

**Published Mark Schemes for
GCE AS Physics**

Summer 2010

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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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New
Specification



Rewarding Learning

**ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2010**

Physics

Assessment Unit AS 1

Module 1: Forces, Energy and Electricity

[AY111]

MONDAY 14 JUNE, MORNING

MARK SCHEME

1 (a)

Physical Quantity	S.I. base unit
(time)	(second or s)
mass	kilogram or kg
length	metre or m
temperature	kelvin or K
current	ampere or A or amp
amount of substance	mole or mol

$\frac{1}{2}$ mark each – round up [3]

(b) $\text{kg m}^{-1} \text{s}^{-2}$, A s, $\text{kg m}^2 \text{s}^{-3}$, $\text{kg m}^2 \text{s}^{-3} \text{A}^{-2}$ 1 mark each [4]

AVAILABLE MARKS

7

2 (a) $v^2 = u^2 + 2as$

$$0 = (25 \sin 30^\circ)^2 - 2(9.81)s,$$

$$s = 8.0 \text{ m}$$

eqn + subs [1]

answer [1] [2]

(b) $v = u + at$

$$\text{time} = 25 \sin 30^\circ / 9.81 = 1.3$$

$$\text{time} \times \frac{2}{1} = 2.6 \text{ s}$$

↑ independent

eqn [1]

subs [1]

answer [1] [3]

(c) $s = 25 \cos 30^\circ \times 2.6$ ecf (b) for time

$$s = 56 \text{ m}$$

subs [1]

answer [1] [2]

7

3 (a) Everybody will continue in a state of (rest or) uniform motion unless acted upon by an unbalanced force.

If body A exerts a force on body B, body B exerts an equal and opposite force on body A

1 mark each [2]

(b) (i) The brick is stationary (so by Newton's first law) [1]

The normal contact force exerted by the ground on the brick =

The weight of the brick or A=B

[1] [2]

(ii) The downwards force exerted by the brick on the ground = The normal contact force exerted by the ground on the brick or C=A

[1]

The gravitational attraction of the brick on the Earth = weight of the brick D=B

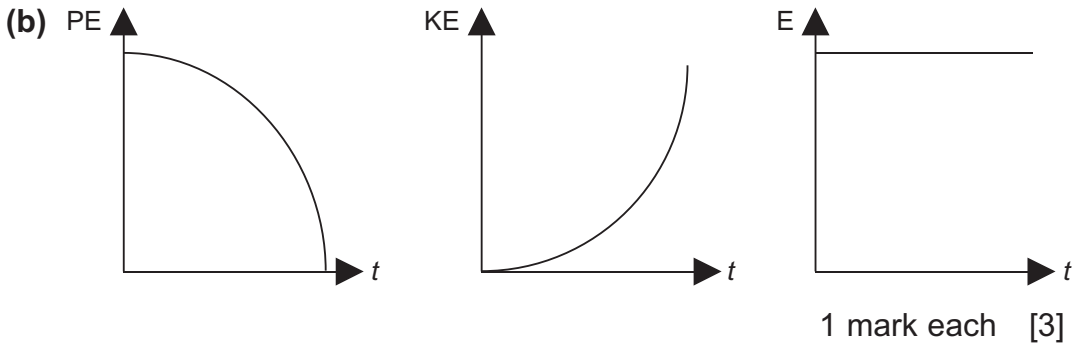
[1] [2]

6

- 4 (a) product of force and the perpendicular distance (from point to the line of action of the force.) [1]
- (b) total clockwise moments (about a point) equals total anti-clockwise moments (about same point) [1] when in equilibrium [1] [2]
- (c) (i) $2 \times 30 \text{ g} + 0.8 \times 65 \text{ g} = 3 \times F_Y$ subs each side [2]
 $F_Y = 366 \text{ N}$ [1] [3]
- (ii) "No" $65 \text{ g} > 30 \text{ g}$ therefore always a resultant clockwise moment; since both forces 1 m from pivot [2] [2]

8

- 5 (a) Apple on tree has PE only, as falls PE decreases KE increases, when hits ground all KE – total energy throughout remains constant $\frac{1}{2}$ each round down [2]



- (c) $h = 0.5 (9.81) 0.8^2 = 3.1 \text{ m}$ [1]
 $PE = mgh = 1.2 \times 3.1$ [1]
 $PE = 3.8 \text{ or } 3.7 \text{ J}$ [1] [3]

8

- 6 (a) stress = F/A , strain = e/L [1]
 $E = FL/Ae$ [1] [2]
- (b) A clearly labelled diagram including clamp, pulley, slotted masses [1]
 An outline of the procedure [1]
 Measure diameter of wire with micrometer [1]
 Measure L + detail (words or diagram) [1]
 Measure resulting extension caused by addition of loads using rule or travelling microscope or vernier [1]
 Plot load against extension [1]
 Gradient = EA/l [1]
 Alternative: ● calculate multiple values of E [1]
 ● find mean [1] [6]

