GCE AS

Physics

January 2009

Mark Schemes

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

MARK SCHEMES (2009)

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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Module 1: Forces and Electricity

[ASY11]

TUESDAY 27 JANUARY, MORNING

MARK SCHEME

AVAILABLE MARKS

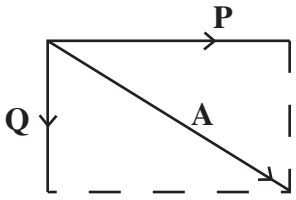
1 **(a)** **Length, Mole, Temperature** all three [2]
Each error or addition, –1

(b) **kg m ^{2} s^{-2}** [1]

(c) **(i)** Scalar has magnitude only [1]
Vector has magnitude and direction [1] [2]

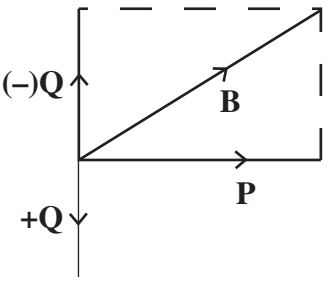
(ii) All energies are scalars
or squaring removes sense of direction
or energy has magnitude only [1]

(d) Completion of rectangle, vector **A** marked (all arrows and labels shown) [1]



Reverse direction of **(–)Q** [1]
Completion of rectangle, vector **B** marked (all arrows and labels shown) (this mark only if direction of Q reversed) [1]

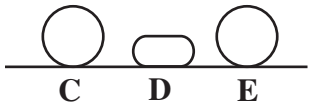
Sign implied by arrow **(–)Q**



[3] 9

[arrows missing, –1 once only]

						AVAILABLE MARKS
2	**(a)**	**(i)**	$t = s/v$ (= 2.37/14.0)	eqn, (subs) [1]		
			Time = **0.169 s**	[1]	[2]	
		(ii)	$s = (ut) + {}^1/_2at^2$	eqn [1]		
			$= 0 + 0.5 \times 9.81 \times (0.169)^2$	subs [1]		
			Vertical distance y = **0.140 m** (0.141 m)	ans [1]	[3]	
			(or e.c.f. from **(i)**)			
		(iii)	Speed of dart should be **decreased**	[1]		
			Time to reach board must increase	[1]		
			so that dart falls further	[1]	[3]	
	(b)		Dart strikes **at point A**	[1]		
			Because mass does not come into projectile equations **or** motion independent of mass	[1]	[2]	10
3	**(a)**		Force = **12 N**	[1]		
			Constant speed means zero resultant force, **or** force from man equals frictional force **or** zero resultant force	[1]	[2]	
	(b)	**(i)**	Component of g down slope = g sin 5.0° (g cos 85.0°) $= 0.86\ m\,s^{-2}$	[1]		
			Quotes $v^2 = u^2 - 2as$	[1]		
			$0 = (1.5)^2 - 2 \times 0.86 \times s$	subs [1]		
			Distance = **1.3 m** (1.31 m)	[1]	[4]	
			Alternative			
			${}^1/_2\ mv^2 = mgh$	[1]		
			h = 0.115 m	[1]		
			constructs triangle	[1]		
			distance = 1.3 m	[1]		
		(ii)	Recognises additional force **or** total force = friction + component of weight	[1]		
			$= 22 \times 9.8 \times \sin 5.0° = 18.8$ N (+12)	[1]		
			Total force = **31 N** (30.8 N)	[1]	[3]	9
			(**or** e.c.f. from **(a)**)			

					AVAILABLE MARKS
4	(a)		**C and E undeformed or** same shape [1] **D squashed, flattened bottom** [1] [2] (i.e. flatter than C,E) (even if not in contact with horizontal axis)		
	(b)	(i) **(Gravitational) potential (energy)** [1]			
		(ii) (**Gravitational) potential (energy) and kinetic (energy)** [1]			
		(iii) **strain elastic/(energy) and kinetic (energy)** [1]		[3]	
	(c)	Collision with surface **inelastic** [1] Some energy **converted** (**allow** "lost") to heat (and/or sound) [1]		[2]	
		Quality of written communication throughout question (not more than three spg errors)		[1]	8
5	(a)	Direction of motion of the (hypothetical) **positive** charge carriers making up the current **or** opposite to direction of electron travel **or** plus to minus		[1]	
	(b)	In time t, all carriers in a cylinder of volume Avt will pass a given point in the wire (or Av in one second) [1] Total charge in this cylinder = $nAvtq$ i.e. multiplies n × volume × e(q) [1] Current = rate of transfer of charge **or** q/t **or** dq/dt [1] Rate of transfer of charge = $nAvq(e) = I$ (as required) [1]		[4]	
	(c)	(i) See $V = {}^1/_4\pi d^2L = 0.25\pi(1.2 \times 10^{-3})^2 \times 2.8$ either here or in $= 3.17 \times 10^{-6}$ m^3 complete eqn [1] See $n = N/V = 2.7 \times 10^{23}/3.17 \times 10^{-6}$ (= 8.5×10^{28} m^3) either here or in complete eqn [1]		[2]	
		(ii) $v = I/(nAe) = 3.5/(8.5 \times 10^{28} \times 1.13 \times 10^{-6} \times 1.6 \times 10^{-19})$ subs [1] Drift speed = **2.3 × 10^{-4} m s^{-1}** (2.28×10^{-4}) [1]		[2]	
	(d)	Because drift speed can't be measured (directly)		[1]	10

