2012 Physics

Higher (Revised)

Finalised Marking Instructions

Scottish Qualifications Authority

Marking Instructions – Higher Physics (Revised)

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

2012 Physics Higher (Revised)

Marking scheme

Section A

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

Sample Answer and Mark Allocation	**Notes**	Inner Margin	Outer Margin
21. (a) (i) $d = vt$ $= 20 \times 3{\cdot}06$ $= 61{\cdot}2$ m (1)	Alternative: distance = area under first graph Deduct (½) for wrong/missing units.	1	5
(ii) $v^2 = u^2 + 2as$ (½) $0 = 15^2 + 2 \times -9{\cdot}8 \times s$ (½) $s = 11{\cdot}5$ m (1)	Alternatives: $s = ut + ½at^2$ (½) $= 15 \times 1{\cdot}53 + ½ \times -9{\cdot}8 \times (1{\cdot}53)^2$ (½) $= 11{\cdot}5$ m (1) or $d =$ area under v-t graph (½) $= ½ \times 1{\cdot}53 \times 15$ (½) $= 11{\cdot}5$ m (1)	2	
(b) More likely (1) because: horizontal velocity will decrease OR vertical velocity will decrease quicker than before (½) range will decrease OR time in air will decrease OR height reached will decrease (½)	Look for this first. 'more likely' with no attempt at a justification – zero marks Energy conservation argument: 1. There is now work done against/ by friction. 2. The E_k of the ball (gradually) reduces compared to before. 3. The max E_p of the ball is less (than before). 4. The max height is therefore less. 5. The ball is more likely to hit the tree.	2 (2A)	

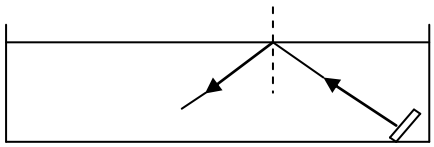
Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
22. (a) $T \times \lambda =$ $4200 \times 6{\cdot}90 \times 10^{-7} = 2{\cdot}898 \times 10^{-3}$ $5800 \times 5{\cdot}00 \times 10^{-7} = 2{\cdot}900 \times 10^{-3}$ $7900 \times 3{\cdot}65 \times 10^{-7} = 2{\cdot}884 \times 10^{-3}$ $12000 \times 2{\cdot}42 \times 10^{-7} = 2{\cdot}904 \times 10^{-3}$ (1½) Concluding $T \times \lambda$ = **$2{\cdot}9 \times 10^{-3}$** (m K) (½) deduct (½) for each wrong or missing calculation	Units not required for Constant, but deduct (½) if wrong unit given. Can be attempted by a graphical method.	2	6
(b) $T \times \lambda = 2{\cdot}9 \times 10^{-3}$ (½) $T \times 76 \times 10^{-9} = 2{\cdot}9 \times 10^{-3}$ (½) $T = 38158$ $T =$ **38000 K** (1)		2	
(c) (i) Cosmic Microwave Background (Radiation) (1)	All three words required "CMBR" – Not acceptable, as this is not "naming".	1	
(ii) Look for any **one** of the following: (1) • It is pervasive throughout space. • It is the dominant source of radiation in the Universe. • It is very uniform (throughout the Universe). • It is isotropic (throughout the Universe). • It shows the characteristics of blackbody radiation. • It has a temperature of approx 3 K (2·74 K) due to cooling on expansion. • It corresponds to a redshift of 1000, so the early temperature of this radiation was approx 3000 K. • CMBR is thought to be the "afterglow" of the Big Bang, cooled to a faint whisper in the microwave region.	"It comes from all directions in space" – Not acceptable as this is given in the question.	1 (1A)	

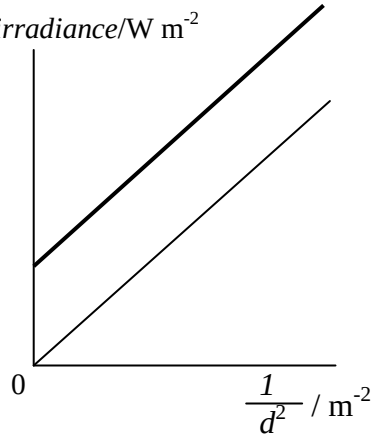
Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
23. (a) (i) $E_w = QV$ (½) $= 1{\cdot}6 \times 10^{-19} \times 1220$ (½) $= 1{\cdot}95 \times 10^{-16}$ (J)	Must have equation at the start, otherwise zero marks. Deduct ½ if final line not shown	1	7
(ii) (electrical) work done = ½ mv^2 (½) $= ½ \times 2{\cdot}18 \times 10^{-25} \times v^2$ (½) $v = 4{\cdot}23 \times 10^4$ m s^{-1} (1)		2	
(b) $Ft = \Delta mv$ (½) $0{\cdot}07 \times 60 = 750 \times \Delta v$ (½) $\Delta v = 5{\cdot}6 \times 10^{-3}$ m s^{-1} (1)	if $Ft = mv - mu$ $0{\cdot}07 \times 60 = 750 \times v - 750 \times 0$ $v = 5{\cdot}6 \times 10^{-3}$ m s^{-1}	2	
(c) Force from Xenon engine greater (1) Change in momentum of the Xenon ions would be greater (than Krypton ions) (½) Impulse from Xenon ions would be greater (½)	Must have force from Xenon engine greater or zero marks Alternative: force from Xenon ion engine greater (1) E_k of xenon ions greater (than krypton ions) (½) more work done ($E_w = Fd$) (½) Must name the engine – saying the 'first' engine means nothing in this question.	2 (2A)	