Quality of Written Communication

AVAILABLE MARKS

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] [2]

10

7 (a) (i) electrons or e⁻

[1]

(ii) correct arrow from Y to X

[1] [2]

(b) 3 coulombs (of charge flows) per second

[1] [1]

(c) (3 x 4 x 60) C

[1]

4.5 x 10²¹ electrons flow per second

[1] [2]

(d) electrons drift immediately pd applied

[1]

At all positions

[1] [2]

7

8 (a) the resistance of 1 m of material of cross sectional area 1 m²

[1] [1]

(b) (i) $\rho = RA/l$

eqn [1]

$$\rho = 9 \times 3.14 \times (0.1 \times 10^{-3})^2 / 15$$

sub [1]

$$\rho = 1.88 \times 10^{-8} (\Omega \text{ m})$$

[1]

$\Omega \text{ m}$

[1] [4]

(ii) 270 Ω Allow ecf for ρ from (i) if calculating using $R = \frac{\rho l}{A}$

[1] [1]

			AVAILABLE MARKS
(c) (i)	heating element B connection A	[1]	
(ii)	Explanation –heating element requires high resistance $P = I^2 R$ so bigger R greater energy lose to heat	[1]	[2]
			8
9 (a)	(more current drawn) the terminal pd falls or energy dissipated as heat in emf source	[1]	[1]
(b) (i)	gradient	[1]	
(ii)	(extrapolate and find) y intercept	[1]	[2]
(c)	$I = V/R = 9.5/2 = 4.75$ $10 = 9.5 + 4.75r$ $r = 0.1\Omega$	[1] [1] [1]	[3]
			6
10 (a) (i)	$4.5\ \Omega$		[1]
(ii)	$I_1 = I_2 + I_3$		[1]
(iii)	$4.5\ \text{A}$	[1]	[3]
(b)	0	[1]	[1]
(c) (i)	$6\ \Omega$	[1]	
(ii)	$12\ \Omega$ and $6\ \Omega$ in / resistance $4\ \Omega$ $10\ \Omega$ in / with $6\ \Omega$ $R_{\text{TOT}} = 3.75\ \Omega$	[1] [1] [1]	[4]
			8
		Total	75

New
Specification



Rewarding Learning

**ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2010**

Physics

Assessment Unit AS 2

Module 2: Waves, Photons and Medical Physics

[AY121]

FRIDAY 18 JUNE, MORNING

MARK SCHEME

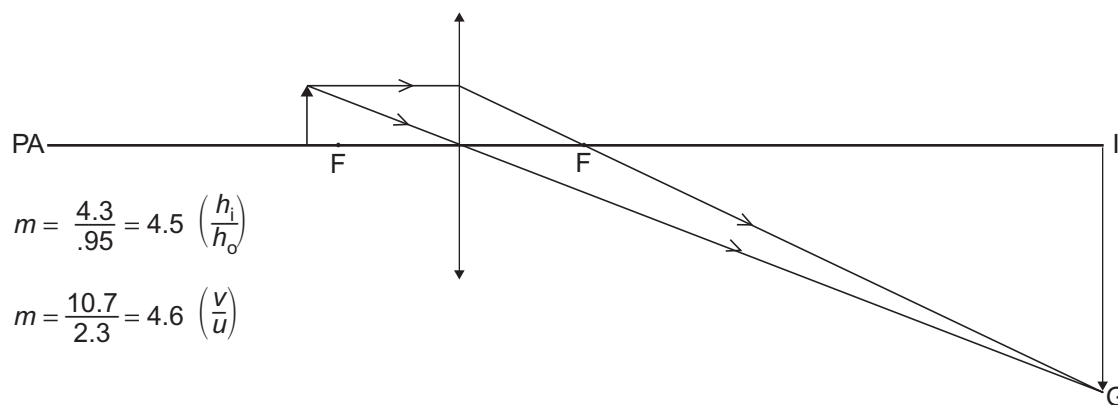
- 1 (a) (i) The (displacement) **oscillations/vibrations** of the waves are confined to any **one** (single) plane (which contains the direction of propagation of the wave.) [1]
- (ii) Pass it through an analyser (or a sheet of polaroid)/which is rotated 360° from a reference position. [1]
The light would be extinguished (darkened) twice during the 360° rotation. [1]
- (iii) The displacement oscillations of particles of a sound wave can never be perpendicular to the direction of propagation (velocity).
OR
The oscillations can only be parallel to the velocity. [1]
- (b) velocity = $\frac{170}{0.51} = 333.3 \text{ (ms}^{-1}\text{)}$ Subs OR value [1]
 $\lambda = v/f$ Eq [1]
 $\lambda = \frac{333.3}{512}$ correct subs [1]
 $= \underline{0.651 \text{ m}}$ ans [1]

