2012 Physics

Standard Grade − General

Finalised Marking Instructions

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Part One: General Marking Principles for Physics Standard Grade – General

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the specific Marking Instructions for each question.

(a) Marks for each candidate response must always be assigned in line with these general marking principles and the specific Marking Instructions for the relevant question. If a specific candidate response does not seem to be covered by either the principles or detailed Marking Instructions, and you are uncertain how to assess it, you must seek guidance from your Team Leader/Principal Assessor.

(b) Guidance for using marking instructions for Standard Grade Physics General level.

The Physics **General Marking Instructions** (GMI) provide guidance on marking issues.
http://www.sqa.org.uk/files_ccc/Physics_General_Marking_Instructions.pdf

When marking Standard Grade Physics, there are common issues which arise when considering candidates' answers.

There is often a range of acceptable answers which would sensibly answer a particular question. However, it is often difficult to anticipate all correct or partially correct responses to questions.

The Principal Assessor and Team Leaders study a large sample of candidates' scripts and use the responses to refine the Marking Instructions (MIs) to include guidance on how to interpret different responses.

The answers given in the MIs represent ideal answers.
Additional acceptable answers are also given in the MIs to offer guidance to assist interpreting candidates' answers.
Also, advice on answers which are NOT acceptable or only attract partial marks may also be given in the MIs for some questions.

Markers are reminded that marks for each candidate response must always be assigned in accordance with these general marking principles and the specific Marking Instructions for the relevant question.

Common issues with candidates' responses:

Spelling:

The incorrect spelling of technical terms should be ignored and candidates should be awarded the relevant mark. If answers can be interpreted and understood without any doubt as to the meaning, then the answer should be marked according to the MIs.
However, care should be taken to ensure that the incorrect spelling does not make the response ambiguous, leading to possible 'wrong physics'.
One notable exception is for questions requiring the responses 'reflection', 'refraction' or 'diffraction'. The spelling of these words is similar, but the words have totally different meanings. If the spelling (or handwriting) in an answer makes it difficult for you to interpret a candidate's intention, then do not award the mark.

Units:

For ***non-numerical*** answers which require a unit to be ***stated*** in an answer, the incorrect spelling of the unit is not usually penalised (if the unit can be clearly identified) eg:

'What is the correct unit for the activity of a radioactive source?' Answer: 'Becquerels'.
The answer: 'beckerels' would be acceptable.
Examples of other common misspellings: Seeverts, decibelles, Diopiters.

Also for ***non-numerical*** answers, do not penalise upper/lower casing when the abbreviated version is given eg DB, sV, hZ, bq.

However, for ***numerical answers,*** care must be taken to ensure that the unit has the correct prefix. eg for an answer t = 0·005 seconds, t = 5 ms is acceptable but NOT t = 5 Ms.

It should be noted that, in any part of a question, multiple unit errors or conversion errors / omissions should only be penalised once (deduct maximum ½ mark).

e.g. when calculating speed from distance and time , and answer required to be in m/s:
If d = 4 km
t = 2 minutes

$$v = \frac{d}{t} \quad (\tfrac{1}{2})$$

$$= \frac{400}{2} \quad (\tfrac{1}{2})$$

$$= 200 \quad (\tfrac{1}{2})$$

Although the candidate has made three unit errors (not correctly converted distance or time and has omitted the final unit) this would only attract **½ mark unit penalty.**

Some common units often attract wrong abbreviations in answers to numerical questions. When the abbreviation can be confused with a different unit then this would attract a unit penalty eg sec or secs as an abbreviation for seconds is NOT acceptable.

Common units and abbreviations:	
Acceptable unit/Abbreviation	*NOT acceptable version*
second, s	sec, secs
ampere, amp, amps, A, a	
metres per second, m/s, ms^{-1},	mps, m/s^{-1}
metres per second per second, m/s/s, m/s^2 , ms^{-2}	mpsps, m/s^{-2}

Standard form:
Candidates may fail to express an answer in standard form correctly.
For an answer t = 400 000 s, then $t = 4 \times 10^5$ s would be correct but $t = 4^5$ s would be treated as an arithmetic error (deduct (½)).

