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NORTHERN IRELAND GENERAL CERTIFICATE OF SECONDARY EDUCATION (GCSE) AND NORTHERN IRELAND GENERAL CERTIFICATE OF EDUCATION (GCE)

MARK SCHEMES (2010)

Foreword

Introduction

Mark Schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16- and 18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

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ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2010

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

WEDNESDAY 13 JANUARY, MORNING

MARK SCHEME

					AVAILABLE MARKS
1	**(a)**	**(i)**	Force and acceleration underlined	[1]	
		(ii)	Vector has direction, scalar doesn't	[1]	
	(b)	**(i)**	210 sin 55° 172 N	[1] [1]	
		(ii)	**(i)** Horizontal components are equal **Forces** are in equilibrium	[1]	
			(ii) 128 cos 20º = 120 (N)	[1]	
			210 cos 55º = 120 (N)	[1]	7
2	**(a)**		Diagram Apparatus [1] and detail [1] Dropped object + stopwatch = 0	[2]	
	(b)		Measurement(s) or instrument(s) Repetition Range	[1] [1] [1]	
	(c)		Equation Graph axes Gradient	[1] [1] [1]	8
3	**(a)**	**(i)**	1.38×10^6 N (1.4×10^6 N)	[1]	
		(ii)	F = ma Resultant force = 4.6×10^5 N Driving force = 4.6×10^5 N + (a) (i) allow ecf 1.84×10^6 N (1.8×10^6 N)	[1] [1] [1] [1]	
	(b)		friction is reduced (between wheel and track) (wheel spin) or forward drive force decreases slows down/acceleration decreases Independent marks	[1] [1]	7
4	**(a)**		The (mass) weight of the **diver** The (perpendicular) distance from diver to pivot	[1] [1]	
	(b)	**(i)**	Moment = F × d (4.88 – 1.60) + 0.28 = 3.56 Subs M = (65)(9.81)(3.56) Allow g = 10ms^{-2} → 2314 N	[1] [1] [1]	
		(ii)	2270 (or ecf) = 75(9.81)d d = 3.09 m 0.19 m or 0.18 or 0.2 Right, towards person	[1] [1] [1] [1]	9

AVAILABLE MARKS

5 **(a)** energy can be changed from one form to another but cannot be **created** or **destroyed** or equivalent [1]

(b) **(i)** Calculates pe at top = 7063J
or states 85% of gpe at start = ke at bottom = 6004J
or 0.85mgh = ½ mv^2 [1]
v = 11.55ms^{-1} [1]
S.E. 4.85 ms^{-1} award [1]/2

(ii) ke at top of 2nd hill = 3564.5J [1]
change in pe going up = 5297J [1]
(3564.5 + 5297) – **6004** ecf from (b)(i) [1]
Work Done = 2858J [1] 7

6 **(a)** extension is (directly) proportional to applied load provided the elastic or plastic or proportional limit is not exceeded [1]

(b)

Mass Added /kg	Load /N	Length of spring /cm	Extension /cm
1.00	9.8	6.1	0.9
2.00	19.6	7.0	1.8
3.00	29.4	7.9	2.7
4.00	39.2	8.8	3.6
5.00	49.1	9.7	4.5

4 or 5 Loads correct [1]
4 or 5 Extensions correct [1]
Accept use of g = 10

(c) **(i)** uses F = kx [1]
Proves k approx constant for 3 values [1]
Value of k = 1090 (N m^{-1}) (1100 N m^{-1}) [1]

(ii) plot F on y axis, x on x-axis
don't accept "plot F and x" for 2nd mark [1]
k = gradient [1]
Accept axes reversed + grad = $\frac{1}{k}$ 8

7 **(a)** **(i)** Base units of force kg m s^{-2} [1]
Base units of voltage kg m^2 s^{-3} A^{-1} [2]
[1] for correct eqn e.g. W = QV

(ii) Not a force, different base units [1]