Sample Answer and Mark Allocation			Notes	Inner Margin	Outer Margin
24.	Demonstrates no understanding Limited understanding Reasonable understanding Good understanding	(0) (1) (2) (3)	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 overall demonstrates 'no', 'limited', 'reasonable' or 'good' understanding.	3 (1A)	3
25. (a)	$E_w = F\,d$ $75000 = F \times 50$ $F = 1500$ N Total resistive force = braking force + friction Force of brakes = 1500 – 300 = 1200 N	(½) (½) (½) (½) (1)		3 (3A)	5
(b)	Braking force less E_k of second car is less work done (= $F\,d$) in stopping car is less (and distance is constant).	(1) (½) (½)	Look for this first, but zero marks if there is no attempt at a justification.	2 (2A)	

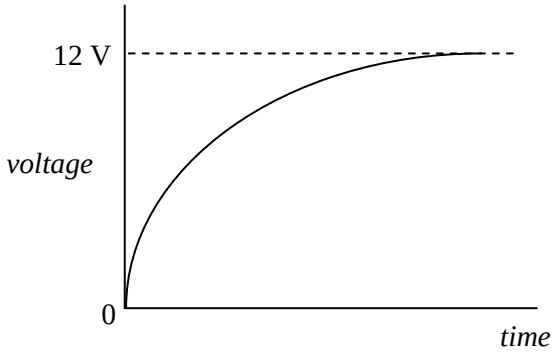
Sample Answer and Mark Allocation	**Notes**	Inner Margin	Outer Margin
26. (a) These particles cannot be broken down (into other sub-particles). (1)	Key point: it is not that they can be used to make bigger 'things', but rather that they are not made from smaller things.	1	5
(b) For the sigma plus particle $2 \times (+ \frac{2}{3}) + q_s = +1$ $q_s = -\frac{1}{3}$ Charge on strange quark = $-\frac{1}{3}$ (1)		1	
(c) Strong force (associated with the gluon) acts over a very short distance. (½) The gravitational force extends over very large/infinite distances. (½)		1 (1A)	
(d) (i) (It is deflected) downwards (1)	Not "south".	1	
(ii) Neutrons don't carry/have (net) charge (½) so cannot be accelerated/guided/ deflected by <u>magnetic</u> fields (½)		1	

Sample Answer and Mark Allocation			Notes	Inner Margin	Outer Margin
27. (a)	$d\sin\theta = m\lambda$ (½) $d \times \sin 35{\cdot}3 = 3 \times 633 \times 10^{-9}$ (½) $d =$ **$3{\cdot}29 \times 10^{-6}$ m** (1)			2	5
(b)	Number of lines per metre $= \frac{1}{3{\cdot}29\times10^{-5}}$ (½) $=$ **$3{\cdot}04 \times 10^{5}$** (½)		or consistent with answer to part (a)	1	
(c)	Substitution here must be to at least three significant figures Difference $= (3{\cdot}04 - 3{\cdot}00) \times 10^{5}$ $= 0{\cdot}04 \times 10^{5}$ Percentage difference $= \frac{0{\cdot}04\times10^{5}}{3{\cdot}00\times10^{5}}\times100$ (½) $= 1{\cdot}33\%$ (½) **Technician's value <u>does</u> agree** (1)		If answer to (b) is wrong, but answer to (c) is consistent – full marks Could answer question by calculating 2% of $3{\cdot}00 \times 10^{5}$ and comparing	2 (2A)	
28.	Demonstrates no understanding (0) Limited understanding (1) Reasonable understanding (2) Good understanding (3)		Open ended question – a variety of physics 'discussions' can be used to answer this question. Marks are awarded on the basis of whether the answer overall demonstrates 'no', 'limited', 'reasonable' or 'good' understanding.	3 (1A)	3

