2013 Physics

Standard Grade General

Finalised 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.

(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', '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 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).

eg when calculating speed from distance and time, and answer required to be in m/s:

If d = 4 km
t = 2 minutes

$$v = \frac{d}{t} \quad (½)$$

$$= \frac{400}{2} \quad (½)$$

$$= 200 \quad (½)$$

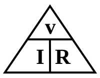
Although the candidate has made three unit errors (not correctly converted distance or time and has omitted the final unit) this would only attract **½ mark unit penalty**.

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	
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.

(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)

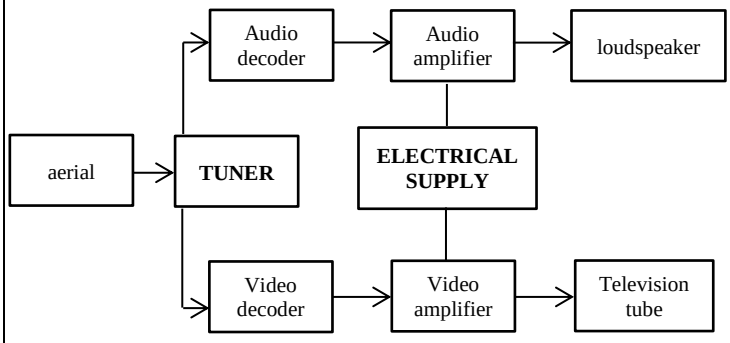
Physics – Marking Issues

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.	$V = IR$ $7{\cdot}5 = 1{\cdot}5 \times R$ $R = 0{\cdot}2\ \Omega$	(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			C	**1** **(KU)**	
2			A	**1** **(KU)**	
3			D	**1** **(PS)**	
4			D	**1** **(KU)**	
5			D	**1** **(PS)**	
6	**a**		$(A =) \frac{0 \cdot 60}{2}$ (1) = 0·3 metres (1)	**2** **(PS)**	deduct (½) for wrong/missing unit
6	**b**		$f = \frac{N}{t}$ (can be implied) (½) $= \frac{4}{2}$ (½) $= 2\,\text{hertz}$ (1)	**2** **(PS)**	If $f = v/\lambda$ is used, a clear indication of how v **and** λ is calculated must be shown in the answer box. If $f = v/\lambda$ is used without a clear indication of how v **and** λ is calculated (even if 5m/s for v and 2·5 m for λ are substituted) award 0 marks. If candidate writes $f = v/\lambda$, then shows v and λ correctly calculated but doesn't continue with the $f = v/\lambda$ calculation then award 0.5 marks (for $f = v/\lambda$ formula). deduct (½) for wrong/missing unit

Question			Expected Answer/s	Max Mark	Additional Guidance	
6	**c**		$\lambda = \frac{d}{N}$ (can be implied) (½) $= \frac{10}{4}$ (½) = 2·5 metres (1)	**2** **(PS)**	If $\lambda = v/f$ is used, a clear indication of how *v* is calculated must be shown in the answer box (or this could be shown in 6(b)). If $\lambda = v/f$ is used without a clear indication of how v is calculated (even if 5m/s is substituted for v) award 0 marks. If candidate writes $\lambda = v/f$, then shows *v* correctly calculated but doesn't continue with the $\lambda = v/f$ calculation then award 0.5 marks (for $\lambda = v/f$ formula). deduct (½) for wrong/missing unit	
6	**d**		$v = \frac{d}{t}$ $= \frac{10}{2}$ = 5 metres per second OR v = fλ = 2 × 2·5 = 5 metres per second	**2** **(KU)**	deduct (½) for wrong/missing unit Accept $v\ (or\ s) = \frac{d}{t}$ if v = fλ used then accept answers **consistent with 6 (b) and 6 (c)**	
7	**a**			**1** **(KU)**	(½) for each correct answer Accept • power supply • mains supply • energy supply • electric(al) supply • battery Do NOT accept • electricity (supply) • electrical/ power source	