8

- 2 (a) Obtain $\sin i$ and $\sin r$ [1]
Evaluate $\sin i / \sin r$ of corresponding pairs of angles [1]
Calculate the average value of $(\sin i / \sin r)$ [1]
OR
Obtain $\sin i$ and $\sin r$ [1]
Draw a graph of these values – (straight line through origin) [1]
Calculate gradient or $1/\text{gradient}$ appropriate to axes to obtain the refractive index. [1]
- (b) $\frac{\sin i}{\sin 43} = \frac{1}{1.38}$ or equivalent eq subs [1]
 $i = 29.62^\circ$ i value [1]
 $\sin C = \frac{1}{n} = \frac{1}{1.38}$ eq or subs [1]
 $C = 46.44^\circ$ C value [1]
Increase = $(46.44 - 29.62) = \underline{16.8^\circ}$ ans [1]

8

3 (a) (i)



2 correct rays [2]
Correct Magnified image (IG) [1]
 (no arrows -1 once only)
 (virtual rays/images not dashed -1 once only)

Fig. 3.1

- (ii) Measure object height h_o and image height h_i [1]
- Evaluate m as h_i/h_o [1]
- Measure v (image distance) and u (object distance) [1]
- Evaluate m as v/u [1]
- Reasonable agreement in the m values $\approx (\pm 10\%)$ [1]
- (Allow measurements ± 1 small square)

AVAILABLE
MARKS

8

4 (a) (i)

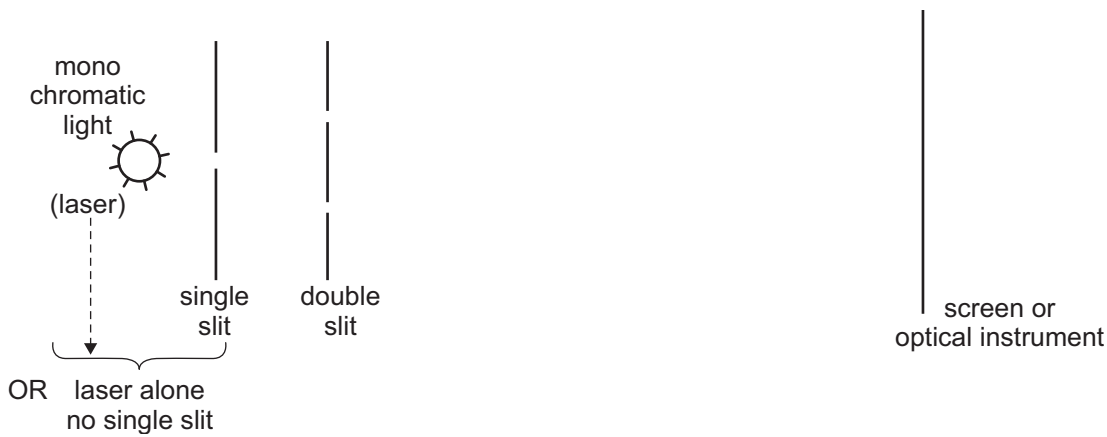


Fig. 4.1

Monochromatic light source (sodium lamp)

Single slit

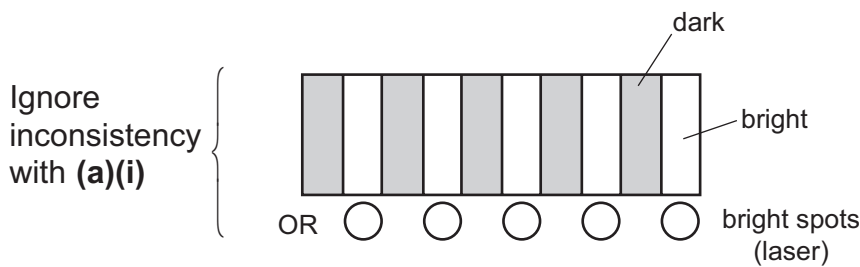
(OR Laser alone [1])

Double slits

Screen/optical instrument

Expect: $4 \times \frac{1}{2} = 2$ round down [2]

(ii)



Ignore inconsistency with (a)(i)

Pattern: Bright and Dark fringes [1]

OR Bright and Dark spots (Laser)

Equally spaced [1]

(b) (i) Use of eq $\lambda = \frac{ay}{d}$ (on data sheet)

$$y = 550 \times 10^{-9} \times \frac{1.8}{0.91 \times 10^{-3}} \quad \text{subs [1]}$$

$$\text{Distance} = 1.09 \times 10^{-3} \text{m} \quad \text{ans [1]}$$

(ii) Red light (700 nm maximum wavelength of visible light) [1]

(iii) In a darkened room OR Low light conditions [1]

5 (a) spread out **only**

[1]

(b) Diffraction depends on the relative size of the aperture and the wavelength of the light.

Maximum effect when wavelength is comparable to aperture size.

