2010 Physics

Higher

Marking Instructions

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Scottish Qualifications Authority

Detailed 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**. (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 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.	$V=IR$ $7{\cdot}5=1{\cdot}5R$ $R=5{\cdot}0\,\Omega$	(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.	$\underline{\qquad}\,\Omega$	(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.	$R=\frac{V}{I}=\underline{\qquad}\,\Omega$	(½) Formula only	GMI 4 and 1
9.	$R=\frac{V}{I}=\frac{7{\cdot}5}{1{\cdot}5}=\underline{\qquad}\,\Omega$	(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

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Marking scheme

Section A

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

Sample Answer and Mark Allocation					**Notes**	Inner Margin	Outer Margin
21.	(a)	(i)	47 km ± 1 $156^{(o)}$ ± 2 24° east of south is correct 66° south of east is correct	1 1	Cosine & sine rules can be used to get these answers but the tolerances are for scale diagrams only	2	7
		(ii)	$v = s / t$ v = 47100 or 47000 / 900 v = 52·3 or 52·2 m s^{-1} [OR 188 km h^{-1}] at 156^{o}	 ½ 1 ½	or consistent with (a)(i) Taking t = 15 is treated as unit error	2●	
	(b)	(i)	Lift = mg OR lift = weight OR forces balanced $W = 1{\cdot}21 \times 10^4 \times 9{\cdot}8$ W = 119 kN	½ ½		1	
		(ii)	Weight is less There is a resultant force OR unbalanced force OR net force upwards Upward acceleration OR The helicopter <u>accelerates upwards</u> weight is less there is a net upward force	½ ½ 1 1 ½ ½	Independent marks Can be done by recalculation, ie New weight = 96 040N ½ F = 119 000 - 96 040N = 22 960 N upwards ½ $a = F / m$ = 22 960 / 9800 = 2·3 m s^{-2} upwards 1 **must have both 2·3 m s^{-2} and 'upwards'** 'upward acceleration' could be described in terms of speed / velocity changes eg "it moves upwards getting faster"	2+	

Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
22. (a) (i) The **total** momentum before (a collision) equals the **total** momentum after (the collision) ½ In the absence of external forces Or in an isolated system ½		1	5
(ii) $m_Au_A + m_Bu_B = m_Av_A + m_Bv_B$ ½ $(0.22 \times 0.25) + 0.16u = (0.38 \times 0.2)$ ½ $0.055 + 0.16u = 0.076$ $u = 0.13\ \text{m s}^{-1}$ 1	'TMB = TMA' is worth nothing by itself − needs substitution before any marks can be allocated.	2●	
(b) Less ½ Total (initial) momentum is less ½ Mass is constant ½ v = momentum / mass ½	Can be done by recalculation	2+	

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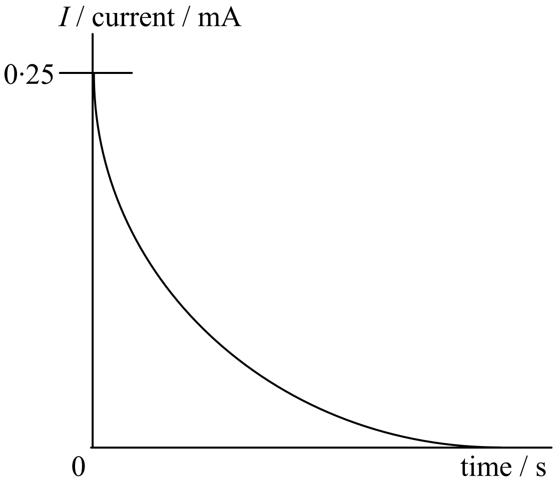
Sample Answer and Mark Allocation		Notes	Inner Margin	Outer Margin
23. (a) (i) $v^2 = u^2 + 2as$	½	must have final answer or -(½) Must start with an equation or else 0 marks. $v = \sqrt{(2gh)}$ is OK.	1	7
$v^2 = 0^2 + 2 \times 9{\cdot}8 \times 2$	½			
$v = 6{\cdot}3\ \text{m s}^{-1}$				
OR				
$(m)gh = ½(m)v^2$	½	If g = -9.8 then ‘s’ or ‘h’ must be -2 or else max ½.		
$v = \sqrt{(2 \times 9{\cdot}8 \times 2)}$	½			
$v = 6{\cdot}3\ \text{m s}^{-1}$				
(ii) $(\Delta p) = m\,(v - u)$	½	If use first method, v and u must have opposite signs and be the correct way around or max (½) Ft = $(v - u)$ is OK	2+	
$= 40\ (-5.7 - 6.3)$	½			
$= -480\ \text{kg m s}^{-1}$	1			
OR				
$\Delta p = \text{m}\ \Delta v$	½			
$\Delta p = 40 \times 12$	½			
$\Delta p = 480\ \text{kg m s}^{-1}$	1			
OR				
$(\Delta p) = m\,(v - u)$	½			
$= 40\ (5.7 - 6.3)$	½			
$= -480\ \text{kg m s}^{-1}$	1			
OR				
$\Delta p = \text{m}\ \Delta v$	½			
$\Delta p = 40 \times -12$	½			
$\Delta p = -480\ \text{kg m s}^{-1}$	1			
(iii) $F = \Delta p / t$	½		2	
$F = (-)480 / 0{\cdot}5$	½			
$F = (-)960\ \text{N}$	1			
(b) Weight / downwards force is constant	½		2+	
vertical component(s) balances weight	½			
as angle increases tension must increase	½			
because T = ½ W / cos θ	½			

Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
24. (a) (i) 0·51 s 1	‘secs’ is a unit error.	1●	6
(ii) Random uncertainty = {max – min} / no. ½ = {0·55 – 0·49} / 6 ½ = 0·01 s		1●	
(b) (i) $Q = CV$ ½ $Q = 1{\cdot}6 \times 10^{-3} \times 4{\cdot}5$ ½ $Q = 7{\cdot}2 \times 10^{-3}$ C 1		2	
(ii) ($I = V / R$ $I = 4{\cdot}5 / 18000$ $I = 0{\cdot}25$ mA)  1 for correct current value 1 for correct shape	No graph, no marks. Wrong or missing units for current − ½ mark. Must start at 0.25 mA on axis and must tend towards zero. Line must not cross axis. -½ for missing origin	2	

2010 Physics − Higher Sample Answer and Mark Allocation				Notes	Inner Margin	Outer Margin
25. (a) (i)	$R_1 / R_2 = R_3 / R_4$ $R_1 = 6000 \times 800 / 4000$ $R_1 = 1200\ \Omega$	½ ½ 1			2	7
(ii)	$V_P = 4{\cdot}0$ V $V_Q = 4{\cdot}8$ V Voltmeter reading = 0·8 V	½ ½ 1			2+	
(b)	$V_o = (V_2 - V_1)(R_f / R_1)$ $V_o = (3{\cdot}2 - 3{\cdot}0)(2{\cdot}0 \times 10^6 / 20 \times 10^3)$ $V_o = 20$ (V) (But, due to saturation, the actual output voltage is) 10 to 12 V	½ ½ 1 1		$V_o = (3{\cdot}0 - 3{\cdot}2)(2{\cdot}0 \times 10^6 / 20 \times 10^3)$, is wrong Physics → max ½ "voltage saturated" is wrong Physics.	3●	

2010 Physics − Higher Sample Answer and Mark Allocation		Notes	Inner Margin	Outer Margin
26. (a) (i) $V_p = 2{\cdot}0$ V			1	7
(ii) $f = 1 / T$ $f = 1 / 0{\cdot}01$ $f = 100$ Hz	½ ½ 1		2●	
(b) Stays the same / constant / no change / nothing	1		1	
(c) Increases / doubles	1		1	
(d) The capacitor <u>will</u> be damaged The peak voltage from this power supply is greater than 16 V	1 1		2+	

Sample Answer and Mark Allocation	Notes	Inner Margin	Outer Margin
27. (a) $S_2P - S_1P = (n + \frac{1}{2})\lambda$ ½ $0{\cdot}34 = \lambda / 2$ ½ $\lambda = 0{\cdot}68$ m 1 OR path difference = ½ λ ½ path difference = 0·34 m ½ $\lambda = 0{\cdot}68$ m 1		2●	4
(b) Increases / greater 1 No longer **destructive** interference 1	Second mark is conditional on the first	2+	

