



2011 Physics

Higher

Finalised Marking Instructions

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Scottish Qualifications Authority

Marking Instructions – Higher Physics

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**. ($\frac{1}{2}$ 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 – $\frac{1}{2}$. 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 NOT 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.	$V=IR$ $7.5=1.5R$ $R=5.0\Omega$	(½) (½) (1)	Ideal Answer
2.	5.0 Ω	(2) Correct Answer	GMI 1
3.	5.0	(1½) Unit missing	GMI 2(a)
4.	4.0 Ω	(0) No evidence/Wrong Answer	GMI 1
5.	_____ Ω	(0) No final answer	GMI 1
6.	$R=\frac{V}{I}=\frac{7.5}{1.5}=4.0\Omega$	(1½) Arithmetic error	GMI 7
7.	$R=\frac{V}{I}=4.0\Omega$	(½) Formula only	GMI 4 and 1
8.	$R=\frac{V}{I}=\text{_____}\Omega$	(½) Formula only	GMI 4 and 1
9.	$R=\frac{V}{I}=\frac{7.5}{1.5}=\text{_____}\Omega$	(1) Formula + subs/No final answer	GMI 4 and 1
10.	$R=\frac{V}{I}=\frac{7.5}{1.5}=4.0$	(1) Formula + substitution	GMI 2(a) and 7
11.	$R=\frac{V}{I}=\frac{1.5}{7.5}=5.0\Omega$	(½) Formula but wrong substitution	GMI 5
12.	$R=\frac{V}{I}=\frac{75}{1.5}=5.0\Omega$	(½) Formula but wrong substitution	GMI 5
13.	$R=\frac{I}{V}=\frac{7.5}{1.5}=5.0\Omega$	(0) Wrong formula	GMI 5
14.	$V=IR$ 7.5 = 1.5 × R R=0.2 Ω	(1½) Arithmetic error	GMI 7
15.	$V=IR$ $R=\frac{I}{V}=\frac{1.5}{7.5}=0.2\Omega$	(½) Formula only	GMI 20

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Marking scheme

Section A

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

2011 Physics – Higher				Inner Margin	Outer Margin			
Sample Answer and Mark Allocation			Notes					
21.	(a)	(i)	$v^2 = u^2 + 2as$ $0 = 7^2 + 2 \times (-9.8) \times s$ $s = 2.5 \text{ m}$	$\frac{1}{2}$ $\frac{1}{2}$ 1	OR $v = u + at$ $0 = 7 + (-9.8)t$ $t = 0.71 \text{ s}$ $s = ut + \frac{1}{2}at^2$ $= 7 \times 0.71 +$ $\frac{1}{2}(-9.8)(0.71)^2$ $= 2.5 \text{ m}$	two equations $\frac{1}{2}$ two substitutions $\frac{1}{2}$ final answer 1	2	6
		(ii)	$v = u + at$ $0 = 7 + (-9.8) \times t$ $t = 0.71 \text{ s}$	$\frac{1}{2}$ $\frac{1}{2}$	OR $s = \left(\frac{u+v}{2}\right)t$ $2.5 = \left(\frac{7+0}{2}\right) \times t$ $t = 0.71 \text{ s}$	Deduct $\frac{1}{2}$ if last line is missing Deduct $\frac{1}{2}$ if missing or wrong unit ‘secs’ is a unit error and loses $\frac{1}{2}$ As this is a ‘show’ question, answer must quote a formula	1	

2011 Physics – Higher							
Sample Answer and Mark Allocation			Notes	Inner Margin	Outer Margin		
21.	(b)	(i)	1.5 ms⁻¹ to the right	1	If miss out direction – deduct ½ Missing units – deduct ½	1•	
		(ii)	Statement Z	1	If no attempt at justification or wrong Physics in justification } zero	2+	
			Horizontal speed of ball remains constant and equal to (horizontal) speed of trolley or Horizontal speed of the ball remains constant at 1.5 m s ⁻¹	1	Horizontal is required		

