2014 Physics

Higher (Revised)

Finalised Marking Instructions

Part One: General Marking Principles for Physics Higher (Revised)

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) Marking should always be positive ie, marks should be awarded for what is correct and not deducted for errors or omissions.

GENERAL MARKING ADVICE: Physics Higher (Revised)

The marking schemes are written to assist in determining the "minimal acceptable answer" rather than listing every possible correct and incorrect answer. The following notes are offered to support Markers in making judgements on candidates' evidence, and apply to marking both end of unit assessments and course assessments.

1. General Marking Instructions

SQA published Physics General Marking Instructions in July 1999. Please refer to this publication when interpreting the detailed Marking Instructions.

2. Recording of marks

The following additional advice was given to markers regarding the recording of marks on candidate scripts.

(a) The total mark awarded for each question should be recorded in the outer margin. The inner margin should be used to record the mark for each part of a question as indicated in the detailed Marking Instructions.

(b) The fine divisions of marks shown in the detailed Marking Instructions may be recorded within the body of the script beside the candidate's response. Where such marks are shown they must total to the mark in the inner margin.

(c) Numbers recorded on candidate scripts should always be the marks being awarded. Negative marks or marks to be subtracted should not be recorded on scripts.

(d) The number out of which a mark is scored should **never** be recorded as a **denominator**.
(½ mark will always mean one half mark and never 1 out of 2)

(e) Where square ruled paper is enclosed inside answer books it should be clearly indicated that this item has been considered by the marker. The mark awarded should be transferred to the script booklet inner margin and marked G.

(f) The mark awarded for each question should be transferred to the grid on the back of the script. When the marker has completed marking the candidate's response to all questions, the marks for individual questions are added to give the total script mark.

(g) The total mark awarded for an individual question may include an odd half mark − ½. If there is an odd half mark in the total script mark, this is rounded up to the next whole number when transferred to the box on the front of the script.

3. Other Marking Symbols which may be used

TICK	–	Correct point as detailed in scheme, includes data entry
SCORE THROUGH	–	Any part of answer which is wrong. (For a block of wrong answers indicate zero marks.)
INVERTED VEE	−	A point omitted which has led to a loss of marks.
WAVY LINE	–	Under an answer worth marks which is wrong only because a wrong answer has been carried forward from a previous part.
"G"	–	Reference to a graph on separate paper. You MUST show a mark on the graph paper and the SAME mark on the script.

4. Marking Symbols which may <u>NOT</u> be used.

"WP"	−	Marks not awarded because an apparently correct answer was due to the use of "wrong physics".
"ARITH"	−	Candidate has made an arithmetic mistake.
"SIG FIGS" or "SF"	−	Candidate has made a mistake in the number of significant figures for a final answer.

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.	5·0	(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

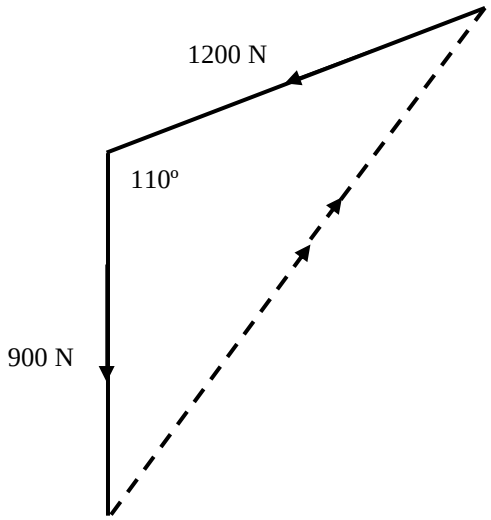
2014 Physics Higher (Revised)

