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2011 Physics

Standard Grade − General

Marking Instructions

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. You can do this by posting a question on the Marking Team forum or by e-mailing/phoning the emarker Helpline.

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

The Physics **General Marking Instructions** (GMI) provides guidance on all 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 response 'reflection' or the response 'refraction'. The spelling of these two 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 mis-spellings: 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.

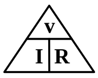
However, for ***numerical answers,*** care must be taken to ensure the unit has the correct prefix. eg for an answer <u>t = 0·005 seconds</u>, t = 5 ms is acceptable but NOT t = 5 Ms.

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	
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 <u>t = 400 000 s</u>, 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 $R = \frac{V}{I}$ to gain (½) mark.

'Dotted line.' :

A dotted line immediately above an answer in the MIs indicates that the answer requires an answer (or value) calculated or stated in a previous part of the question to be used.
If the candidate's answer in the first part of the question is wrong, this wrong answer may be used by the candidate in the subsequent question. If the subsequent answer is correctly completed, then full marks may be awarded.

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)

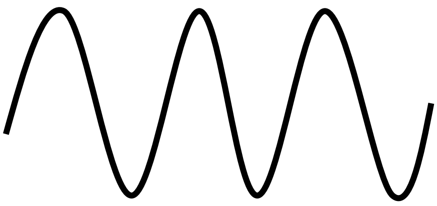
Physics – Marking Issues

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.

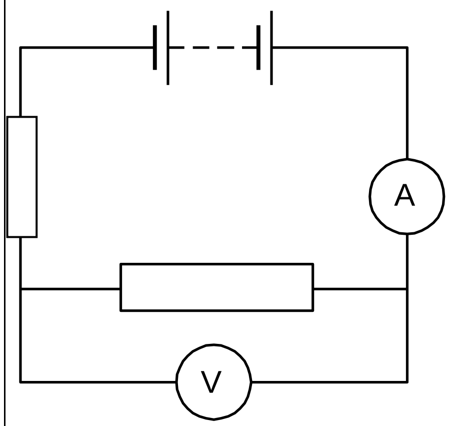
	Answers	**Mark + Comment**	**Issue**
1.	$V=IR$ $7{\cdot}5=1{\cdot}5R$ $R=5{\cdot}0\ \Omega$	(½) (½) (1)	Ideal answer
2.	$5{\cdot}0\ \Omega$	(2) Correct answer	GMI 1
3.	$5{\cdot}0$	(1½) Unit missing	GMI 2 (a)
4.	$4{\cdot}0\ \Omega$	(0) No evidence/wrong answer	GMI 1
5.	_____ Ω	(0) No final answer	GMI 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			B	**1**	
2			D	**1**	
3			D	**1**	
4			B	**1**	
5			D	**1**	
6	**a**		$d = vt$ (½) $34 = v \times 2 \cdot 5$ (½) $v = 13 \cdot 6$ (km/h) (1)	**2**	No unit required in final answer but if incorrect unit given then deduct (½) mark. If answer converted into m/s then treat as unit error deduct (½)
6	**b**	**i**	$f = \frac{n}{t}$ (½) $= \frac{8}{10}$ (½) $= 0 \cdot 8$ Hertz (1)	**2**	Deduct (½) if wrong/missing unit in final answer. $f = v/\lambda$ (0) marks

Question			Expected Answer/s	Max Mark	Additional Guidance
6	**b**	**ii**	 (1) mark for showing greater amplitude than waves in sea (1) mark for showing shorter wavelength than waves in sea	**2**	Diagram need not be labelled Same number of waves as waves in sea need not be drawn – but drawing should have sufficient waves to identify changes Allow 'passable' constant amplitude and wavelength Can show original wave then changed wave.
7	**a**	**i**	Lamp/bulb	**1**	
7	**a**	**ii**	lamp is switched/flashed on and off OR switch is open and closed (1) according to code (1) – some mention of agreed code	**2**	
7	**b**	**i**	**aerial** **decoder**	**1**	(½) for each correct

