback circuit is present • Shows understanding that this implies an open loop only	2
• Explains that no feedback circuit is present OR • Shows understanding that the circuit configuration is open loop	1

Question 35 (c)

Criteria	Marks
• Identifies correct formula • Correctly substitutes variable to arrive at algebraic answer	2
• Identifies correct formula • Incorrectly substitutes variables	1

Question 35 (d)

Criteria	Marks
• Correctly identifies that the LED lights up when $O_{Ø} = 0$ • Correctly identifies that $O_{Ø} = 0$ for a range of V_{in} values set by the potential divider in Question 35 (c) AND • Correctly connects this to a range of V_{batt} values through the potential divider in Question 35 (c)	3
• Correctly identifies that the LED lights up when $O_{Ø} = 0$ • Shows understanding that this corresponds to a range of V_{batt} voltages through the potential dividers in Question 35 (c)	2
• Shows understanding that the state of output $O_{Ø}$ is related to the value of V_{batt} or V_{in}	1

Question 35 (e) (i)

Criteria	Marks
• Draws a clear labelled diagram that describes all the key elements of an LED	3
• Draws a clear labelled diagram that describes the majority of the elements of an LED OR • Draws an unclear diagram that describes all the key elements of an LED	2
• Draws a diagram that demonstrates an understanding of the construction of an LED	1

Question 35 (e) (ii)

Criteria	Marks
• Identifies one advantage • Identifies one disadvantage	2
• Identifies one advantage OR • Identifies one disadvantage	1

Question 35 (f)

Criteria	Marks
• Identifies in clear language three key optical properties that are desirable	3
• Identifies at least two key optical properties that are desirable	2
• Shows understanding of the desirable optical properties	1

Question 35 (g)

Criteria	Marks
• Provides a clear and concise explanation of the fundamental physics limitations that restrict the reduction in size and speed of digital integrated circuits • Makes a clear connection between these size/speed limitations and the operation of computers • Makes a clear connection between the limitations and the need to fundamentally change the way computers are designed	6–7
• Provides an explanation of the key physics limitations of size reduction and speed increase on digital circuits AND • Connects these limitations to the operation of computers OR • Makes a connection between the limits and the need to change the design of computers	4–5
• Shows some understanding of the limitations that physics places on the operation and the design of computers	1–3

Physics

2011 HSC Examination Mapping Grid

Section I
Part A

Question	Marks	Content	Syllabus outcomes
1	1	9.2.2.2.11	H9
2	1	9.2.1.2.3, 9.2.3.3.2	H9
3	1	9.4.4.2.2	H10
4	1	9.4.3.2.2	H9, H10
5	1	9.3.4.2.4	H7
6	1	9.3.2.2.4	H9
7	1	9.4.1.3.3	H9
8	1	9.2.2.2.7, 9.2.2.2.5	H9
9	1	9.2.4.2.9	H6
10	1	9.3.1.2.2	H9, H11
11	1	9.3.2.3.2, 9.3.2.3.3	H9
12	1	9.3.1.2.4, 9.3.1.2.5	H9
13	1	9.4.3.2.6	H10
14	1	9.3.2.2.3	H9
15	1	9.2.2.3.1	H6
16	1	9.2.2.2.10	H9
17	1	9.4.2.2.5	H10, H13, H14
18	1	9.3.1.3.4	H9
19	1	9.4.2.1.6, 9.4.2.1.7	H6, H9
20	1	9.2.1.2.3, 9.2.3.3.2	H9

Section I
Part B

Question	Marks	Content	Syllabus outcomes
21 (a)	3	9.4.4.2.4	H13, H14
21 (b)	2	9.4.4.2.4	H12, H14
22 (a)	1	9.2.4.2.2, 9.2.4.2.3	H8
22 (b)	4	9.2.4.2.2, 9.2.4.2.3	H13
23 (a)	1	9.2.1.2.1	H9
23 (b)	2	9.2.2.2.10, 9.2.2.3.4	H9
23 (c)	4	9.2.2.2.10, 9.2.2.2.11, 9.2.2.3.5	H9
24	4	9.2.4.2.9	
25	4	9.3.2.2.7	H9
26 (a)	3	9.3.3	H7, H9
26 (b)	6	9.3.3.2.5	H4
27 (a)	2	9.3.1.3.3	H9, H12

