edexcel

GCE

Edexcel GCE

Physics (6736/01)

Summer 2005

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Mark Scheme (Results)

Edexcel GCE
Physics (6736/01)

Contents

Notes on the Mark Schemes

1. *Alternative responses:* There was often more than one correct response to a particular question and these published mark schemes do not give *all* possible alternatives. They generally show only the schemes for the most common responses given by candidates. They are **not** model answers but indicate what the Examiners accepted in this examination.

2. *Error carried forward:* In general, an error made in an early part of a question is penalised there but not subsequently, i.e. candidates are penalised once only, and can gain credit in later parts of a question by correct reasoning from an earlier incorrect answer.

3. *Quantity algebra:* The working for calculations is presented using quantity algebra in the mark schemes for Units PHY1, PHY2, PHY3 (Topics), PHY4, PHY5/01, and PHY6 but candidates are not required to do this in their answers.

4. *Significant figures:* Use of an inappropriate number of significant figures in the theory papers will normally be penalised only in "show that" questions where too few significant figures has resulted in the candidate not demonstrating the validity of the given answer. Use of an inappropriate number of significant figures will normally be penalised in the practical tests. In general candidates should nevertheless be guided by the numbers of significant figures in the data provided in the question.

5. *Unit penalties:* A wrong or missing unit in the answer to a calculation will generally lose one mark unless otherwise indicated.

6. *Quality of written communication:* Each theory paper will usually have 1 or 2 marks for the quality of written communication. The mark will sometimes be a separate mark and sometimes be an option in a list of marking points.

Within the schemes:

- / indicates alternative marking point
  ( ) brackets indicate words not essential to the answer
  [ ] brackets indicate additional guidance for markers

- The following standard abbreviations are used:

a.e.	arithmetic error (–1 mark)
e.c.f.	error carried forward (allow mark(s))
s.f.	significant figures (–1 mark only where specified)
no u.e.	no unit error

6736 Unit Test PHY6

1. (a) (i) $E = F/q$ Force divided by charge [must define F and q] ✓

Small / point (test) charge OR E parallel to F ✓

(ii) A graph with straight line through origin one increases by factor N, other increases by factor N ✓

OR $y = mx$ $y = kx$ / $I = kE$ where m, k is a constant

Charges produced/separated by <u>E-field</u> ✓ **4**

(b) (i) (Produced) when two different materials / insulators rub together / a cloth rubs a polythene rod / other explicit example / thundercloud [not lightning] / belt of V der G ✓

(ii) (Used to) check for E-field under power lines/ (build up) of <u>atmospheric</u> charges ✓ **2**

(c) (i) Use of $E = V/d$ ✓

$V = Ed = (240 \text{ N C}^{-1}) (60 \times 10^3 \text{ m})$ ✓

$= 1.4(4) \times 10^7$ V/14 MV ✓

Assume that <u>field</u> is uniform / constant / parallel field lines ✓

(ii) $q = CV \Rightarrow C = q/V$ ✓

$\therefore C = 1.1 \times 10^6$ C ÷ 14.4 / 14×10^6 V e.c.f. ✓

[$\Rightarrow$ 77 mF / 79 mF] **6**

(d) (i) Positive charge collects in ionosphere ✓

Negative charge collects on Earth / surface / ground ✓

[Because the atmosphere acts as a giant capacitor $\Rightarrow$ 1 out of 2 – consolation mark]

(ii) Ionosphere and Earth's surface labelled ✓

[could be concentric circles/parallel lines]

Field lines reaching Earth's surface ✓

Arrows towards Earth's surface ✓ **5**

(e)	(i)	Attempt to draw plates one above the other	✓	
		Holes not overlapping at all	✓	**2**
	(ii)	Aware that $q = \varepsilon 0EA$ is relevant	✓	
		$I = q/t$ $\Delta q \div \Delta t$ / rate of flow of charge	✓	
		For $I \propto E$, there must be no other variable – so speed constant	✓	**3**
	(iii)	Curve: period (shown as) 0.01(s)	✓	
		symmetric + and –	✓	**2**

(f)	*Either*	*Or*		
	Unit for E: $N\ C^{-1}$	Unit for E: $V\ m^{-1}$	✓	
	Unit for ε_0: $F\ m^{-1} \Rightarrow C\ V^{-1}\ m^{-1}$	Unit for ε_0 & A: $F\ m^{-1}$ and m^2	✓	
	Unit: $V = J\ C^{-1}$ or $J = N\ m$	Unit: F as $C\ V^{-1}$	✓	**3**
	[or look for $\varepsilon_0 \equiv kg^{-1}\ m^{-3}\ s^4\ A^2 \Rightarrow 2/3$; $E \equiv kg\ m\ s^{-3}\ A^{-1} \Rightarrow 2/3$; if both 3/3]			