Here wavelength is very much smaller than aperture dimension hence no noticeable diffraction – dependent on explanation. [2] or [0]

(Sharp shadows occur, beam width is of no relevance)

(c)

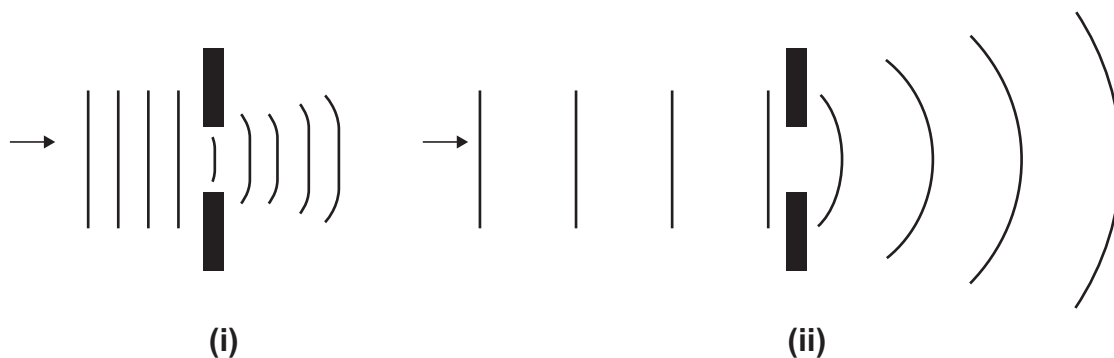


Fig. 5.1

(i) Small diffraction (straight with slight curved edges, wavefront lengths increasing) [1]
Wavelength preserved [1]

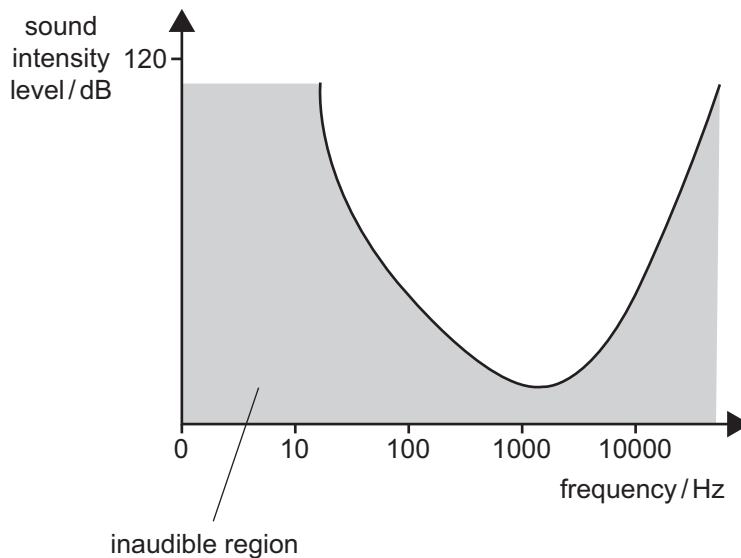
(ii) Large diffraction (general curved shape, wavefront lengths increasing) [1]
Wavelength preserved [1]

(<4 wavefronts: penalty –1 once only)

AVAILABLE MARKS

7

- 6 (a) (i) A Microphone [1]
- (ii) Horizontal measurement from trace e.g. 2.30 (1 cycle);
or 5.60 (2.5 cycles) cm value [1]
- (Periodic) time $T = 5.6 \times 2 \times \frac{10^{-3}}{2.5}$ (4.48×10^{-3}) T [1]
- $F = \frac{1}{T}$ eq [1]
- Frequency = 223.2 Hz (215 to 230) ans [1]
- (b) (i) 2 to 3 kHz [1]
- (ii) 0 dB [1]
- (iii) Shade the region outside the curve.
(Additional shading: penalty -1) [1]



- 7 (a) It is a medical instrument which passes light through *optical/glass fibres* to illuminate internal organs of the body and transfer *images* of these to a medical observer.
e.g. Irrigation (water/washing) channel OR Tissue sampling (tools/cutters etc.) channel OR Equivalent. $3 \times [1]$ [3]
- (b) Non-coherent applies to a randomly orientated bundle of optical fibres which transfer light (light pipe) to illuminate the internal structures being examined. [2]
Coherent applies to a bundle of optical fibres which maintain “spatial relationship” between each end of the bundle to allow the accurate transfer of images without distortion from one end to the other.
“ordered”, “parallel” = having a spatial relationship [2]

AVAILABLE
MARKS

8

9

Quality of written communication

AVAILABLE
MARKS

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]

- 8 (a) 1. The photons must be absorbed by the electrons in the metal. [1]
2. The photons must have energy greater than or equal to the workfunction of the metal.