Sample Answer and Mark Allocation	**Notes**	Inner Margin	Outer Margin
29. (a) $n = \frac{\sin \theta_1}{\sin \theta_2}$ (½) $1{\cdot}33 = \frac{\sin X}{\sin 36}$ (½) X = **51°** (1)	Accept 51·42, 51·4, 51 and 50° but 51·0° - (½) off Degree symbol missing - (½) off	2	6
(b) (i) Angle of <u>refraction</u> is 90° or <u>Refracted</u> ray makes an angle of 90° with normal or <u>Refracted</u> ray is along surface of water 1	"There is no refracted ray" – zero marks "Total internal reflection is about to take place" – zero marks	1	
(ii) $\sin \theta_C$ = *1/n* (½) = 1/1·33 (½) θ_C = **49°** (1)		2	
(c)  Totally internally reflected ray shown (1) Angles of incidence and reflection must be the same as each other.		1 (1A)	

Sample Answer and Mark Allocation			Notes	Inner Margin	Outer Margin
30. (a)	Since graph is <u>straight line</u> through the <u>origin</u>,	(1)	"straight line" is not sufficient	1	4
(b)	$I_1 d_1^2 = I_2 d_2^2$	(½)		2	
	$4{\cdot}0 \times 1{\cdot}6^2 = I_2 \times 0{\cdot}40^2$	(½)			
	$I_2 = 64$ W m^{-2}	(1)	deduct (½) for wrong or missing units		
(c)			Both lines must be shown. Second line must be both parallel to and above original graph line. 1 or 0	1 (1A)	

Sample Answer and Mark Allocation	**Notes**	Inner Margin	Outer Margin
31. (a) (i) $I = \frac{E}{(R+r)}$ (½) $= \frac{12}{(6+2)}$ (½) $=$ **1·5 A** (1)		2	7
(ii) $V = Ir$ $= 1{\cdot}5 \times 2$ (½) $=$ **3·0 V** (½)	or $V = E - IR$ $= 12 - (1{\cdot}5 \times 6)$ (½) $=$ **3·0 V** (½) or $V_1 = \left(\frac{R_1}{R_1+R_2}\right) \times V_S$ $= \left(\frac{2}{2+6}\right) \times 12$ (½) $=$ **3·0 V** (½) **(½) off if no/wrong unit**	1	
(iii) $P = I^2R$ (½) $= (1{\cdot}5)^2 \times 6$ (½) $=$ **13·5 W** (14 W) (1) or $P = V^2/R$ (½) $= 9^2/6$ (½) $=$ **13·5 W** (14 W) (1) or $P = IV$ (½) $= 1{\cdot}5 \times 9$ (½) $=$ **13·5 W** (14 W) (1)		2	
(b) $P = I^2R$ (½) (Circuit) current increases (½) Total or circuit resistance decreases (½) Internal resistance less (½) or $P = V^2/R$ (½) Voltage across lamp increases (½) Lost volts decreases (½) Internal resistance less (½)	Look first for "**internal resistance less**" (½) Could be attempted by calculation	2 (2A)	

Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
32. (a)  shape levelling off (1) at 12 V (1) Curved shape must be correct before other mark can be awarded	Origin missing - (½) off	2	7
(b) $R = V/I$ (½) $= \frac{12}{2\times10^{-3}}$ (½) = **6000 Ω** (1) (6·0 k Ω)		2	
32. (c) (i) Initial current only depends on the values of the e.m.f. of the supply and resistor R which do not change. (1)	Both e.m.f. and resistance are required If miss out "which do not change" – zero marks	1	
(ii) Smaller capacitance because (1) Capacitor takes less time to discharge (1)	Must attempt an explanation Correct conclusion 1 mark, so long as not followed by wrong physics. "smaller capacitor" is wrong physics. **"Graph falls faster than before"** is not precise enough for second mark.	2 (2A)	

2012 Physics − Higher (Revised)						
Sample Answer and Mark Allocation				**Notes**	Inner Margin	Outer Margin
33.	(a)	Correct plotting of points and a Smooth curve through these points showing peak	(1) (1)	Deduct (½) for each error/omission in plotting the points. Deduct (½) for incomplete labelling of either axis (ie quantity and units). Deduce 1 for a missing graph line or if it is 'dot-to-dot' or 'multiple' lines.	2	7
	(b)	35 degrees ± 2		or consistent with (a)	1	
	(c)	Repeat measurements More measurements around/close to peak or smaller 'steps' in angle	(1) (1)		2 (1A)	
	(d)	Any valid work: including launch speed, mass of projectile, etc Brief plan of how experiment would be undertaken, including details of other variables kept constant		Looking for: • identification of a suitable variable to be investigated. • a description of how the independent variable could be changed and/or measured. • naming at least one variable to be kept constant.	2	

[END OF MARKING INSTRUCTIONS]