Relationship (equation) selection:

No marks should be awarded if a 'magic triangle' eg

was the only statement in a candidate's response.

The correct relationship must be stated eg V = IR or $R = \frac{V}{I}$ etc. to gain (½) mark.

'Dotted line.' : - - - - - - - - - - - - - - -

A dotted line immediately above an answer in the MIs indicates that the answer requires use of an answer (or value) calculated or stated in a previous part of the question.
If the candidate's answer in the previous part of the question is wrong, this wrong answer may be used by the candidate in the subsequent part of the question. If the subsequent answer is correctly completed, then full marks may be awarded.
Where a question requires a Data value and the candidate has selected the wrong value, the candidate may use either the wrong value given OR the correct data value in the subsequent answer and could gain full marks if correctly completed.
Example:

(a) What is the speed of microwaves?
Candidate's answer: 340 m/s This answer would attract zero marks.

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(b) What distance would be travelled by these microwaves in 0.34 seconds?
Candidate may use either the value given in part (a) OR the correct value for the speed of microwaves and could gain full marks if correctly completed.

Marking from Image Issues:

When marking candidates' scripts on screen, it is important to start by checking the 'full response view' in case answers are continued elsewhere outside the answer boxes or spaces provided and to identify unreadable responses.

Also, for each candidate, the end of the script (up to very last page) should be checked for any answers completed at the end. Candidates may not indicate that an answer is continued at the end of the script.

If an answer or part of an answer is unreadable, the marker should then click the " ! " button *to raise an exception.*

This process is illustrated by :

SQA Academy, My Courses, e-marking 2012, Topic 4, Section 7 – Communications.

Or Scoris Assessor Guide , page 76-80.

Candidates are advised in the 'Your Exams ' booklet to cross out any rough work when they have made a final copy. However, crossed-out work must be marked if the candidate has not made a second attempt to answer the question. When a second attempt has been made, or started, the crossed-out marking should be ignored.

PART (c)

Part (c) below sets out how to apportion marks to answers requiring calculations.
These are the '**standard two marker**' type of questions.

Unless a numerical question specifically requires evidence of working to be shown, full marks should be given for a ***correct*** answer to a numerical question even if the steps are not shown explicitly. The individual marks shown in **part (c)** are for use when marking partially correct answers.

Markers who are new to marking Standard Grade Physics should study these issues closely, since the guidance illustrates common faults in candidates' answers to the 'standard two marker' type of question. Items 1-15 below illustrate how to apportion marks accordingly.

Experienced markers should also re-acquaint themselves with these examples before marking.

For some questions requiring numerical calculations, there may be alternative methods (eg alternative relationships) which would lead to a correct answer.

These alternative methods of reaching the answer and how to apportion marks are also included in the specific MIs for these questions.

Sometimes, a question requires a calculation which does not fit into the 'standard two marker' type of response. Full guidance on how to apportion marks will be given in the MIs for that specific question.

Part (c)

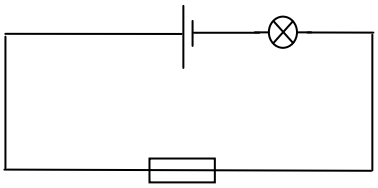
Physics – Marking Issues

The current in a resistor is 1·5 amperes when the potential difference across it is 7·5 volts. Calculate the resistance of the resistor.