OR The frequency of the photons must be greater than or equal to the threshold frequency (f_0) of the metal. [1]

(b) Energy of photon $E = \frac{hc}{\lambda}$ eq [1]

$$E = 6.63 \times 10^{-34} \times 3 \times \frac{10^8}{450 \times 10^{-9}} \text{ (J)} \quad \text{subs [1]}$$

$E = 4.42 \times 10^{-19} \text{ J}$ which is greater than the workfunction so photoelectric emission will occur.

Correct E value and statement [1]

5

OR Equivalent considering threshold frequency, Max (2 of 4) if energy not calculated

Useful Data

$$2.4 \text{ eV} = 3.84 \times 10^{-19} \text{ J} = f_0 \sim 5.79 \times 10^{14} \text{ Hz}$$

$$2.76 \text{ eV} = 4.42 \times 10^{-19} \text{ J} = f_0 \sim 6.67 \times 10^{14} \text{ Hz}$$

- 9 (a) 1. The lines or colours in emission spectra indicate discrete (exact, or unique) amounts of energy for the photons of radiation emitted. [1]
2. This energy obtained by fall (transition) of an electron between two discrete levels or energy states. [1]
3. So electrons must exist in discrete (unique) energy states for spectra to reproduce these emissions. [1]

(b) Between levels $E = -0.85 - (-1.51)$ Levels used [1]

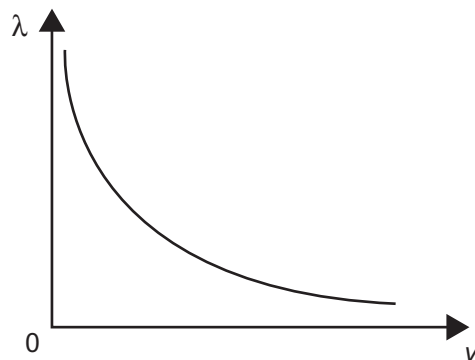
$E = hf$ eq [1]

$f = 0.66 \times 1.6 \times \frac{10^{-19}}{6.63 \times 10^{-34}}$ eV conversion + subs [2]
(independent of E)

Frequency = 1.59×10^{14} Hz ans [1]

- 10 (a) (i) It is the wavelength of a (matter) wave associated with a moving mass. [1]

(ii)



Correct decreasing curve [1]
not touching either axes [1]

Fig. 10.1

(b) $\lambda = \frac{h}{mv}$ (must convert p to mv) eq [1]

$v = 6.63 \times \frac{10^{-34}}{1.67 \times 10^{-27} \times 1.13 \times 10^{-13}}$ subs [1]

Speed = 3.51×10^6 ms⁻¹ ans [1]

Total

8

6

75

New
Specification



Rewarding Learning

**ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2010**

Physics

Assessment Unit AS 3

Practical Techniques (Internal Assessment)

Session 1

[AY131]

MONDAY 10 MAY, MORNING

**MARK
SCHEME**

Instructions for Internal Assessment

1. **Mark strictly according to this mark scheme.** Do not agonize over awarding “charity” or “benefit of doubt” marks. Give credit for numerical answers only if they are within the ranges indicated in this mark scheme. Remember, every script will be checked later to ensure that candidates are not disadvantaged.
2. Mark in **red** ball-point pen. For each correct point in the scheme you are rewarding, place a tick in the text of the script; for each incorrect point, place a cross. Then add up the ticks for each part of a question for which there is a sub-total in square brackets, and write this total in the “Teacher Mark” column to the right of the text. When you have finished marking a question, write the total for the question as a ringed mark at the beginning of the question and in the appropriate box on the front of the script.

Taking **Question 1** as an example, if you see two markworthy points in part **(a)** on p 4, you will mark two ticks at the points you are rewarding and a cross at the point where an error has been made or where there is an omission. Then you will put a “2” in the “Teacher Mark” column near the [3] in the text. Moving on to part **(b)** on p 5, if the candidate scores the one possible mark, you will put a tick in the text and a “1” in the “Teacher Mark” column near the [1] in the text at the end of the question. Moving on to part **(c)** on p 5, if the candidate scores the one possible mark, you will put a tick in the text and a “1” in the “Teacher Mark” column near the [1] in the text at the end of the question. These sub-totals are not to be ringed, but when you come to add up the total for the question ($2 + 1 + 1 = 4$ in our example) you will put a “4” with a ring round it at the top of the “Teacher Mark” column at the beginning of this question on p 4. You will also transcribe this total of 4 to the “Teacher Mark” column of the mark box for **Question 1** on the front of the question/answer booklet.

In **Question 5 (a)** there is a possibility that a candidate may have been told the equation to calculate P and R from the values given in the table. If this is the case for either or both, you will already have marked one or both of the first and second “YES” boxes in the “For Teacher’s use only” area on the front of the booklet. When marking, you will apply the 1 or 2-mark deduction by noting one or two crosses in the text and putting a “1 or 0” in the “Teacher Mark” column, opposite the [2] in the text. (In the majority of cases, you will have marked “NO” on the front of the booklet, and will then give two ticks in the text and a “2” in the “Teacher Mark” column.)