		AVAILABLE MARKS
(b) **(i)** energy transferred per unit charge don't accept definition of the volt	[1]	
(ii) when there is no load, no current, open circuit	[1]	6
8 **(a)** Combined resistance of parallel resistors = 80Ω	[1]	
80 + 80 = 160 Ω	[1]	
(b) **(i)** $P = i^2 R$	Eqn [1]	
$I = i^2 \times 80$	Subs [1]	
(ii) $\sum i = 0.112$ or $V_{TOT} = 17.9$	[1]	
Ratio 2:1 V(120 Ω) = 8.96	[1]	
$i = 0.075$ (A) $i = \frac{V}{R} = 0.075$ (A) = 75m A	[1]	
S.E. 37.1 mA → [1]/3		7
9 **(a)** Power pack or batteries & variable resistor or variable power supply	[1]	
ammeter in series with bulb	[1]	
voltmeter across bulb	[1]	
–1 for non-standard symbols (apply once only)		
(b) resistance increases	[1]	
as I increases, temperature increases	[1]	
fixed ions vibrate more, electrons collide more often (losing energy or equivalent)	[1]	
Quality of Written Communication		
[2] marks The candidate expresses ideas clearly and fluently, through well-linked sentences and paragraphs. Arguments are generally relevant and well structured. There are few errors of grammar, punctuation and spelling.		
[1] mark The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There are some errors in grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.		
[0] marks The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage.	[2]	

			AVAILABLE MARKS
(c) Reads V = 6.0(V)	[1]		
R = 12 (Ω)	[1]		10
10 **(a)** **(i)** $V_{out} = \dfrac{500(12)}{500 + 10000}$	[1]		
0.57(V)	[1]		
(ii) $V_{out} = \dfrac{200000(12)}{200000 + 10000}$	[1]		
11.42 > **10 therefore lights** or alternative statement	[1]		
(b) Voltage across it would decrease as darker	[1]		
Work in reverse (light when bright, go off when dark)	[1]		6

New Specification

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2010

Physics

Assessment Unit AS 2

Module 2: Waves, Photons and Medical Physics

[AY121]

MONDAY 18 JANUARY, AFTERNOON

MARK SCHEME

					AVAILABLE MARKS
1	**(a)**	**(i)** amplitude = 4.0 cm		[1]	
		(ii) f = 1/T	[1]		
		= $1/(8 \times 10^{-3})$ = 125 Hz	[1]	[2]	
	(b)	**(i)** Not useful Graphs show particle oscillation without reference to its direction or suitable alternative		[1]	
	(c)	**(i)** Corresponding points on each wave coincide in time		[1]	
		(ii) Time difference = 2 ms	[1]		
		$\frac{1}{4}$ wave	[1]		
		Phase difference = 90° ($\frac{\pi}{2}$ rad → 2/3)	[1]	[3]	8
2	**(a)**	Apparatus (illuminated object, lens, screen)		[1]	
	(b)	Object (at fixed) distance from lens explained	[1]		
		Find screen (image) position for sharp focus	[1]		
		Repeat (for other object distances) defined	[1]	[3]	
	(c)	Measure object distances (u) and image distances consistent with **(b)**		[1]	
	(d)	Graph $\frac{1}{u}$ v $\frac{1}{v}$, Intercept (either axis) $= \frac{1}{f}$; $f = \frac{1}{\text{intercept}}$ | Calculate using $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$	[1]		
		| Average	[1]	[2]	

I at ∞, averaging values → 2/2

Quality of written communication

2 marks
The candidate expresses ideas clearly and fluently, through well-linked sentences and paragraphs. Arguments are generally relevant and well structured. There are few errors of grammar, punctuation and spelling.

1 mark
The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There are some errors in grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.