	Answers	**Mark + Comment**	**Issue**
1.	$V=IR$ $7{\cdot}5=1{\cdot}5R$ $R=5{\cdot}0\ \Omega$	(½) (½) (1)	Ideal answer
2.	$5{\cdot}0\ \Omega$	(2) Correct answer	GMI 1
3.	$5{\cdot}0$	(1½) Unit missing	GMI 2 (a)
4.	$4{\cdot}0\ \Omega$	(0) No evidence/wrong answer	GMI 1
5.	_____ Ω	(0) No final answer	GMI 1
6.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=4{\cdot}0\Omega$	(1½) Arithmetic error	GMI 7
7.	$R=\frac{V}{I}=4{\cdot}0\Omega$	(½) Formula only	GMI 4 and 1
8.	$R=\frac{V}{I}=$ _____Ω	(½) Formula only	GMI 4 and 1
9.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=$ _____Ω	(1) Formula + subs/No final answer	GMI 4 and 1
10.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=4{\cdot}0$	(1) Formula + substitution	GMI 2 (a) and 7
11.	$R=\frac{V}{I}=\frac{1{\cdot}5}{7{\cdot}5}=5{\cdot}0\Omega$	(½) Formula but wrong substitution	GMI 5
12.	$R=\frac{V}{I}=\frac{75}{1{\cdot}5}=5{\cdot}0\Omega$	(½) Formula but wrong substitution	GMI 5
13.	$R=\frac{I}{V}=\frac{7{\cdot}5}{1{\cdot}5}=5{\cdot}0\Omega$	(0) Wrong formula	GMI 5
14.	$V = IR\quad 7{\cdot}5 = 1{\cdot}5 \times R\quad R = 0{\cdot}2\ \Omega$	(1½) Arithmetic error	GMI 7
15.	$V = IR$ $R=\frac{I}{V}=\frac{1{\cdot}5}{7{\cdot}5}=0{\cdot}2\Omega$	(½) Formula only	GMI 20

Part Two: Marking Instructions for each Question

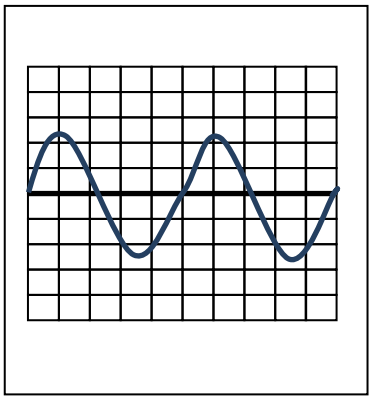
Question			Expected Answer/s	Max Mark	Additional Guidance
1			A	**1**	Accept any clear indication of the letter of an answer e.g circling the letter, writing the answer in the box.
2			C	**1**	
3			D	**1**	
4			B	**1**	
5			A	**1**	
6	**a**	**i**	microphone	**1**	
6	**a**	**ii**	Sound to electrical (energy)	**1**	Accept: • 'Electric' Do Not accept: • 'electricity'. No half marks: (1) or (0)
6	**b**	**i**	B	**1**	0 marks if other patterns also given
6	**b**	**ii**	D	**1**	0 marks if other patterns also given
7	**a**		$\text{wavelength} = \frac{\text{total distance}}{\text{number of waves}}$ (½) $= \frac{2 \cdot 5}{5}$ (½) $= 0 \cdot 5$ metres (1)	**2**	**Not standard 2 marker**, If wrong number of waves is counted and clearly identified/stated **and** if 2·5 divided by this wrong number is shown then (½) (max) for implied equation. eg 2.5/10 =0.25 m award ZERO marks BUT No. Of waves = 10 2.5/10 =0.25m AWARD ½ mark for implied formula Deduct (½) for wrong/missing unit in final answer. Accept abbreviated units: m Watch for use of $\lambda = v/f$ with correct answer: this is wrong Physics: award (0)
7	**b**		$v = f\lambda$ (½) $= 2 \times 0 \cdot 5$ (½) $= 1$ metre per second (1)	**2**	Must use answer from 7(a) or fresh start with correct value for wavelength. deduct (½) for wrong/missing unit accept abbreviated units: m/s, $m\,s^{-1}$
7	**c**		Energy is lost (from wave as it moves)	**1**	Answer should indicate energy being lost Accept : • (kinetic) energy lost