27 (b)	2	9.3.1.2.5	H6, H9
28 (a)	3	9.4.1.3.2	H2, H10
28 (b)	3	9.4.1.2.9	H9
29 (a)	3	9.4.2.3.4	H7, H10, H12
29 (b)	3	9.4.2.2.5	H10
30 (a)	1	9.4.4.2.4	H10
30 (b)	4	9.4.4.2.6	H9

Section II

Question	Marks	Content	Syllabus outcomes
Question 31 — Geophysics			
31 (a)	3	9.5.5.2.2	H4, H7, H9
31 (b) (i)	3	9.5.4.3.2	H9, H14
31 (b) (ii)	2	9.5.4.3.2	H9, H14
31 (c) (i)	4	9.5.2.3.1, 9.5.2.2.1	H3, H8, H14
31 (c) (ii)	2	9.5.2.2.2	H3, H8, H14
31 (d) (i)	2	9.5.2.2.4, 9.5.1.3.1	H9
31 (d) (ii)	3	9.5.2.2.9	H9
31 (e)	6	9.5.3.2.1, 9.5.3.2.2, 9.5.3.2.3, 9.5.3.2.5, 9.5.3.2.6	H8
Question 32 — Medical Physics			
32 (a) (i)	2	9.6.1.2.7	H8
32 (a) (ii)	2	9.6.1.2.3, 9.6.1.2.4, 9.6.1.2.5	H7, H8
32 (a) (iii)	3	9.6.1.3.5	H7, H8
32 (b) (i)	3	9.6.2.2.1	H9, H10
32 (b) (ii)	3	9.6.2.3.2	H10
32 (c)	3	9.6.4.3.2	H9
32 (d)	3	9.6.2.2.5, 9.6.2.2.6, 9.6.2.2.7	H3, H10
32 (e)	6	9.6.3.all	H3, H4
Question 33 — Astrophysics			
33 (a) (i)	2	9.7.2.2.1	H13.1d
33 (a) (ii)	3	9.7.1.2.3, 9.7.2.1.2.1	H3, H10
33 (a) (iii)	2	9.7.1.2.5	H3, H10
33 (b) (i)	3	9.7.6.2.3, 9.7.6.3.3	H7
33 (b) (ii)	2	9.7.4.3.1	H12
33 (b) (iii)	2	9.7.4.3.1	H12
33 (c)	4	9.7.5.2.3	H12
33 (d)	7	9.7.4.2.2, 9.7.5.2.4, 9.7.5.2.2, 9.7.6.2.5, 9.7.6.3.2, 9.7.2.2.3	H10

Question 34 — From Quanta to Quarks			
34 (a)	2	9.8.4.3.2	H3
34 (b) (i)	4	9.8.4.2.1, 9.8.3.2.11	H7
34 (b) (ii)	2	9.8.3.2.9	H7
34 (c)	3	9.8.4.2.5	H9
34 (d)	2	9.8.2.3.1	H8
34 (e)	2	9.8.4.2.5, 9.8.3.2.1	H12
34 (f)	4	9.8.2.3.2	H2
34 (g)	6	9.8.1, 9.8.2	H2
Question 35 — The Age of Silicon			
35 (a)	3	9.9.5.3.1	H12
35 (b)	2	9.9.6.2.5	H9
35 (c)	2	9.9.2.3.3	H9, H12
35 (d)	3	9.9.6.3.1, 9.9.2.3.3, 9.9.6.3.5	H12
35 (e) (i)	3	9.9.4.2.3	H9
35 (e) (ii)	2	9.9.4.3.3	H9
35 (f)	3	9.9.1.3.2	H10
35 (g)	7	9.9.7.2.2, 9.9.7.3.1	H3, H4, H5, H8