					AVAILABLE MARKS
6	**(a)**	$R = \rho L/A$ **with L = length, A = area of cross-section**	[1]		
	(b)	**(i)** $A = \pi r^2 = \pi(0.56 \times 10^{-3})^2$ $(= 9.85 \times 10^{-7}\ m^2)$ subs for A	[1]		
		$R = V/I = 0.013/0.32 = (4.06 \times 10^{-2}\ \Omega)$ subs for R	[1]		
		$\rho = AR/L = (9.85 \times 10^{-7} \times 4.06 \times 10^{-2})/1.50$ correct subs	[1]		
		(No e.c.f. from wrong A, R)			
		Resistivity = $\mathbf{2.7 \times 10^{-8}\ \Omega\ m}$ (2.67×10^{-8})	[1]	[4]	
		(ii) Resistance of wire B is **four times** resistance of wire A	[1]		
		Because resistance inversely proportional to area, and area proportional to square of radius	[1]		
		Resistivity of wire B is **same as** resistivity of wire A	[1]		
		Because resistivity a property of the material	[1]	[4]	9
7	**(a)**	**(i)** Resistance of upper series path between X and Y = resistance of lower series path = 20 Ω	[1]		
		Resistance of two 20 Ω paths in parallel = **10 Ω**	[1]	[2]	
		(ii) Total circuit resistance = 20 Ω			
		Current in main circuit = 6/20 = 0.3 A	[1]		
		I_1 = **0.15 A** or e.c.f. from **(i)**	[1]	[2]	
	(b)	Equal potential drops between X and B and between X and C, (so zero p.d. between B and C)	[1]		5
			Total		**60**

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2009

Physics

Assessment Unit AS 2

assessing

Module 2: Waves and Photons

[ASY21]

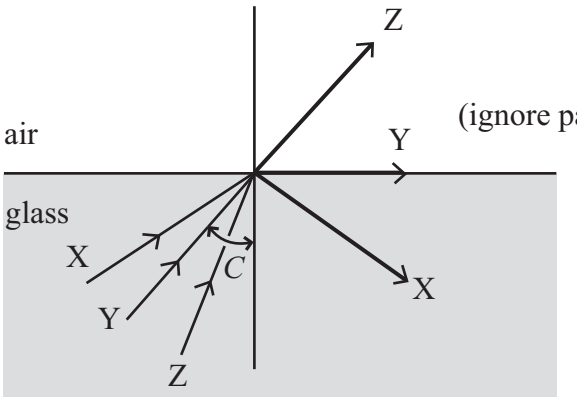
TUESDAY 27 JANUARY, MORNING

MARK SCHEME

					AVAILABLE MARKS
1	(a)	(i)	**Perpendicular (to the velocity);** [1] **Transverse** [1]	[2]	
		(ii)	**6.0** mm	[1]	
		(iii)	$f = \frac{1}{T}$ or subs $f = \frac{1}{0.005}$ [1] frequency = **200** Hz ans [1]	[2]	
		(iv)	$\lambda = \frac{v}{f}$ [1] $\lambda = \frac{80}{200}$ subs [1] λ = **0.40** m ans [1] [or e.c.f. from **(iii)**]	[3]	
	(b)		Position **A** = $\frac{1}{3}$ of cycle from **S** recognition [1] Phase relative to **S** = $\frac{1}{3} \times 360$ **or** $\frac{1}{3} \times 2\pi$ subs [1] Phase = **120** **or** **2.09** $\left(\text{accept } \frac{2\pi}{3}\right)$ ans [1] Unit = **degrees** **or** **radians** (independent mark for reasonably consistent answer) [1]	[4]	12

AVAILABLE MARKS

2 **(a)** Diagram to indicate rays



(ignore partial internal reflection)

(No arrow(s) –1 once only)

Each ray [1] [3]

(b) **(i)** speed in fibre $v = \frac{x}{t} = \frac{1.2 \times 10^3}{5880 \times 10^{-9}}$ eqn or subs [1]

$= \mathbf{2.04 \times 10^8}$ m s^{-1} (accept 2.0, 2) speed [1] [2]

(ii) refractive index $n = \frac{c}{v} = \frac{3 \times 10^8}{2.041 \times 10^8}$ eqn or subs [1]

$n = \mathbf{1.47}$ (1.5, or e.c.f. from **(i)**) n [1] [2]