Marking scheme

Section A

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

Part Two: Marking Instructions for each Question

Question		Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
21.	**(a) (i)**	A **single force** which will have the **same effect** as all the other forces. **(1)**	'Same effect' could be described e.g. 'same acceleration (in same direction)'. **or** the vector sum of all the forces (or equivalent, e.g. by suitable diagram)	**1**	**6**
	(ii)	 Correct diagram method: Both the 900 N and 1200 N vectors drawn to scale **(½)** Correct angle between vectors **(½)** 1730 ± 30 N **(1)** 41± 2º from vertical or 49 ± 2º from horizontal **(1)**	Alternative method using the cosine and sine rules: $a^2 = b^2 + c^2 - 2bc \cos \theta$ **(½)** $a^2 = 900^2 + 1200^2 - 2 \times 900 \times 1200 \cos 110^\circ$ **(½)** $a = 1728{\cdot}8$ $a = 1730$ N **(1)** $a/sinA = b/sinB$ $1728{\cdot}8/sin110^\circ = 1200/sin\theta$ $\theta = 40{\cdot}7^\circ$ $\theta = 41^\circ$ from the vertical. **(1)** 1700 N gives $\theta = 41{\cdot}6^\circ$ $\theta = 42^\circ$ from the vertical Any bearings taken from North gets **(0)** for direction, i.e. max mark for part (a)(ii) is **(2)**	**3 (3A)**	
	(b)	**The vertical component** of the force exerted by the parasail is **greater** than the **weight** of the parascender. **(2)**	Upward force is greater than downwards force. **(1)** **Or** "There is now an unbalanced force (upwards)" **(1)** (these are partial explanations)	**2 (2A)**	

Question		Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
22.	**(a)**	Total momentum before = 0 (kg m s^{-1}) **(½)** Total momentum after = $m_X v_X + m_Y v_Y$ **(½)** = (0·70 × 0·51) + (0·30 × -1·19) **(½)** = 0 (kg m s^{-1}) **(½)** (same answers)	units are not required here, but deduct **(½)** if wrong units given. **not** $m_X v_X - m_Y v_Y$ If $m_X v_X$ and $m_Y v_Y$ are worked out separately, marks are only awarded if one is <u>negative</u> and they are <u>combined</u>.	**2**	**5**
	(b) (i)	½$mv^2 = mgh$ **(½)** ½ × 0·2 × v^2 = 0·2 × 9·8 × 0·15 **(½)** v = 1·7 (m s^{-1}) **[MUST BE SHOWN]**	Must have both formulas somewhere to get first **(½)**, otherwise **(0)**. Unit not required here, but deduct **(½)** if wrong unit given.	**1**	
	(ii)	<u>Total</u> momentum before = <u>Total</u> momentum after **(½)** 0·05u + 0 = (0·20 + 0·050) × 1·7 **(½)** u = 0·25 × 1·7/0·05 u = 8·5 m s^{-1} **(1)**	Must have 'total' on both sides. If a candidate forgets to add the mass of the dart (0·050 kg), they will get u = 6·8 m s^{-1} as their answer. This gets a max of **(½)** for the full formula, <u>but only if it is written down</u>.	**2**	

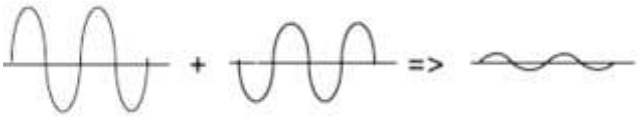
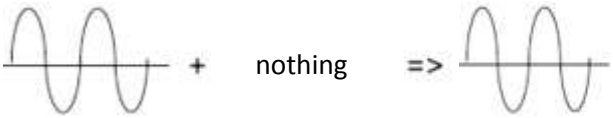
Question		Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
23.	**(a) (i)**	Force = $1{\cdot}56 \times 10^{-9} \times 0{\cdot}45$ **(1)** $= 7{\cdot}0 \times 10^{-10}$ (N)	Must show multiplication Deduct **(½)** if final answer is <u>not</u> $7{\cdot}0 \times 10^{-10}$ e.g. $7{\cdot}02 \times 10^{-10}$ N $7{\cdot}00 \times 10^{-10}$ N 7×10^{-10} N	**1**	**7**
	(ii)	$G = \frac{Fr^2}{Mm}$ **or** $G = \frac{Fr^2}{m_1 m_2}$ **(½)** $= \frac{7{\cdot}0 \times 10^{-10} \times 0{\cdot}0465^2}{1{\cdot}52 \times 0{\cdot}0148}$ **(½)** $= 6{\cdot}7 \times 10^{-11}$ m^3 kg^{-1} s^{-2} **(1)** [or N m^2 kg^{-2}]	Allow F = $7{\cdot}02 \times 10^{-10}$ N here giving G = $6{\cdot}7474 \times 10^{-11}$ $6{\cdot}747 \times 10^{-11}$ $6{\cdot}75 \times 10^{-11}$ $6{\cdot}7 \times 10^{-11}$ Accept $6{\cdot}728 \times 10^{-11}$ $6{\cdot}73 \times 10^{-11}$ $6{\cdot}7 \times 10^{-11}$ 7×10^{-11}	**2**	
	(b)	$\pm$ 2·5% of $6{\cdot}67 \times 10^{-11} = \pm 1{\cdot}7 \times 10^{-12}$ **(½)** [or $\pm 0{\cdot}17 \times 10^{-11}$] claim between $(6{\cdot}50 \times 10^{-11})$ and $6{\cdot}84 \times 10^{-11}$ **(½)** [or between $6{\cdot}5 \times 10^{-11}$ and $6{\cdot}8 \times 10^{-11}$] within range, so the manufacturer's claim is correct **(1)**	If answer to (a)(ii) is wrong, but answer to (b) is consistent, give full marks arithmetic mistake, **(½)** off value for *G* must be at least 2 sig. fig, otherwise 0 marks No justification, 0 marks could do by finding 6·73 as a percentage of 6·67 and showing it is within 2·5% N.B. it is wrong Physics to attempt to answer by finding 2.5% of the student's value (to compare with the accepted value).	**2 (2A)**	
	(c)	reflection would result in increased/double the reading on the (fixed) scale **(1)** smaller <u>percentage</u> uncertainty **(1)**		**2 (2A)**	