Question			Expected Answer/s	Max Mark	Additional Guidance
7	**b**		Electrical → light (+ heat)(energy)	**1** **(KU)**	Accept • 'electric' • "-" in place of arrow • "to/into" in place of arrow Do NOT accept • 'electricity' • light and sound • Simple space in place of arrow
7	**c**	**i**	Ultra high frequency OR UHF	**1** **(PS)**	Do NOT accept frequency range *i.e.* 300 – 3000 MHz
7	**c**	**ii**	Any value between 30 megahertz and 300 megahertz inclusive	**1** **(PS)**	must quote **single** value only unit required Do NOT accept a range
8	**a**		$P = V \times I$ (½) $= 2 \times 0{\cdot}2$ (½) $= 0{\cdot}4$ watts (1)	**2** **(KU)**	deduct (½) for wrong/missing unit

Question			Expected Answer/s	Max Mark	Additional Guidance
8	**b**	**i**	$R = \frac{V}{I}$ (½) $= \frac{2}{0{\cdot}2}$ (½) = 10 ohms (1) OR $R = \frac{V^2}{P}$ (½) $= \frac{2^2}{0.4}$ (½) = 10 ohms (1) OR $R = \frac{P}{I^2}$ (½) $=\frac{0.4}{0.2^2}$ (½) =10 ohms (1)	**2** **(KU)**	deduct (½) for wrong/missing unit
8	**b**	**ii**	$V_R = V_S - V_L$ (can be implied) = 6 – 2 = 4 volts (1)	**1** **(PS)**	deduct (½) for wrong/missing unit
8	**c**	**i**	Brightness reduces OR Lamp becomes dimmer	**1** **(PS)**	Any answer indicating that the lamp or light (level) gets dimmer or the brightness reduces Do NOT accept Goes out
8	**c**	**ii**	Current decreases OR Voltage **across the bulb** decreases OR The power **output** from the bulb decreases	**1** **(PS)**	Do not accept: • "less current getting to the lamp"

Question			Expected Answer/s	Max Mark	Additional Guidance
9	**a**	**i**	230 volts	**1** **(KU)**	Unit required Do NOT accept 240 volts
9	**a**	**ii**	<table><tr><td>Name of wire</td><td>Colour of insulation</td></tr><tr><td>Live</td><td>Brown</td></tr><tr><td>Neutral</td><td>**Blue**</td></tr><tr><td>**Earth**</td><td>Green/yellow</td></tr></table>	**1** **(KU)**	(½) for each correct Do not accept 'black'
9	**a**	**iii**	3 ampere	**1** **(PS)**	accept any <u>clear</u> indication of 3A selection
9	**b**		Eh = cmΔT (½) = 4180 × 2·5 × 50 (½) = 522500 joules (1)	**2** **(KU)**	if value of c used not 4180 then (½) max for equation
10	**a**		Infrared or Heat or IR	**1** **(KU)**	Do NOT accept Thermal
10	**b**		Temperature/reading is above **37 °C** / **normal** / usual / average body temperature	**1** **(PS)**	Accept Normal / usual / average body temperature is 37(°C) Do NOT accept • "temperature is above 38 °C" **alone** • temperature is 39 °C Ignore any incorrect attempts to write °C
10	**c**	**i**	x-rays	**1** **(KU)**	
10	**c**	**ii**	Gamma (rays) OR ultraviolet/UV	**1** **(KU)**	

Question			Expected Answer/s		Max Mark	Additional Guidance
10	**d**		(It can cause) **skin cancer**	**1** **(KU)**	Answer MUST refer to **skin** cancer. Ignore any other information. Accept: • "can damage eyes" • "can cause sunburn / cataracts / melanoma" • "can kill / damage skin cells" Do not accept: • cancer • skin disease	
11	**a**	**i**	The sound gets quieter/stops OR 'it gets quieter' OR 'there is no sound (heard)'	**1** **(PS)**	Any indication of the sound level reducing Do NOT accept The sound disappears	
11	**a**	**ii**	There are fewer/no particles in the jar OR Sound cannot travel through vacuum	**1** **(PS)**	Answer MUST refer to particles or vacuum. Do NOT accept No air/nothing in the jar	
11	**b**		Reason 1. The sound levels **without the materials** are not the same / are different (1) Reason 2. The thicknesses (of the materials) are different (1)	**2** **(PS)**	Accept • sound levels **at the start** are not the same • **initial** sound levels are not the same Do NOT accept • "the sound levels are different" alone	
11	**c**		Sound levels **above** 80dB/90dB can cause damage to hearing	**1** **(KU)**	Must link <u>numerical sound level value</u> to <u>damage to hearing</u> A sound level value <u>must</u> be given Accept 80dB or 90dB as threshold Do NOT accept • 'damage to ears' • Loud sounds damage hearing	