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Sample Answer and Mark Allocation					Notes	Inner Margin	Outer Margin
28.	(a)	(i)	$P = F / A$ $F = 4{\cdot}6 \times 10^5 \times 3{\cdot}00 \times 10^{-2}$ $F = 13800$ N	½ ½ 1		2	12
		(ii)	$P_1V_1 = P_2V_2$ $4{\cdot}6 \times 10^5 \times 1{\cdot}6 \times 10^{-3} = 1{\cdot}0 \times 10^5 \times V_2$ $V_2 = 7{\cdot}36 \times 10^{-3}$ m^3 V of water = $(7{\cdot}36 – 1{\cdot}6) \times 10^{-3}$ $= 5{\cdot}76 \times 10^{-3}$ m^3	½ ½ 1 1		3+	
	(b)	(i)	Stays the same / constant / nothing / no change	1		1	
		(ii)	$n = \sin \theta_1 / \sin \theta_2$ $n = \sin 60 / \sin 41$ $n = 1{\cdot}32$	½ ½ 1	Do not accept a bare statement of $n = 1{\cdot}33$	2●	
		(iii)	$\sin \vartheta_C = 1 / n$ $\sin \vartheta_C = 1 / 1{\cdot}32$ $\vartheta_C = 49^o$	½ ½ 1	 or consistent with (b)(ii) Degrees is a unit and is needed.	2	
		(iv)	Less Larger refractive index	1 1	Look for this first.	2+	

Sample Answer and Mark Allocation			Notes	Inner Margin	Outer Margin
29.	(a)	Very small area / diameter / radius (of beam) ½ $I=P / A$ OR High irradiance ½		1	7
	(b)	$E = hf$ ½ $E = 6{\cdot}63 \times 10^{-34} \times 4{\cdot}74 \times 10^{14}$ ½ $E = 3{\cdot}14 \times 10^{-19}$ J 1		2	
	(c)	Frequency / wavelength / energy Direction Speed Phase / coherent velocity	any 2 rows ½ mark each Not 'kinetic energy' / 'amplitude' / 'in step'	1	
	(d)	$\lambda = v / f = 3 \times 10^8 / 4{\cdot}74 \times 10^{14} = 633$(nm) 1 $n\lambda = d \sin \theta$ ½ $d = (2 \times 633 \times 10^{-9}) / \sin 30$ ½ $d = 2{\cdot}5 \times 10^{-6}$ m 1	← anywhere	3+	

Sample Answer and Mark Allocation		Notes	Inner Margin	Outer Margin
30. (a) 146			1●	8
(b) (i) $r = 93$ $s = 237$	½ ½		1●	
(ii) T = Neptunium (OR Np)	1	or consistent with (b)(i)	1●	
(c) $N = At$ $N = 30 \times 10^3 \times 60$ $N = 1{\cdot}8 \times 10^6$	½ ½ 1	Deduct ½ if any units given If 't' not in seconds → max ½ mark.	2●	

Sample Answer and Mark Allocation		Notes	Inner Margin	Outer Margin
(d) $I = V / R$			3+	
$I = 5 / 16$	½			
$I = 0·3125$ (A)	½			
$E = I(R + r)$				
$9 = 0·3125\ (R + 2)$	½			
$9 = 0·3125R + 0·625$				
$8·375 = 0·3125R$				
$R = 26·8\ \Omega$	½			
$R = 26·8 – 16 = 10·8 = 11\ \Omega$	1			
OR				
$I = V / R$				
$I = 5 / 16$	½			
$I = 0·3125$ (A)	½			
$V_{lost} = Ir = 2 \times 0·3125 = 0·625$ (V)	½			
$V_{resistor} = 9 – (5 + 0·625) = 3·375$ (V)	½			
$R = V / I$				
$R = 3·375 / 0·3125$				
$R = 10·8 = 11\ \Omega$	1			
OR				
$I = V / R$				
$= 5 / 16$	½			
$= 0·3125$ (A)	½			
$R_T = E/I$				
$= 9 / 003125$	½			
$= 28·8\ \Omega$	½			
$R = R_T - 18 = 28·8 - 18$				
$= 10·8 = 11\ \Omega$	1			

[END OF MARKING INSTRUCTIONS]