Question			Expected Answer/s	Max Mark	Additional Guidance
7	**b**	**ii**	A Supplies (electrical) energy (for the radio to work)	**1**	Accept: • 'to power the amplifier' NOT: • to supply electricity Ignore any extra correct but irrelevant information – otherwise apply +/- rule if extra information is wrong NOT: To get voltage to radio To power the speakers
			B Selects one particular frequency/wavelength	**1**	Accept: Selects/picks/finds one: • radio wave • (radio) station • channel • signal • carrier wave NOT: • 'tunes into' radio signals etc. • selects a program • 'wave' alone

Question			Expected Answer/s	Max Mark	Additional Guidance
8	a		 (½) for resistor symbol (½) for correct placement	1	If resistor drawn in series and has printed line through it then assume to be resistor and award (½) for resistor symbol.
8	b	i	$R = \frac{V}{I}$ (½) $= \frac{1 \cdot 5}{7 \cdot 5}$ (½) $= 0 \cdot 2$ ohms (1)	2	Deduct (½) if wrong/missing unit in final answer. If values for resistor X used then (½) max for equation.
8	b	ii	a decrease	1	Circle <u>or</u> any clear indication of intended answer
9	a	i	Live and Neutral only	1	(1) mark or zero no (½) marks Do NOT accept colours eg brown/blue alone If Earth included then zero marks
9	a	ii	Live is brown Neutral is blue	1	NO DOTTED LINE from (a)(i) – answers must clearly refer to live and neutral (½) for each correct answer Ignore any additional correct info. eg Earth wire but apply +/- rule if wrong info given
9	b		$I = \frac{P}{V}$ (½) $= \frac{115}{230}$ (½) $= 0 \cdot 5$ amperes (1)	2	Deduct (½) if wrong/missing unit in final answer. Accept: • amps • amperes • A • a

Question			Expected Answer/s	Max Mark	Additional Guidance
9	**c**	**i**	3 amperes (no other value) unit required (1) or zero marks	**1**	NO DOTTED LINE from answer to (b)
9	**c**	**ii**	To protect the flex/cable/wire	**1**	DO NOT accept "to protect appliance" or answers relating to how a fuse works
10	**a**		Liquid expands (more than glass) when heated	**1**	OR liquid contracts when cooled NOT "it" expands when heated
10	**b**	**i**	(Thermometer) B	**1**	
10	**b**	**ii**	Lowest recordable temperature is 35 ^{o}C (1) OR Starts at around body temperature OR (Highest) temperature is retained (1) OR Smaller temperature range (1)	**2**	(1) mark each correct Accept corollaries eg 'temperature in thermometer A falls away when removed' NOT "starts at a higher temperature" Accept "temp" for temperature NOT: 'Kink' without explanation of function NOT "scale" or "shape"
10	**c**		Recorded temperature is above **37 ^{o}C/normal** body temperature/ patient has a fever	**1**	NOT temperature is above 38 ^{o}C NOT temperature is 41 ^{o}C
11	**a**	**i**	Students are at different distances (from the loudspeaker) OR Inference that sound heard by students in the back row is blocked by students in front row	**1**	NOT different angles/positions
11	**a**	**ii**	Ultrasound OR ultrasonic	**1**	

<table>
<tr><th colspan="3">Question</th><th>Expected Answer/s</th><th>Max Mark</th><th>Additional Guidance</th></tr>
<tr><td>11</td><td>b</td><td></td><td>Accept any two from:

Bell: gathers/amplifies sound

(Rubber) tubing: transmits sound from table/bell to student

Earpieces: transfer (loudspeaker) sound to student’s ears
OR
excludes external sounds from student’s ears.</td><td>2</td><td>(1) mark for each correct answer</td></tr>
<tr><td>12</td><td>a</td><td></td><td>(System) B (1); both switches need to be closed before (the output is logic level 1 and) (the door opening mechanism operates) (1)</td><td>2</td><td>Must attempt an explanation to get first mark
• System B (1) mark
• Indication that both switch P and switch Q need to be closed/or button pressed and key used (to open doors) (1) mark
If wrong system identified, zero marks
Answer in terms of AND gate operation alone (0) marks</td></tr>
<tr><td>12</td><td>b</td><td></td><td>(System) A (1); only one switch needs to be closed for (the output to be logic level 1) (and the doors open) (1)</td><td>2</td><td>Must attempt an explanation to get first mark
• System A (1) mark
• Indication that either switch X or switch Y need to be closed/or button pressed (to open doors) (1) mark
If wrong system identified, zero marks
Answer in terms of OR gate operation alone (0) marks</td></tr>
<tr><td>13</td><td>a</td><td></td><td>process</td><td>1</td><td>For process accept:
• processor
• processing</td></tr>
<tr><td>13</td><td>b</td><td>i</td><td>thermistor</td><td>1</td><td>Accept any clear indication of correct answer eg
• arrow pointing to thermistor
• circle indicating thermistor</td></tr>
<tr><td>13</td><td>b</td><td>ii</td><td>seven-segment display</td><td>1</td><td>Accept:
• LCD
• Array of LEDs
Do NOT accept:
• LED/group of LEDs
• Computer/display screen</td></tr>
</table>

Question			Expected Answer/s	Max Mark	Additional Guidance
13	**c**		$V_{gain} = \frac{V_{out}}{V_{in}}$ (½) $= \frac{10}{0 \cdot 4}$ (½) $= 25$ (1)	**2**	Accept any correct pair of values from graph substituted to give answer of 25 (exactly) Deduct (½) if unit given in final answer. Do NOT accept power gain formula
13	**d**		1000 (hertz) accept '(the) same'	**1**	Unit not required but deduct (½) if wrong unit given
14	**a**	**i**	$F = ma$ (½) $= 800 \times 8$ (½) $= 6400$ newtons (1)	**2**	Deduct (½) if wrong/missing unit in final answer. Ignore any + or – signs.
14	**a**	**ii**	$E_W = Fd$ (½) $= 6400 \times 50$ (½) $= 320\ 000$ joules (1) OR $E_w = E_k = ½ mv^2$ (½) $= ½ \times 800 \times 28^2$ (½) $= 313\ 600$ joules (1)	**2**	Must use answer for force from (a) (i) or fresh start with correct value Deduct (½) if wrong/missing unit in final answer.
14	**b**		(Not a fair test) because cars may have different: braking systems OR drag coefficients OR Masses/weights/one car is heavier (but NOT lighter)	**1**	Accept any mention of any specific difference between the cars OR not a fair test because more than one variable is changed

Question			Expected Answer/s	Max Mark	Additional Guidance
15	**a**		Change of speed per unit time/per second OR Rate of change of speed	**1**	Not: 'increase in speed' alone Must have mention of time or rate But NOT "a given time"/"how quickly speed changes" Do NOT accept formula for acceleration alone
15	**b**		$a = \frac{\Delta v}{t}$ OR $a = \frac{v-u}{t}$ (½) $= \frac{1 \cdot 2 - 0}{0 \cdot 001}$ (½) $= 1200$ metres per second per second (1) If incorrect relationship stated (eg $a = v/t$) stop marking and award (0) marks Candidates who <u>start</u> with $a = \frac{1 \cdot 2}{0 \cdot 001}$ have not shown an incorrect relationship so should not be penalised eg $a = \frac{1 \cdot 2}{0 \cdot 001}$ (½) for implied formula, (½) for substitution a = 1200 m/s/s (1)	**2**	Deduct (½) if wrong/missing unit in final answer.
15	**c**		$W = mg$ (½) $= 0 \cdot 0001 \times 10$ (½) $= 0 \cdot 001$ newtons (1)	**2**	Deduct (½) if wrong/missing unit in final answer. Accept g = 9·8, 9·81