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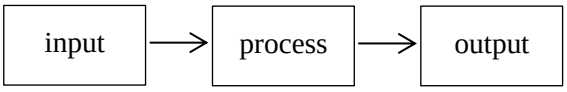
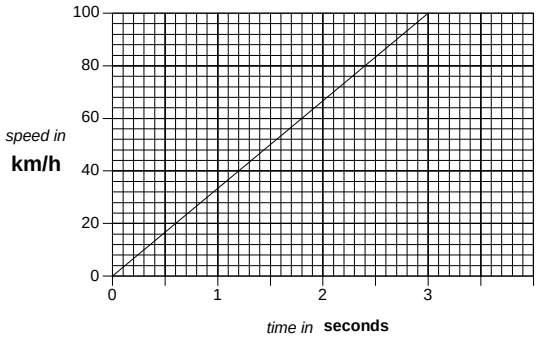
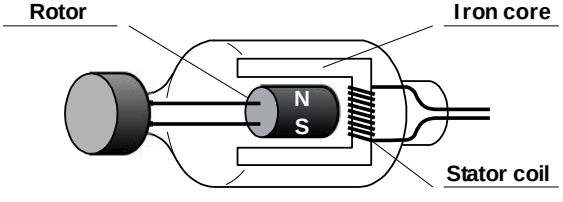
Question			Expected Answer/s		Max Mark	Additional Guidance
12	**a**	**i**	OR (gate)	**1** **(KU)**		
12	**a**	**ii**	<table><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table>	**1** **(KU)**		Only acceptable answer. Must all be correct for 1 mark
12	**b**		Alarm would sound when statue was in position OR Alarm would **not** sound when the statue is removed	**1** **(PS)**		Accept Alarm would • come on • go off Do NOT accept • answers in terms of logic states/levels • function of NOT gate e.g. "to invert the signal"
13	**a**			**1** **(KU)**		must have all correct for 1 mark Accept: "Processor" in place of process Do not accept: "processing"
13	**b**	**i**	$R = \frac{V}{I}$ (½) $= \frac{5}{0{\cdot}002}$ (½) = 2 500 ohms (1)	**2** **(KU)**		deduct (½) for wrong/missing unit
13	**b**	**ii**	Resistance increases	**1** **(PS)**		Accept any indication of increasing resistance Accept • it goes up/gets bigger

Question			Expected Answer/s	Max Mark	Additional Guidance
13	**c**		<table><tr><td>Label</td><td>Letter</td></tr><tr><td>analogue signal</td><td>A</td></tr><tr><td>analogue input device</td><td>E</td></tr><tr><td>digital input device</td><td>F</td></tr><tr><td>digital output device</td><td>C</td></tr></table>	**2** **(PS)**	(½) each correct answer
14	**a**		W = mg (½) = 1·4 × 10 (½) = 14 newtons (1)	**2** **(KU)**	deduct (½) for wrong/missing unit If g = 9.8, W = 13.72 newtons If g = 9.81, W = 13.734 newtons No sig fig issues
14	**b**	**i**	14 newtons	**1** **(KU)**	Unit required. Accept numerical value consistent with 14a but unit must be newtons. Answer must state the value of the force, not a description.