3. In marking graphs (as in **Question 5**) you will have to exercise some professional judgment, but other features must be marked strictly according to the scheme.

In **5(b)(ii)** candidates are told to label the axes. Table 5.1 gives P/ and R/ with a solidus (or “slash”), so the candidate should answer in the form P/mW or W and R/Ω. **Only** these forms are to be credited; either or both of “P in mW or W” or “R in Ω” scores a cross for the “Axes labelled” mark.

The mark for “Scales” in **5(b)(ii)** is awarded only if the plotted points occupy at least half of the printed graph grid along each axis. A factor of, for example, 10 mm to represent 300 mW does not score because of the difficulty of accurately plotting or reading off values. The credit for plotting the points in **5(b)(ii)** is, following the normal tariff, 2 marks for plotting 5 points correctly and 1 mark for plotting 4. “Correctly” means to within \pm one small square (+ 2 mm) on the printed grid in either x- or y-direction. The marker’s professional judgment comes in here.

One tick is to be awarded for drawing the best smooth curve through the points. Do not agonize over scoring (or not) this mark; your professional judgment will allow you to come to a decision very quickly.

In measuring the maximum in **5(c)**, one mark is for reading P_{\max} and one mark for the R value at P_{\max} to within the tolerances given in the mark scheme.

4. When you have finished marking the paper, add up the marks for the five questions in the "Teacher Mark" column in the box on the front page of the booklet and enter the total. Check this total by adding up all the sub-total marks for parts of questions throughout the script (**not** the ringed total question marks). The totals arrived at in these two different ways should agree. If you cannot get agreement after a re-count, go back to counting the individual ticks throughout the text of the script.

			AVAILABLE MARKS	
1	(a) (i)	$L = 850 \text{ mm} \pm 5 \text{ mm}$	[1]	5
	(ii)	$x_1 = 195 \text{ mm} \pm 25 \text{ mm}$	[1]	
	(iii)	$x_2 = 655 \text{ mm} \pm 25 \text{ mm} -1$ for x_1 and x_2 reversed	[1] [3]	
	(b)	Candidate's correct, consistent value for f (guide value 150 mm)	[1] [1]	
Penalty marks in (a) and (b); -1 for use of cm (apply once only)				
1	(c)	Either difficulty in focussing or only one set of values Not parallax error	[1] [1]	
	2	(a)	Voltmeter reading in range 10 V – 12.5 V and I_A in range 70 mA – 110 mA	[1]
		Total circuit resistance in range 105 Ω – 145 Ω	[1] [2]	
2	(b) (i)	I_B in range 20 mA – 35 mA	[1]	5
	(ii)	I_C in range 50 mA – 75 mA Apply 10^n error once only from (a) to (b)(ii)	[1] [2]	
	(iii)	Identifies $I_B + I_C$ equals I_A or equivalent. The mark is for the statement. Accept conditional statements for incorrect I_B and I_C	[1] [1]	
	3	(a)	• Evidence of 5 or more oscillations timed (both balls)	
		• Evidence of repetition of multiple oscillations and average (1 or more repeats) (both balls)	[1]	
		• Second period within $\pm 10\%$ of first period (correct calculation)	[1] [3]	
	(b)	Given to 0.01 mm	[1] [1]	
	(c)	Deducing independent or no relationship or insufficient data to make deduction	[1] [1]	5

- 4 (a) $Y_0 = 50 \text{ mm} \pm 5 \text{ mm}$ [1]
- Quotes two values with $Y_2 > Y_1$ and both values to nearest mm (unless averaged) [1] [2]
- (b) k_1 & k_2 should be correctly consistent with pupil's results [2] [2]
 Allow $g = 9.8 \text{ ms}^{-2}$ or 10 ms^{-2}
- Penalty of -1 for
- omitting g from the calculation
 - a 10^n error
- (c) Smaller *percentage* uncertainty in extension x_2 [1] [1]

5

- 5 (a) $P = I^2R$ or IV or V^2/R [1]
- $R = \frac{V}{I}$ or $\frac{P}{I^2}$ [1] [2]

Deduct 1 mark for each equation that required assistance.
 See front of pupil booklet.