(iii) Sin C $= \frac{1}{n} = \frac{1}{1.47} = 0.6802$ eq or subs or sin C [1]

Critical angle = **42.9°** or e.c.f. from **(ii)**) ans [1] [2]

(c) **(i)** angle $i = (90 - 27) = \mathbf{63}°$ (63.0°) i angle [1]

(ii) $\frac{\sin 63}{\sin r} = 1.31$ eqn or subs [1]

$\sin r = \frac{0.8910}{1.31} = 0.6801$

$r = \mathbf{42.9}°$ r angle [1] [2]

(iii) Hence Deviation = (63.0 – 42.9) = **20.1** °(or e.c.f.) [1] 13

AVAILABLE MARKS

3 **(a)** **(i)** Real light rays pass through it *or* it may be formed on a screen.
Virtual light rays appear to come from it *or* it cannot be formed on a screen. [1]

(ii) (It is upright.) As the object moves towards the lens the image **remains** upright, virtual and diminished throughout. [1]
Continues to **increase** in height (as its position moves towards the lens). [1] [2]

Quality of communication [1] [1]

(b) **(i)** Image is **real**, **enlarged** (accept magnified) and **inverted** [1]

(ii) $\text{Mag} = \frac{v}{u} = \frac{0.8}{0.02} = 40$ so $u = \frac{2.4}{40} = 0.06$ (m)
$= \mathbf{6.0\ cm}$ [1]

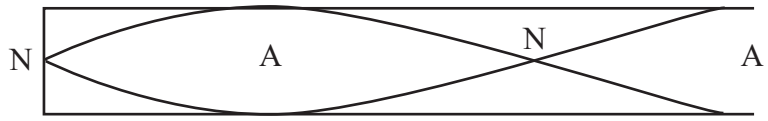
(iii) $\frac{1}{f} = \frac{1}{0.06} + \frac{1}{2.4} = 17.09$ **correct** subs in eq [1] (no e.c.f. from **(i)**)

Focal length = **5.85** cm ans [1] [2] 8

4 **(a)**
- Equal frequency *or* period *or* wavelength *or* amplitude
- Equal speed/velocity
- travelling in opposite directions [3]

"coherent" scores first two points

(b) **(i)** Diagram:



Shape [1]
all Ns, As [1] [2]
for correct pattern only

(ii) second mode hence $\frac{3}{4}\lambda$ (= 0.88 m) mode
$\lambda = 1.173$ m or λ [1]
Speed ($= f \times \lambda$) = 1.173×288 subs [1]
$= \mathbf{338}$ (337.8) m s^{-1} ans [1] [3] 8
(No e.c.f. from wrong diagram)

						AVAILABLE MARKS
5	**(a)**	● Glass/perspex/transparent material with ● many ● parallel ● equally spaced opaque lines.	$4 \times \frac{1}{2} = [2]$ (Round down)		[2]	
	(b)	**(i)** see $d = \frac{n\lambda}{\sin\theta} = \frac{1 \times 589 \times 10^{-9}}{\sin 20.7°}$ (= 1.667×10^{-6} m)	Subs, correct 10^n [1]			
		see $n = \frac{1}{d} = 6.00 \times 10^5$ lines per metre (= 600 lines per mm)	[1]		[2]	
		(ii) $n = \frac{d\sin\theta}{\lambda}$; for highest order, $\theta = 90°$ or $\sin\theta = 1$		[1]		
		$n = \frac{1.667 \times 10^{-6}}{589 \times 10^{-9}} = 2.8$				
		so highest order = **2**	1sf, rounds correctly [1]		[2]	6
6	**(a)**	**(i)** $h = m$			[1]	
		(ii) $\phi = c$ (not $-c$)			[1]	
	(b)	**(i)** UV is high frequency radiation hence $> f_0$ hence emission		[1]		
		red light long λ but low frequency hence $< f_0$ hence no emission		[1]	[2]	
		(ii) Increase the intensity of the UV radiation **or** increase frequency of incident radiation			[1]	
	(c)	$KE_{max} = hf - \phi$ (on sheet)				
		$\phi = 6.63 \times 10^{-34} \times 6 \times 10^{14} - 1.06 \times 10^{-19}$	subs [1]			
		$= 2.92 \times 10^{-19}$ (J)	in J [1]			
		Work function = **1.82** eV	ans [1]		[3]	8

					AVAILABLE MARKS
7	**(a)**	Higher PD so higher KE *or* higher p *or* higher ν [1] so wavelength of electrons decreases [1] (As for em wave diffraction) sin $\theta \propto \lambda$ Hence θ less [1] allow "less diffraction"		[3]	
	(b)	$\lambda = h/p$ (on sheet) $= \dfrac{6.63 \times 10^{-34}}{9.11 \times 10^{-31} \times 1.2 \times 10^{7}}$ subs [1] $= 6.06 \times 10^{-11} \times 10^{9}$			
		Wavelength = **0.0606** nm (**0.061**)	ans [1]	[2]	5
			Total		**60**