Question		Sample Answers and Mark Allocation		Notes	Inner Margin	Outer Margin
24.		Demonstrates no understanding Limited understanding Reasonable understanding Good understanding	**(0)** **(1)** **(2)** **(3)**	This is an open ended question A variety of physics arguments can be used to answer this question. Marks are awarded on the basis of whether the answer, <u>overall</u>, demonstrates 'no', 'limited', 'reasonable' or 'good' understanding	**3 (1A)**	**3**
25.	**(a)**	$f = \frac{v}{\lambda}$ $= \frac{3\times10^{8}}{656\cdot28\times10^{-9}}$ ($= 4{\cdot}57 \times 10^{14}$ (Hz)) $E = hf$ $= 4{\cdot}57 \times 10^{14} \times 6{\cdot}63 \times 10^{-34}$ $= 3{\cdot}03 \times 10^{-19}$ (J) the transition is from E_3 to E_2 **or** $E_3 \rightarrow E_2$ but <u>not</u>: E_2 to E_3 or E_3 — E_2	**(½)** **(½)** **(½)** **(½)** **(1)**	- this **(½)** mark is available anywhere in the answer The unit is not required, but if an incorrect unit is given, **(½)** off - this **(½)** mark is available anywhere in the answer this mark stands alone arithmetic mistake, **(½)** off, but final mark is not obtainable if their answer cannot be closely matched to any of the possible transitions.	**3 (2A)**	**9**

Question		Sample Answers and Mark Allocation		Notes	Inner Margin	Outer Margin
25.	**(b) (i)**	12 days		deduct **(½)** for wrong or missing units	**1**	
	(ii)	$z = \frac{\lambda_{observed} - \lambda_{rest}}{\lambda_{rest}}$	**(½)**		**3 (2A)**	
		$= \frac{656 \cdot 41 - 656 \cdot 28}{656 \cdot 28}$	**(½)**			
		($= 1 \cdot 98 \times 10^{-4}$)				
		$v = cz$	**(½)**			
		$= 3 \cdot 00 \times 10^{8} \times 1 \cdot 98 \times 10^{-4}$	**(½)**			
		$= 5 \cdot 94 \times 10^{4}$ m s^{-1}	**(1)**			
	(iii)	blueshift is less than redshift	**(1)**	independent marks or 'the difference in wavelength for approach is less than that for recession'	**2 (2A)**	
		approach velocity is less	**(1)**			