- (b) (i) No ecf from (a)

Accept VA^{-1} (not V/A)

V / V	I / mA	Power P / mW (or W)	Resistance R / Ω or VA
		0(.00)	0(.00)
		1040 (1.04)	0.797
		2270 (2.27)	2.50
		2960 (2.96)	5.01
		3050 (3.05)	11.0
		2780 (2.78)	16.0

- 6 values of P and R [4]
- Penalty mark -1 for each value error down to 0
 Sig fig error -1 once only and not to zero value
- Both units (see table)
 10^n error -1 once only [1] [5]

- (ii) Suitable scale (more than half each axis used) [1]
- Axes labelled with quantity and unit [1]
- FIVE of their 6 points correctly plotted to $\pm 2 \text{ mm}$ [2]
- Penalty -1 per omission and error to 0
- Smooth curve [1] [5]
- Transposed axes: max 4/5, do not award "axes" mark
- Wrong graphs: max 3/5, can only score for "points" and "scale"

			AVAILABLE MARKS
<p>(c) P_{\max} = Value consistent with candidate's graph</p> <p>$R_m = 6.0 \Omega - 9.5 \Omega$</p>	}	<p>Not available for wrong graphs (b)</p>	<p>[1]</p> <p>[1] [2]</p>
<p>(d) (i) More readings <i>near maximum</i></p>			<p>[1] [1]</p>
<p>(ii) Total resistance = $2 \times R_m$ (see (c))</p>			<p>[1] [1]</p>
<p>(iii) Efficiency = $\frac{I^2 R}{2I^2 R}$ or any correct expression for efficiency</p>			<p>[1]</p>
<p>Efficiency = 50%</p>			<p>[1] [2]</p>
<p>(iv) A comment identifying the battery still has an internal resistance</p> <p>e.g. 1 a p.d. across the internal resistance exists, or</p> <p>e.g. 2 internal resistance is still present</p> <p>Another comment identifying zero load resistance</p> <p>e.g. Battery is short circuited</p>			<p>[1]</p> <p>[1] [2]</p>
Total			20
			40



Rewarding Learning

**ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2010**

Physics

Assessment Unit AS 3

Practical Techniques (Internal Assessment)

Session 2

[AY132]

TUESDAY 11 MAY, MORNING

MARK SCHEME

Instructions for Internal Assessment

1. **Mark strictly according to this mark scheme.** Do not agonize over awarding “charity” or “benefit of doubt” marks. Give credit for numerical answers only if they are within the ranges indicated in this mark scheme. Remember, every script will be checked later to ensure that candidates are not disadvantaged.
2. Mark in **red** ball-point pen. For each correct point in the scheme you are rewarding, place a tick in the text of the script; for each incorrect point, place a cross. Then add up the ticks for each part of a question for which there is a sub-total in square brackets, and write this total in the “Teacher Mark” column to the right of the text. When you have finished marking a question, write the total for the question as a ringed mark at the beginning of the question and in the appropriate box on the front of the script.

Taking **Question 1** as an example, if you see two markworthy points in part **(a)** on p 4, you will mark two ticks at the points you are rewarding and a cross at the point where an error has been made or where there is an omission. Then you will put a “2” in the “Teacher Mark” column near the [3] in the text. Moving on to part **(b)** on p 5, if the candidate scores the one possible mark, you will put a tick in the text and a “1” in the “Teacher Mark” column near the [1] in the text at the end of the question. Moving on to part **(c)** on p 5, if the candidate scores the one possible mark, you will put a tick in the text and a “1” in the “Teacher Mark” column near the [1] in the text at the end of the question. These sub-totals are not to be ringed, but when you come to add up the total for the question ($2 + 1 + 1 = 4$ in our example) you will put a “4” with a ring round it at the top of the “Teacher Mark” column at the beginning of this question on p 4. You will also transcribe this total of 4 to the “Teacher Mark” column of the mark box for **Question 1** on the front of the question/answer booklet.

In **Question 5 (a)** there is a possibility that a candidate may have been told the equation to calculate P and/or R from the values given in the table. If this is the case for either or both, you will already have marked one or both of the first and second “YES” boxes in the “For Teacher’s use only” area on the front of the booklet. When marking, you will apply the 1 or 2-mark deduction by noting one or two crosses in the text and putting a “1 or 0” in the “Teacher Mark” column, opposite the [2] in the text. (In the majority of cases, you will have marked “NO” on the front of the booklet, and will then give two ticks in the text and a “2” in the “Teacher Mark” column.)

3. In marking graphs (as in **Question 5**) you will have to exercise some professional judgment, but other features must be marked strictly according to the scheme.

In **5(b)(ii)** candidates are told to label the axes. Table 5.1 gives P/ and R/ with a solidus (or “slash”), so the candidate should answer in the form P/mW or W and R/ Ω . **Only** these forms are to be credited; either or both of “P in mW or W” or “R in Ω ” scores a cross for the “Axes labelled” mark.

The mark for “Scales” in **5(b)(ii)** is awarded only if the plotted points occupy at least half of the printed graph grid along each axis. A factor of, for example, 10 mm to represent 300 mW does not score because of the difficulty of accurately plotting or reading off values. The credit for plotting the points in **5(b)(ii)** is, following the normal tariff, 2 marks for plotting 5 points correctly and 1 mark for plotting 4. “Correctly” means to within \pm one small square (+ 2 mm) on the printed grid in either x- or y-direction. The marker’s professional judgment comes in here.