Question			Expected Answer/s	Max Mark	Additional Guidance
16	**a**	**i**	Potential → Kinetic	**1**	Accept symbols for energies if unambiguous eg E_P to E_K OR (G.)P.E to E.K.
16	**a**	**ii**	Kinetic → Electric(al) (1) or (0)	**1**	Do not accept 'electricity' NOT "stored" or "movement"
16	**b**	**i**	primary (coil) core secondary (coil) All 3 correct (2) marks 2 correct (1) mark 1 correct (½) mark	**2**	
16	**b**	**ii**	$\frac{n_s}{n_p} = \frac{V_s}{V_p}$ (½) $\frac{n_s}{18000} = \frac{275\,000}{16000}$ (½) $n_s = 309\,375$ (turns) (1) unit not required but if wrong unit given then deduct (½) eg 'volts', 'T', 't'	**2**	If $\frac{V_s}{V_p} = \frac{275\,000}{16000}$ is calculated as an intermediate step and rounded up (to $17 \cdot 2$) then answer is $n_s = 309\,600$ (turns)
16	**b**	**iii**	To reduce the energy/power loss	**1**	Accept: • Lower current • Less I^2R loss • Less heat loss • Less overheating • To reduce voltage drop/lost • Less power loss NOT: • Less 'current loss' unless qualified • Electricity loss • Energy/power is lost • More efficient

Question			Expected Answer/s	Max Mark	Additional Guidance
17	**a**		$E = P \times t$ (½) $= 25 \times 24$ (½) $= 600$ (kilowatt – hours) (1) Unit not required but deduct (½) if wrong unit given eg kWhr, J (correct abbreviation is kW h)	**2**	If power and/or time converted into watts and seconds then treat as unit error penalty and deduct (½) max if calculated answer is correct. (**no** additional penalty if wrong unit is given in final answer) ACCEPT "units" as units
17	**b**		Remaining energy = 600 – 200 = 400 (kilowatt – hours) (1) ignore unit cost of electricity = No of kilowatt –hours × cost per kilowatt – hour (½) = 400 × 9 (½) = 3600 pence (p) (1) Deduct (½) mark if final answer **wrongly** converted into £	**3**	Must use answer for electrical energy generated from 17 (a) or fresh start using correct value If subtraction attempted but incorrect answer (2) marks still possible. If no attempt at subtraction then max (½) for formula
17	**c**		solar OR wave OR tidal OR hydro OR geothermal OR biomass OR Wood	**2**	Do not accept: • sun • light • water • nuclear • peat

Question			Expected Answer/s	Max Mark	Additional Guidance
18	**a**		$F = ma$ (½) $4800 = 6000 \times a$ (½) $a = 0 \cdot 8$ metres per second per second (1) Ignore any +/- signs		
18	**b**	**i**	the same rate as	**1**	Circle or any clear indication of intended answer
18	**b**	**ii**	friction OR air resistance OR drag	**1**	Not: 'gravity'
18	**c**		Point B (only)	**1**	Accept any clear, unambiguous indication of the answer on the graph.
19	**a**	**i**	Miranda OR Moon OR "the Moon"	**1**	For 19(a)(i) – (iv): Answers must be from information **given in the passage** No (½) marks If more than one answer is given for any answer then apply +/- rule
19	**a**	**ii**	Sun OR Proxima Centauri OR star	**1**	
19	**a**	**iii**	Proxima Centauri	**1**	
19	**a**	**iv**	Neptune/planet OR (Halley's) comet OR The Oort Cloud	**1**	Not 'Earth'(not mentioned in passage)

Question			Expected Answer/s	Max Mark	Additional Guidance
19	**b**		A group/collection of stars	**1**	Accept: • Group/collection/cluster of stars (+ solar systems) (+ planets) • Any indication of a vast amount/lots of stars • Lots of solar systems NOT: • Constellation • Star system • ‘contains stars’
19	**c**		A star (or the Sun) and its (orbiting) planets	**1**	Not simply ‘a collection of planets’

[END OF MARKING INSTRUCTIONS]