Question			Expected Answer/s	Max Mark	Additional Guidance
8	**a**		$V = IR$ (½) $230 = 1 \cdot 25 \times R$ (½) $R = 184$ ohms (1)	**2**	deduct (½) for wrong/missing unit accept symbol: Ω
8	**b**		$E = Pt$ (½) $= 1 \cdot 6 \times 8 \times 7$ (½) $= 89 \cdot 6$ (kilowatt - hours) (1)	**2**	Correct units: Kilowatt-hour(s), kWh If no multiplication by 7 days then treat as unit penalty deduct (½) Units **NOT** required but if wrong unit given then deduct (½) If P = 1600 watts and/or no multiplication by 7, treat as one unit error max (i.e. deduct ½) If the equation has not been stated, the implied formula (½ mark) can only be given if 8 is present in the substitution.
8	**c**			**2**	(½) cell/s or battery symbol (½) correct lamp symbol (1) for connected in a complete series circuit Accept any number of cells but they must be **shown** to be connected correctly together to be awarded the battery symbol (½) mark. Deduct (½) if additional components shown

Question			Expected Answer/s	Max Mark	Additional Guidance
9	**a**		(In the) filament OR (resistance) wire	**1**	NOT "tungsten" alone Answer must clearly relate to the filament
9	**b**		Less energy is transformed/changed into heat OR more energy transformed/changed into light	**1**	Accept: Any answer that refers to the amount of heat/ light produced by each lamp • More energy transformed into light • Less energy wasted/given off as heat • Less energy transformed into heat Do NOT accept: • Lasts longer • "Less energy wasted/lost" alone
9	**c**		$P = IV$ (½) $= 5 \times 12$ (½) $= 60$ watts (1)	**2**	deduct (½) for wrong/missing unit accept abbreviated units: W accept joules per second
9	**d**	**i**	Mains (electricity) supply/cable/ socket/plug/flex/appliance/kettle too close to water/sink/tap OR implication of the above, e.g. splashing of water onto kettle	**1**	**The response required for this part must relate to proximity.** Must link mains (electricity) supply/kettle and water/sink Do NOT accept "electricity" alone eg "electricity too close to sink" Disregard any other information in candidate response.
9	**d**	**ii**	Risk of shock/electrocution	**1**	**The response required for this part must relate to risk of shock/electrocution.** Do NOT accept answers in terms of water being a good conductor alone Do NOT accept "wet hands are close to a plug/socket" Disregard any other information in candidate response.
10	**a**		Neutron (GIVEN) proton(s) electron(s)	**1**	(½) for each correct
10	**b**	**i**	Gamma (rays/particles) OR γ symbol	**1**	
10	**b**	**ii**	Alpha (rays/particles) OR α symbol	**1**	

Question			Expected Answer/s	Max Mark	Additional Guidance
10	**c**		• Geiger Muller tube OR • Geiger Muller counter OR • Geiger counter OR • GM tube OR • GM counter OR • Photo(graphic) film/plate OR • Scintillation counter OR • Film badge	**1**	Any acceptably recognised detector

Question			Expected Answer/s	Max Mark	Additional Guidance
11	**a**	**i**	<table><tr><td>**Type** of radiation</td></tr><tr><td></td></tr><tr><td>**Answer**: X-Rays (x rays)</td></tr><tr><td></td></tr><tr><td>**Answer**: Ultra violet OR infra red</td></tr></table>	**1**	(1) or (0): Must have both entries correct Accept: • Uv/UV • Ir/IR <u>Do not accept:</u> Laser light
11	**a**	**ii**	<table><tr><td>**Use** of radiation</td></tr><tr><td>**Answer:** thermograms</td></tr><tr><td></td></tr><tr><td>**Answer:** treatment of cancer</td></tr><tr><td></td></tr></table>	**1**	(1) or (0): Must have both entries correct **For infra red** Accept: • muscle / tissue treatment • detect/treat tumours • body heat scans • measure/check temperature Do not accept: • 'Temperature' alone **For gamma** Accept: • Used as tracer • Destroy tumours • Sterilisation • Radiotherapy Do not accept: • Detect tumours
11	**b**	**i**	• laser scalpel OR • remove birth marks OR • vapourise/treat tumours OR • treat acne OR • removal of tattoos OR • eye surgery	**1**	
11	**b**	**ii**	 Laser light 1 mark for showing total internal reflection. 1 mark for 'quality'.	**2**	Quality mark lost if: • Not passably straight lines • Incoming ray does not continue as a passably straight line • More than 5 reflections shown Note: arrows, normals NOT required