2011 Physics – Higher						
Sample Answer and Mark Allocation				Notes	Inner Margin	Outer Margin
23.	(a)	(i)	$m = 111.49 - 111.26$ $= 0.23 \text{ g}$ ½ $\rho = m/V$ ½ $= 0.23 \times 10^{-3} / 2.0 \times 10^{-4}$ ½ $= 1.15 \text{ kg m}^{-3}$ ½	If calculate two densities and subtract – no penalty ½ off for each unit error	2	7
		(ii)	Not all the air will be evacuated from jar OR It is impossible to get a (perfect) vacuum OR Some air has leaked back in	1	1•	
	(b)	(i)	$P_1 V_1 = P_2 V_2$ ½ $1.01 \times 10^5 \times 200 = P_2 \times 250$ ½ $P_2 = 8.1 \times 10^4 \text{ Pa}$ 1	Accept: $P_2 = 8, 8.1, 8.08, 8.080 \times 10^4 \text{ Pa}$ OR 80 000, 81 000, 80 800 Pa	2•	
		(ii)	<u>Particles collide</u> with <u>walls</u> of jar ½ Number of collisions on walls of jar is less frequent/less often ½ Average force (on walls) decreases ½ Pressure on walls of jar decreases ½	Look for this description first - it is needed before any other marks can be given For ‘particles’ accept ‘molecules’ Must be frequency, not just “less collisions” Any mention of E_k or speed of particles changing – max ½ mark	2	

2011 Physics – Higher			
Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
25. (a) 200 μC of charge increases voltage across plates by 1 volt OR 200 μC per volt OR One volt across the plates of the capacitor causes 200 μC of charge to be stored	1	1	10
(b) (i) $I = E/R$ $= 12/1400$ $= \mathbf{0.0086 \text{ A}}$ $(\mathbf{8.6 \text{ mA}})$	$\frac{1}{2}$ $\frac{1}{2}$ 1	2	
(ii) $E = \frac{1}{2} CV^2$ initial stored energy $= \frac{1}{2} \times (200 \times 10^{-6}) \times 12^2$ $= 0.0144 \text{ J}$ final stored energy $= \frac{1}{2} \times (200 \times 10^{-6}) \times 4^2$ $= 0.0016 \text{ J}$ Difference = $0.0144 - 0.0016$ decrease in stored energy $= \mathbf{0.0128 \text{ J}}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 1	3•	If this number is rounded off (eg to 0.014) – deduct $\frac{1}{2}$ Deduct $\frac{1}{2}$ if missing or wrong unit

2011 Physics – Higher			
Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
(c) (i) 0.30 s	Deduct ½ if missing or wrong unit	1•	
(ii) $s = ut + \frac{1}{2} a t^2$ ½ $0.80 = 1.5 \times 0.3 + \frac{1}{2} \times a \times (0.3)^2$ ½ $a = 7.8 \text{ m s}^{-2}$ 1	OR consistent with 25(c) (i)	2+	
(iii) Percentage (fractional) uncertainty in (measuring) <u>distance</u> will be smaller or Percentage (fractional) uncertainty in (measuring) <u>time</u> will be smaller	Must be <i>percentage</i> or <i>fractional</i> uncertainty ie “uncertainty in time is less” is insufficient	1+	

2011 Physics – Higher						
Sample Answer and Mark Allocation			Notes	Inner Margin	Outer Margin	
26.	(a)	(i) Inverting	1	Do not accept “inverted” or “inverse”	1	7
		(ii)	$V_o = -\frac{R_f}{R_1} \times V_1$ $12 = \frac{-80}{10} \times V_1$ $V_1 = -1.5 \text{ V}$	½ Formula is wrong if negative sign is missing ½ or using any other correct points from graph 1 Accuracy of calculation determined from $\pm \frac{1}{2}$ scale division reading from graph	2	
		(iii) Output cannot be greater than (approx 85% of) the supply voltage OR Saturation <u>of the amplifier</u> has been reached	1	<i>“Output voltage saturates” - no</i> <i>“It saturates” - no</i> <i>“Op amp saturates” - yes</i>	1	

2011 Physics – Higher			
Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
<p>(b)</p> <p>(0 – 1s) constant positive voltage ½</p> <p>(1 – 2s) constant negative voltage ½</p> <p>(2 – 3s) constant positive voltage ½</p> <p>Correct values of these constant voltages 3 × ½</p>	<p>Either or both labels missing ½ off</p> <p>Either or both units on axes is missing ½ off</p>	3+	

2011 Physics – Higher			
Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
27. (a) (i) $n = \frac{\sin \theta_1}{\sin \theta_2}$ ½ $1.66 = \frac{\sin 40}{\sin \theta}$ ½ $\theta = 22.8^\circ$ 1	Degrees symbol missing – ½ off	2	7
(ii) (A) $\sin \theta_c = 1/n$ ½ $= 1/1.66$ ½ $\theta_c = 37.0^\circ$ 1	Degrees symbol missing – ½ off	2	
(B) 74° 1	or consistent with 27(a)(ii)(A) Degrees symbol missing – ½ off	1+	