0 marks
The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage. [2] — 9

						AVAILABLE MARKS
3	**(a)**	48.6°			[1]	
	(b)	$\sin C = \frac{1}{n}$ etc		[1]		
		C = 43.2°		[1]	[2]	
	(c)	TIR Allow “reflected” if TIR on diagram (ECF from **(b)**)			[1]	
	(d)	Reflection (i ≈ r) from AD and normal refraction at DC (ECF from **(b)**)			[1]	5
4	**(a)**	**(i)**	Waves from S_1 meet waves from S_2 and displacements add up or superposed waves		[1]	
		(ii)	Constant phase difference (same frequency) or coherent sources Do **not** accept “in phase” on its own		[1]	
		(iii)	Similar amplitude		[1]	
	(b)	1.	Fringe(s) become **brighter**	[1]		
			Light does not travel as far	[1]		
		2.	Fringes become closer together	[1]		
			Fringe spacing proportional to distance to screen	[1]	[4]	7
5	**(a)**	$dB = 10\log_{10}\left(\frac{9.9 \times 10^{-5}}{1.0 \times 10^{-12}}\right)$ subs [1] each		[2]		
		80 (dB)		[1]	[3]	
	(b)	**(i)**	86 (dB) (ECF **(a)**)		[1]	
		(ii)	New $I = 4.0 \times 10^{-4}$ ($W\,m^{-2}$) (ECF **(b)(i)**)	[1]		
			Factor $\left(= \frac{4.0 \times 10^{-4}}{9.9 \times 10^{-5}}\right) = 4$	[1]	[2]	6
6	**(a)**	(Slowly) **raises (inner) tube** until loud(est) note is heard		[1]		
		Small adjustment to fine tune		[1]	[2]	
	(b)	**(i)**	$\lambda = 4l = 4 \times 38 \times 10^{-2} = 1.52\,m$	[1]		
			$v = f\lambda = 200 \times 1.52$	[1] subs or eqn		
			$= 304\,m\,s^{-1}$	[1] ans	[3]	
		(ii)	Gives an average of results or spot anomalies		[1]	
		(iii)	L = 3.8 cm or λ = 0.152 or too small	[1]		
			For accurate measurement	[1]	[2]	8

						AVAILABLE MARKS
7	**(a)**	**(i)**	U.S. has to travel through bone or longer path	[1]		
			Energy absorbed	[1]	[2]	
		(ii)	$t = 8 \times 1 \times 10^{-6}$	[1]		
			$s = v \times t = 4000 \times 8 \times 10^{-6} = 3.2 \times 10^{-2}$	[1]		
			thickness $= 1.6 \times 10^{-2}$ m = 1.6 cm	[1]	[3]	
	(b)	**(i)**	**Transducer is moved** (so that multiple reflections are made)	[1]		
			Image is composed using **computer**	[1]	[2]	
		(ii)	Antenatal scan [1] size of foetal head [1] **or** Disease diagnosis [1] tumour location [1]		[2]	9
8	**(a)**		Energy of **photons** (of light given to electrons in metal)	[1]		
			Energy used to enable electrons to escape.	[1]	[2]	
	(b)	**(i)**	Minimum energy	[1]		
			For electron to escape from metal (from metal surface = minimum)	[1]	[2]	
		(ii)	2.96×10^{-19} (J)		[1]	
		(iii)	E = hf or subs (ECF **(ii)**)	[1]		
			$f = 4.46 \times 10^{14}$ (Hz)	[1]	[2]	7
9	**(a)**	**(i)**	An orbit with an energy where an electron can remain or permitted energy state or stable state		[1]	
		(ii)	Energy level closest to the nucleus/lowest state/ most stable state		[1]	
	(b)	**(i)**	Electrons given (a positive amount of) energy to be ionised	[1]		
			Electrons considered to have zero energy when ionised	[1]	[2]	
		(ii)	$E = E_1 - E_2$ $= (-3.34 - -13.6) \times 1.6 \times 10^{-19} = 1.64 \times 10^{-18}$	[1]		
			$hc/\lambda = 1.64 \times 10^{-18}$ subs	[1]		
			$\lambda = 1.21 \times 10^{-7}$ m	[1]	[3]	
	(c)		Visible photon energy ≠ energy level difference	[1]		
			Photon must yield all its energy instantaneously or not at all/ Cannot be absorbed	[1]	[2]	9

						AVAILABLE MARKS
10	**(a)**	Interference or polarisation			[1]	
	(b)	**(i)** Fast moving electrons in **evacuated tube**	[1]			
		Diffracted by a crystalline target	[1]			
		Form **concentric circles** on (fluorescent) screen	[1]		[3]	
		(ii) Rings spread out more	[1]			
		de Broglie wavelength increased	[1]			
		Diffraction increases with wavelength	[1]		[3]	7
					Total	**75**