Question			Expected Answer/s	Max Mark	Additional Guidance
12	**a**		(loud)speaker	**1**	
12	**b**		Signal from microphone  Figure 1	**2**	(1) mark for smaller amplitude – less than 4 boxes –allow some non uniformity of amplitude –but less than 4 boxes (1) mark for 2 crests and 2 troughs. Allow some distortion in the shape of waves.
12	**c**		$\text{Voltage Gain} = \frac{\text{voltage out}}{\text{voltage in}}$ (½) $= \frac{2 \cdot 25}{0 \cdot 25}$ (½) $= 9$ no unit (1)	**2**	Deduct (½) if any unit **IS** given Accept: 9 times OR 9x
13	**a**	**i**	• Change OR • Increase OR • decrease in temperature/heat	**1**	Accept: • 'heating it' • 'cooling it' Accept "temp" as abbreviation for temperature • Do NOT accept: "temperature" or "heat" alone
13	**a**	**ii**	(electronic) switch	**1**	Accept **implication** of switch action. Do not accept any answers which refer to voltage "flowing" which is wrong Physics and attracts (0) marks Any other extra information may be ignored.
13	**a**	**iii**	Lamp/bulb/light will come on/go off	**1**	

Question			Expected Answer/s	Max Mark	Additional Guidance
13	**a**	**iv**	accept any suitable application where temperature needs to be monitored	**1**	Accept: • greenhouse OR • incubator OR • car engine OR • oven OR • freezer OR • heating system Note: the circuit can be used to detect when temperature is becoming hotter OR colder.
13	**b**		• 7 segment display OR • LED OR • relay OR • solenoid	**2**	Any 2 correct, 1 mark each correct Apply ± rule if more than 2 answers given and wrong answers included

Question			Expected Answer/s	Max Mark	Additional Guidance
14	**a**		$a = \frac{\Delta v}{t}$ (½) $= \frac{18}{6}$ (½) $= 3$ metres per second per second (1)	**2**	deduct (½) for wrong/missing unit other acceptable units: m/s/s, m/s^2 , m s^{-2} Or accept $a = \frac{v-u}{t}$ If incorrect relationship stated (eg a = v/t) stop marking and award (0) marks . Candidates who start with a =18/6 have not shown an incorrect relationship so should not be penalised
14	**b**		$d = vt$ (½) $= 18 \times 5 \times 60$ (½) $= 5400$ metres (1)	**2**	deduct (½) for wrong/missing unit if *t* not converted into seconds then unit penalty- deduct (½) Accept use of S = D/T as initial formula even if substitution is incorrect.
14	**c**		Seat belt exerts a decelerating/ backwards/ unbalanced force on/ against the driver (1) This decelerates/slows down/stops the driver (1)	**2**	**The response required must relate to an opposing force on the driver and the driver's motion.** 2 independent marks *ie* Candidate must give: • A correct statement describing a force opposing the driver's motion • A correct statement describing the driver's movement <u>For force mark:</u> Do NOT accept: • answer in terms of seat belt **pulling** driver back. • answer in terms of equal and opposite forces An answer based on *not* wearing a seatbelt <u>could</u> be worth 1 or 2 marks, eg • "driver would keep moving until he hits the windscreen (1) • because there's no force to stop him" (1)