Question		Sample Answers and Mark Allocation		Notes	Inner Margin	Outer Margin
26.	**(a) (i)**	meson made of 2 quarks	**(½)** **(½)**	must have 'meson' before second **(½)** can be awarded	**1**	**7**
	(ii)	$\pi^+ = \mathrm{u} + \bar{\mathrm{d}}$ $+1 = \frac{2}{3} + \bar{\mathrm{d}}$ charge on anti-down = $+\frac{1}{3}$	**(1)**	clear arithmetic error, **(½)** off	**1**	
	(iii)	"anti-up" and "down"	**(1)**	both required, **(1)** or **(0)** not "anti-anti-down"	**1** **(1A)**	
	(iv)	$t^1 = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}}$ $= \frac{2 \cdot 6 \times 10^{-8}}{\sqrt{1-\frac{(0 \cdot 9c)^2}{c^2}}}$ $= 6 \cdot 0 \times 10^{-8}$ s	**(½)** **(½)** **(1)**	accept: $5 \cdot 965 \times 10^{-8}$ $5 \cdot 96 \times 10^{-8}$ $6 \cdot 0 \times 10^{-8}$ 6×10^{-8}	**2**	
	(b) (i)	electric field (to accelerate)	**(1)**		**1**	
	(ii)	magnetic field (to deflect)	**(1)**		**1**	

Question		Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
27.	**(a) (i)**	$E_k = hf - hf_0$ **(½)** $E_k = (6{\cdot}63\times10^{-34}\times6{\cdot}74\times10^{14}) - 3{\cdot}78\times10^{-19}$ **(½)** $E_k = 6{\cdot}89\times10^{-20}$ J **(1)** Accept: $6{\cdot}9\times10^{-20}$ $6{\cdot}89\times10^{-20}$ $6{\cdot}886\times10^{-20}$ $6{\cdot}8862\times10^{-20}$	"$E = hf$" on its own **(0)**	**2**	**6**
	(ii)	$E_k = ½\ mv^2$ **(½)** $v^2 = \frac{2\times6{\cdot}9\times10^{-20}}{9{\cdot}11\times10^{-31}}$ **(½)** $v = 3{\cdot}89\times10^5$ m s^{-1} **(1)**	Or consistent with (a)(i)	**2**	
	(b)	The maximum velocity remains the same **(1)** one photon releases one electron **(½)** each photon has same energy as before **(½)**	- look for this first Do not accept a statement such as 'changing the irradiance has no effect on the rate of emission of photoelectrons'. The candidate must explain <u>why</u> this is true in order to gain the second two **(½)** marks.	**2** **(2A)**	

Question		Sample Answers and Mark Allocation		Notes	Inner Margin	Outer Margin
28.	**(a)**	$d \sin\theta = m\lambda$ $5{\cdot}0 \times 10^{-6} \sin\theta = 3 \times 589 \times 10^{-9}$ $\theta = 21^{o}$	**(½)** **(½)** **(1)**	deduct **(½)** for wrong or missing units	**2**	**6**
	(b) (i)	Path difference = 500 − 425 Path difference = 75 mm number of wavelengths 75/30 number of wavelengths 2·5 Destructive interface Look for this first – must be this (or a demonstrated arithmetic error) for any marks. A demonstrated arithmetic error could allow (1½) marks to be awarded.	**(½)** **(½)** **(1)**	If there is no calculation shown – no marks can be awarded. do not accept "a minimum" or 'deconstructive'. Must be 'destructive' to gain any marks (unless there is a demonstrated arithmetic error).	**2**	
	(ii)	increases (dest.) interference no longer occurs. **OR** /'now only one set of waves, so they cannot cancel out'/suitable diagram e.g. before:  after: 	**(1)** **(1)**	- look for this first There must be an attempt at a justification (and not wrong Physics) to get first mark.	**2** **(2A)**	

Question		Sample Answers and Mark Allocation		Notes	Inner Margin	Outer Margin
29.	**(a)**	$\sin\theta_1 / \sin\theta_2 = n$	**(½)**	this mark anywhere in part(a)	**2**	**4**
		$n = 1{\cdot}615$	**(½)**	this mark is awarded anywhere (e.g. the value might appear in the substitution)		
		$\sin\theta_1 / \sin 38^o = 1{\cdot}615$	**(½)**	if there is a wrong value for n here, then max **(½)** for formula if it is shown (e.g. in first line of answer)		
		$\theta_1 = 83{\cdot}9^o$	**(½)**	deduct **(½)** for wrong or missing units		
	(b)	Refractive index larger.	**(½)**	Must have v_g smaller, else **(0)** (You cannot justify a wrong answer)	**2**	
		$v_{air} / v_{glass} = {}_a n_g$ **or** $n = v_1/v_2$ **or** "there is a greater decrease/change in speed"	**(½)**		**(2A)**	
		$v_{(glass)}$ smaller	**(1)**	- look for this first - it stands alone Do not accept up and down arrows. If a candidate uses $v = f\lambda$ and says "v is smaller because is λ smaller and f is constant on refraction" – this is wrong Physics in this situation.		