One tick is to be awarded for drawing the best smooth curve through the points. Do not agonize over scoring (or not) this mark; your professional judgment will allow you to come to a decision very quickly.

In measuring the maximum in **5(c)**, one mark is for reading P_{\max} and one mark for the R value at P_{\max} to within the tolerances given in the mark scheme.

4. When you have finished marking the paper, add up the marks for the five questions in the "Teacher Mark" column in the box on the front page of the booklet and enter the total. Check this total by adding up all the sub-total marks for parts of questions throughout the script (**not** the ringed total question marks). The totals arrived at in these two different ways should agree. If you cannot get agreement after a re-count, go back to counting the individual ticks throughout the text of the script.

			AVAILABLE MARKS	
1	(a) (i) $L = 700 \text{ mm} \pm 5 \text{ mm}$	[1]		
	(ii) $x_1 = 120 \text{ mm} \pm 25 \text{ mm}$	[1]		
	(iii) $x_2 = 580 \text{ mm} \pm 25 \text{ mm}$	[1]	[3]	
	} x_1, x_2 reversed -1 penalty only			
(b) Candidate's correct, consistent value for f (guide value 100 mm)	[1]	[1]		
Penalty marks (a) and (b) -1 for use of cm (apply once only)				
(c) Either difficulty in focussing				
or one set of values				
Not parallax error	[1]	[1]	5	
2	(a) Voltmeter reading in range 10 V – 12.5 V and I_C in range 60 mA – 100 mA	[1]		
	Total circuit resistance in range 123 Ω – 167 Ω	[1]	[2]	
	(b) (i) I_A in range 48 mA – 80 mA	[1]	[2]	
	(ii) I_B in range 12 mA – 20 mA Apply 10^n error once only from (a) to (b)(ii)	[1]		
	(iii) Identifies $I_A + I_B$ equals I_C or equivalent. The mark is for the statement. Accept conditional statements for incorrect I_A and I_B	[1]	[1]	5
3	(a) • Evidence of 5 or more oscillations timed (both balls)	[1]		
	• Evidence of repetition of multiple oscillations and average (one or more repeats) (both balls)	[1]		
	• Second period within $\pm 10\%$ of first period (correct calculations)	[1]	[3]	
	(b) Given to 0.01 mm	[1]	[1]	
(c) Deducing independent or no relationship or insufficient data to make deduction	[1]	[1]	5	

4 (a) $Y_0 = 50 \text{ mm} \pm 5\text{mm}$ [1]
 Quotes two values with $Y_2 > Y_1$ and both values to the nearest mm (unless averaged) [1] [2]

(b) k_1 & k_2 should be correctly consistent with pupil's results [2] [2]
 Allow $g = 9.8 \text{ m s}^{-2}$ or 10 m s^{-2}

Penalty of -1 for omitting g from the calculation or a 10^n unit error

(c) Smaller *percentage* uncertainty in extension x_2 [1] [1]
 Accept value of $Y_2 >$ value of Y_1

5 (a) $P = I^2R$ or IV or V^2/R [1] [2]
 $R = \frac{V}{I}$ or $\frac{P}{I^2}$ [1] [2]

(b) (i) No ecf from (a)

Accept VA^{-1} (not V/A)

V / V	I / mA	Power P / mW (or W)	Resistance R / Ω or VA
		0(.00)	0(.00)
		2460 (2.46)	0.500
		4970 (4.97)	1.50
		5930 (5.93)	2.50
		4960 (4.96)	10.8
		4000 (4.00)	16.0

6 values of P and R [4]

Penalty mark -1 for each value error down to 0
 Sig fig error -1 once only and not to zero value

Both units (see table)
 10^n error - 1 once only [1] [5]

(ii) Suitable scale (more than half each axis used) [1]

Axes labelled with quantity and unit [1]

FIVE of their 6 points correctly plotted to $\pm 2 \text{ mm}$ [2]

Penalty -1 per omission and error to 0

Smooth curve (peak > 6W) [1] [5]

Transposed axes: max 4, do not award "axes" mark

Wrong graph: max 3, can only score for "points" and "scale"

5

			AVAILABLE MARKS
<p>(c) P_{\max} = Value consistent with candidate's graph</p> <p>$R_m = 6.0 \Omega - 9.5 \Omega$</p>	}	<p>Not available for wrong graphs (b)</p>	<p>[1]</p> <p>[1] [2]</p>
<p>(d) (i) More readings <i>near maximum</i></p>			<p>[1] [1]</p>
<p>(ii) Total resistance = $2R$ i.e. $2 \times R_m$ (see (c))</p>			<p>[1] [1]</p>
<p>(iii) Efficiency = $\frac{I^2 R}{2I^2 R}$ or any correct expression for efficiency</p>			<p>[1]</p>
<p>Efficiency = 50%</p>			<p>[1] [2]</p>
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