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Sample Answer and Mark Allocation		Notes	Inner Margin	Outer Margin
(b)	No OR “it is totally internally reflected” $\frac{1}{2}$ n depends on frequency } OR $n_{\text{blue}} > n_{\text{red}}$ } $\frac{1}{2}$ OR blue refracts more than red } (critical angle) $_{\text{blue}} < (\text{critical angle})_{\text{red}}$ } OR } $\frac{1}{2}$ the angle of incidence has increased } angle of incidence of blue light on face PQ } is greater than the critical angle } $\frac{1}{2}$	Look for “ No ” first before progressing Must be totally internally reflected, not just internally reflected	2+	

2011 Physics – Higher						
Sample Answer and Mark Allocation			Notes	Inner Margin	Outer Margin	
28.	(a)	Light travels as waves OR Energy in light is carried as a wave OR Light is a wave	1	“Light carries waves” - NO	1	5
	(b)	(i)	$d \sin \theta = n \lambda$ ½ $5 \times 10^{-6} \times \sin 11 = 2 \times \lambda$ ½ $\lambda = 480 \text{ nm}$ 1	If use 22° then only ½ for formula Must be 11° and $n = 2$	2	
		(ii)	Spacing of maxima increases ½ λ in liquid increases ½ (as n decreases) $\sin \theta = n \lambda / d$ ½ θ increases ½	Look for first statement before progressing No justification – zero Wrong Physics in justification gets zero, eg any mention of the ‘n’ in this formula being the refractive index	2+	

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Sample Answer and Mark Allocation		Notes	Inner Margin	Outer Margin
29.	(a) (i)	$f = \frac{c}{\lambda} \quad \frac{1}{2}$ $= \frac{3.00 \times 10^8}{525 \times 10^{-9}} \quad \frac{1}{2}$ $= 5.71 \times 10^{14} \text{ Hz}$ $E = hf \quad \frac{1}{2}$ $= 6.63 \times 10^{-34} \times 5.71 \times 10^{14} \quad \frac{1}{2}$ $= \mathbf{3.79 \times 10^{-19} \text{ J}}$		6
	(ii)	$\left[\begin{aligned} E_k &= hf - hf_0 \\ &= 3.79 \times 10^{-19} - 2.24 \times 10^{-19} \end{aligned} \right]$ $= \mathbf{1.55 \times 10^{-19} \text{ J}} \quad 1$	<p>Must use 3.79×10^{-19}</p> <p>A negative answer gets zero</p>	1
	(b) (i)	<p><u>Photons</u> with frequency below f_0 do not have enough <u>energy</u> to release electrons</p> <p>OR</p> <p><u>Photons</u> with frequency below f_0 have <u>energy</u> smaller than work function</p>	<p>“because f_0 is threshold frequency” – No</p> <p>Must be an answer in terms of photon energy</p>	1
	(ii)	<p>Work function = hf_0 (or $E = hf_0$) $\frac{1}{2}$</p> $2.24 \times 10^{-19} = (6.63 \times 10^{-34}) \times f_0 \quad \frac{1}{2}$ $f_0 = \mathbf{3.38 \times 10^{14} \text{ Hz}} \quad 1$		2•

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Sample Answer and Mark Allocation				Notes	Inner Margin	Outer Margin	
30.	(a)	(i)	(Nuclear) Fusion	1	“Fussion” gets 0 marks	1	8
		(ii)	Total mass before $= 3.342 \times 10^{-27} + 5.005 \times 10^{-27}$ $= 8.347 \times 10^{-27} \text{ (kg)}$	½	If one mass is rounded, max 1 If both rounded, max ½ (formula)	3•	
			Total mass after $= 6.642 \times 10^{-27} + 1.675 \times 10^{-27}$ $= 8.317 \times 10^{-27} \text{ (kg)}$	½			
			Loss in mass = $0.030 \times 10^{-27} \text{ (kg)}$				
			Energy released = mc^2	½			
			$= 0.030 \times 10^{-27} \times (3.00 \times 10^8)^2$	½			
			$= \mathbf{2.7 \times 10^{-12} \text{ J}}$	1			
	(b)	(i)	Energy absorbed $= -1.360 \times 10^{-19} - (-5.424 \times 10^{-19})$ $= 4.064 \times 10^{-19} \text{ (J)}$	½	If subtraction results in a negative energy – only formulae marks	3+	
			$E = hf$	½			
			$4.064 \times 10^{-19} = 6.63 \times 10^{-34} \times f$	½			
			$f = 6.13 \times 10^{14} \text{ (Hz)}$				
			$\lambda = \frac{c}{f}$	½			
			$= \frac{3.00 \times 10^8}{6.13 \times 10^{14}}$ $= \mathbf{489 \text{ nm}}$	½			
		(ii)	“Blue” OR “blue-green” NOT “green”		<i>or</i> consistent with (b)(i) as long as in the visible spectrum	1•	

[END OF MARKING INSTRUCTIONS]