Question			Expected Answer/s	Max Mark	Additional Guidance
15	**a**		$E_P = mgh$ (½) $= 55 \times 10 \times 10$ (½) $= 5500$ joules (1)	**2**	deduct (½) for wrong/missing unit If g = 9.8, E_p = 5390 J If g = 9.81, E_p = 5395.5 J
15	**b**		$P = \frac{E}{t}$ (½) $= \frac{5500}{11}$ (½) = 500 watts (1)	**2**	Must use answer from 15(a) or correct answer deduct (½) for wrong/missing unit If E_p = 5390, P = 490 W If E_p = 5395.5, P = 490.5 W
15	**c**		crumpled (1) (will hit first as it is) more streamlined/aerodynamic OR less **air** resistance/surface area (in contact with the air) (1)	**2**	First mark is only available if an explanation is attempted (even if explanation is wrong)
16	**a**	**i**	Any one from: • b: double glazing • c: loft insulation • d: cavity wall insulation	**1**	Apply ± rule if more than 1 answer given and wrong answers included Accept the written version of the answer instead of the letter if correct.
16	**a**	**ii**	Any one from: • a: draught proofing • c: loft insulation • d: cavity wall insulation • e: reduce room height	**1**	Apply ± rule if more than 1 answer given and wrong answers included. Accept the written version of the answer instead of the letter if correct.
16	**b**	**i**	Braemar	**1**	only acceptable response.
16	**b**	**ii**	Temperature difference (between the inside and the outside of the house) is greatest / largest / biggest OR (Temperature) difference is 15^OC (unit required)	**1**	Answer must refer to temperature **difference.**
16	**c**		(the metal cubes are) different: • sizes OR • volumes OR • shapes (the thermometers are at) different distances (from cubes)	**2**	(1) for each correct reason. Do not accept answers relating to colour (given in question).

Question			Expected Answer/s	Max Mark	Additional Guidance
17	**a**		<table><tr><td>Renewable</td><td>Non-renewable</td></tr><tr><td>Wind</td><td>coal</td></tr><tr><td>Solar</td><td>oil</td></tr><tr><td>Wave</td><td>gas</td></tr><tr><td>Hydro</td><td></td></tr></table>	**2**	2 marks for 7 correct entries in table . 1 ½ marks for 6 correct entries 1 mark for 5 correct entries ½ mark for 4 correct entries 0 marks for ≤ 3 correct entries
17	**b**		chemical to heat (energy)	**1**	1 or 0 no (½) marks Arrow, dash, "to" all acceptable "chemical potential" is acceptable but not "potential" alone
17	**c**	**i**	$\text{number of schemes} = \frac{3960}{440}$ (½) $= 9$ (*schemes*) (½)	**1**	award full mark if correct answer is given without working does not require to state 'power stations'
17	**c**	**ii**	$\text{total mass of water} = 200 \times 22 \times 60 \times 60$ $= 15840000$ kg (1)	**1**	If final answer is incorrect, award (½) mark if calculation shows or implies a multiplication of 200 and 22. deduct (½) for wrong/missing unit
18	**a**		300 000 000 metres per second OR 3×10^8 metres per second	**1**	Unit required 1 or 0 NOT; 'same as the speed of light'
18	**b**	**i**	Prism	**1**	Do not accept "triangle" on its own. Do not accept "diffraction prism" Glass/plastic/triangular prism acceptable.
18	**b**	**ii**	Refraction	**1**	Only acceptable answer Not: 'defraction':
18	**b**	**iii**	X red R Y green OR G Z blue B	**2**	All 3 correct – 2 marks 2 correct – 1 mark 1 correct – (½) mark

Question			Expected Answer/s	Max Mark	Additional Guidance
19	**a**		The gas AND/OR water exerts a force upwards on the container	**1**	(½) for each correct entry • Gas or water or both (½) mark • Upwards (½) mark
19	**b**	**i**	$W = mg$ (½) $= 0 \cdot 05 \times 10$ (½) $= 0 \cdot 5$ newtons (1)	**2**	g = 9.8: 0.49N g = 9.81: 0.4905N
19	**b**	**ii**	$F_{un} =$ upward force $-$ weight $= 2 - 0 \cdot 5$ $= 1 \cdot 5$ newtons (1)	**1**	Must use answer in 19(b)(i) or correct answer deduct (½) for wrong/missing unit NB: in this context F = ma is not appropriate other acceptable units: N g = 9.8: 1.51N g = 9.81: 1.5095N
19	**b**	**iii**	$F_{un} = ma$ (½) $1 \cdot 5 = 0 \cdot 05 \times a$ (½) $a =$ 30 metres per second per second (1)	**2**	Must use answer in 19(b)(ii) or correct answer deduct (½) for wrong/missing unit other acceptable units: m/s/s, m/s^2 , ms^{-2} g = 9.8: 30.2 m/s^2 g = 9.81: 30.19 m/s^2

[END OF MARKING INSTRUCTIONS]