Question			Expected Answer/s		Max Mark	Additional Guidance
14	**b**	**ii**	E_w = Fd = 14 × 2·5 = 35 joules OR $E_w = mgh$ =1.4 × 10 × 2.5 = 35 joules	(½) (½) (1) (½) (½) (1)	**2** **(KU)**	Must use numerical value for force from 14(b)(i) OR Fresh start with numerical value from 14(a) deduct (½) for wrong/missing unit If g = 9.8 in 14a: E_w =34.3 joules If g = 9.81 in 14a: E_w =34.335 joules If E_w = mgh is used accept g = 10 or 9.8 or 9.81 regardless of value used in part (a)
15	**a**		$\bar{v} = \frac{d}{t}$ $= \frac{2820}{75}$ = 37·6 metres per second	(½) (½) (1)	**2** **(KU)**	deduct (½) for wrong/missing unit Accept $v\ (or\ s) = \frac{d}{t}$

Question			Expected Answer/s	Max Mark	Additional Guidance
15	**b**		• (Measure) the length of the car (1) • (Measure) the time taken to pass the **finishing line** (1) • Calculate instantaneous speed using $v = \frac{\text{length of car}}{\text{time to cross finish line}}$ (1)	**3** **(PS)**	3 independent marks Do NOT accept Distance/size of the car Candidates may describe a method using a light gate or timer to measure the time taken to pass the finishing line. Do NOT accept suggestion of two light gate**s** for time measurement Accept statement of the equation: $v\ (or\ s) = \frac{d}{t}$
15	**c**		Bugatti Veyron	**1** **(PS)**	

Question			Expected Answer/s	Max Mark	Additional Guidance
15	**d**			**3** **(PS)**	3 independent stages: • correct axis unit label (**kilometres per hour** or **km/h** and **seconds** or **s)** (½) each. • for completing passably straight line from the origin (1) • for the line reaching 100km/h in 3s shown on the graph (1) If *y* axis is labelled in m/s the acceptable value for speed is 27.8 (28) m/s Ignore any incorrect subdivision of the speed or time axis as long as the required time and speed are indicated.
16	**a**		kWh per day $= \frac{18250}{365}$ = 50 (kilowatt-hours) (1)	**1** **(PS)**	Unit not required but deduct (½) if wrong unit given. Correct units: kilowatt-hours (per day) OR kW h (per day)
16	**b**		E = P × t (½) So P $= \frac{50}{8}$ (½) = 6·25 kilowatts (1)	**2** **(KU)**	Accept: • kWh = kW × h for formula • correct calculations which use power converted to watts and time converted to seconds energy value consistent with that calculated in Q16 (a) deduct (½) for wrong/missing unit
16	**c**			**1** **(KU)**	must have all correct for (1) mark.

Question			Expected Answer/s	Max Mark	Additional Guidance
17	**a**	**i**	**(A)** 0 degrees Celsius (1) **(B)** Changing state OR changing from ice to water OR melting (1)	**1** **(PS)** **1** **(PS)**	0 °C Unit required Do NOT accept 'turning into water' alone
17	**a**	**ii**	Organ is losing heat (energy) to the ice OR Heat (energy) is being transferred from the organ to the ice	**1** **(PS)**	There must be a clear indication of where **heat** is **coming from** and where it is **going to**
17	**b**		To reduce/stop heat (energy) from outside transferring inside (the container).	**1** **(PS)**	There must be a clear indication of heat transferring from outside to inside the container. Do NOT accept • to stop cold escaping • to keep it cool
18	**a**	**i**	Jupiter and Saturn	**1** **(PS)**	**both** answers required if wrong answer included in answers then 0 marks
18	**a**	**ii**	Jupiter	**1** **(PS)**	
18	**a**	**iii**	Mercury	**1** **(PS)**	
18	**b**		Star Planet Moon Universe	**2** **(PS)**	(½) for each correct answer
18	**c**	**i**	Lens P: Objective (lens) (1) Lens Q: Eyepiece (lens) (1)	**2** **(KU)**	Do NOT accept • Object lens • Eye lens

Question			Expected Answer/s	Max Mark	Additional Guidance
18	**c**	**ii**	Produces/creates an image (of a distant object)	**1** **(KU)**	Accept • focusses the light **to produce an image** Do NOT accept • collects light • focusses the image • "focusses the light" alone
18	**d**		$a = \frac{F}{m}$ (½) $= \frac{1900}{76}$ (½) = 25 metres per second per second (1)	**2** **(KU)**	ignore any ± signs for acceleration

[END OF MARKING INSTRUCTIONS]