Question		Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
30.	**(a) (i)**	(Extended line until it cuts vertical axis.) *e.m.f.* = 12 V	Deduct **(½)** for wrong or missing units.	**1**	**7**
	(ii)	Gradient = $-r = \dfrac{(V_2 - V_1)}{(I_2 - I_1)}$ **(½)** $-r = \dfrac{(6-10)}{(240-80)}$ **(½)** $\left\{\dfrac{10-6}{240-80}\text{ is wrong}\right\}$ $-r = -0{\cdot}025$ $r = 0{\cdot}025\ \Omega$ **(1)** Alternative methods: using $E = I(R + r)$ (also $E = V + Ir$) $12 = 80\ (0{\cdot}125 + r)$ **(1)** $r = 0{\cdot}025\ \Omega$ **(1)** **OR** $r = \dfrac{e.m.f.}{I_{short\ circuit}}$ $r = \dfrac{12}{480}$ **(1)** $= 0{\cdot}025\ \Omega$ **(1)**	**Or** r = − gradient $r = -\dfrac{(V_2 - V_1)}{(I_2 - I_1)}$ **(½)** $-r = \dfrac{(6-10)}{(240-80)}$ **(½)** [or other appropriate substitutions] r = 0·025 Ω **(1)** V | I | R 11 | 40 | 0·275 10 | 80 | 0·125 9 | 120 | 0·075 8 | 160 | 0·050 7 | 200 | 0·035 6 | 240 | 0·025 **OR**, $r = V_{(lost)}/I$ $= (12 - 10)/80$ **(1)** [or other appropriate substitutions] $= 0{\cdot}025\ \Omega$ **(1)**		
	(iii)	$I = \dfrac{e.m.f.}{r}$ **or** $\dfrac{E}{r}$ **(½)** $I = \dfrac{12}{0{\times}025}$ **(½)** $I = 480\text{A}$ **(1)**	**Or** consistent with (a)(i) and (a)(ii) Accept $I = \dfrac{V}{R}$ as long as correct substitution, i.e. by itself it does not get first **(½)**.	**2**	

Question		Sample Answers and Mark Allocation		Notes	Inner Margin	Outer Margin
30	**(b)**	Total resistance in circuit decreases Current increases Larger value of lost volts So less voltage across headlight (Therefore headlight dimmer)	**(½)** **(½)** **(½)** **(½)**	Independent **(½)** marks If candidate says voltage "through" or "flowing", then zero marks for whole of part (b). If candidate says current "across", then zero marks for whole of part (b).	**2** **(2A)**	
31.		Demonstrates no understanding Limited understanding Reasonable understanding Good understanding	**(0)** **(1)** **(2)** **(3)**	This is an open ended question A variety of physics arguments can be used to answer this question. Marks are awarded on the basis of whether the answer, <u>overall</u>, demonstrates 'no', 'limited', 'reasonable' or 'good' understanding	**3** **(1A)**	**3**

Question		Sample Answers and Mark Allocation	Notes	Inner Margin	Outer Margin
32	**(a)**	correct drawing of axes, plotting of points and drawing a smooth curve **(2)** non-linear scale on either axis is wrong Physics and prevents access to any marks	any quantity or unit missing from labels, **(½)** off per axis, but labelling of origin is not required in this answer. correct plotting of points to ± half scale division, **(½)** off each error to a max of **(2)** marks missing/wrong curve, deduct **(1)** mark, e.g. multiple lines, dot-to-dot, line rising too high then back down	**2**	**7**
	(b)	7·5 mm ± 1 **(1)**	or consistent with (a) deduct **(½)** for wrong/missing units	**1 (1A)**	
	(c)	repeat measurements **(1)** smaller steps/divisions in radius {around the 75% value (or equivalent)} **(1)**	"more measurements" alone, award **(1)** N.B. the same apparatus must be used	**2 (1A)**	
	(d)	suitable variable **(½)** state at least one other variable to be controlled **(½)** indication of how independent variable can be measured/changed **(1)**	this **(½)** is needed first to access subsequent marks variables could include: • length of fibre • thickness of fibre • colour/wavelength of light • material of fibre	**2**	

[END OF MARKING INSTRUCTIONS]