(g)	Resistor/R in series with electrostatic mill	✓	
	Voltmeter / oscilloscope across R	✓	
	(Measure) I as (peak) V/R [not $V = IR$]	✓	
	$R \geq 10\ k\Omega$	✓	
	R in $k\Omega/M\Omega \rightarrow V$ in $\mu V/mV$ [battery in circuit, first two marks only]	✓	**Max 4**
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2. (a) (i) QOWC ✓

Link track to bubbles ✓

Which reflects light / are illuminated ✓

(produced as) the electron / it ionises liquid / particles / H_2 / air ✓ **4**

(ii) Mention of *B*-field/$F = Bq\upsilon$ / $F = Be\upsilon$ / FLHR ✓

B is perpendicular to υ / direction of motion / in or out of page ✓

Electron loses energy/slows down ✓

Colliding with / interacting with / ionising liquid particles / H_2 ✓ **4**

(b) (i) & (ii)

	r/m	*r*/mm	*p*/kg m s^{-1}	*m*/kg
P	62-67 × 10^{-3}	62-67	1.2-1.3 × 10^{-20}	4.0-4.3 × 10^{-29}
Q	43-48 × 10^{-3}	43-48	0.83-0.92 × 10^{-20}	2.8-3.1 × 10^{-29}
R	28-33 × 10^{-3}	28-33	0.54-0.63 × 10^{-20}	1.8-2.1 × 10^{-29}

Values for *r* in range above [ignore 10^n and units] ✓

$p = Ber \Rightarrow$ any one correct *p* [ignore 10^n but must have unit] [ecf] ✓

✓ **3**

All *p*s correct numerically [no ue] ✓

$p = m\upsilon \Rightarrow m = p/\upsilon$ ✓

Any one correct *m* [ignore 10^n but must have unit]

EITHER

Comment [e.c.f.]: any reference to 9 × 10^{-31} kg/rest mass (of electron) / electron mass ✓

Because electron is moving close to / at the speed of light ✓

OR ✓

(effective) mass (of electrons) is decreasing ✓ **4**

reference to $E = mc^2$ / $\Delta E = c^2\Delta m$ / mass-energy conservation **15**

3. (a) (i) Lead shot loses g.p.e. (which becomes k.e.) ✓
(which becomes/lost to/transfers to) internal energy/heat ✓ **2**

(ii) Use of 60 $mg\Delta h$ [allow between 0.70 m and 0.80 m] ✓

Use of $mc\Delta\theta$ / $mc\Delta T$ ✓

= 3.6 K [$\Rightarrow$ 3.2 K] / 3.6 °C ✓ **3**

(iii) Expect ΔT to be less ✓

Any 2 of: Tube/plastic warms up; cork/air warms up; because lead falls < 80 cm; energy lost to surroundings/tube/cork/air ; poor thermal contact with thermocouple ✓✓ **3**

(iv) As m cancels / mass does not matter ✓

but as c is higher ✓

ΔT will be lower ✓ **3**

(b) (i)

Either	*Or*
$I = (1.50\ \text{V} \div 47\,025\ \Omega)$	
$V_{25} = (3.19 \times 10^{-4}\ \text{A})(25.0\ \Omega)$	$\frac{V_{25}}{1.50\ \text{V}} = \frac{25.0\ \Omega}{47\,025\ \Omega}$

Correct method [ignore no k / no 25 Ω] ✓

Using k and 25 Ω in correct method ✓

= 0.797 or 0.798 or 0.799 × 10^{-3} V [n.b. 3 s.f.] ✓

Assume resistance of (micro)ammeter negligible [not resistance cell / wires negligible] ✓ **4**

(ii) 0.797 mV / 0.799 mV [e.c.f. value from (i)] ✓

(iii) Advantage:
Low heat capacity/low energy needed to warm up/ can detect small ΔTs / more sensitive
OR can be a transducer sensor for datalogging
OR no parallax problem with thermocouple ✓ **2**

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4.	(a)	(i)	Its chemical composition / surface temperature (not velocity)	✓	**1**
		(ii)	Use of $\Delta\lambda/\lambda = \upsilon/c$ [some substitution or rearrange]	✓	
			see λ = 440 or 400	✓	
			= 1.36 × 107 m s-1 [if bald answer: 1.43 × 107 ✓xx; 1.4 × 107 ✓xx ; 1.50 × 107 ✓✓x; 1.5 × 107 ✓✓x]	✓	
			towards the Earth / us	✓	**4**
	(b)	(i)	Electrons (are removed) from P / photoelectric effect	✓	
			Current is from P to capacitor / left to right / opposite to emitted e-	✓	**2**
		(ii)	P/plate becomes positively charge/voltage of P rises	✓	
			until electrons can no longer escape/don't have k.e. to escape	✓	**2**
		(iii)	Use of Q = CV = [(22 × 10-12 F) (0.58 V)]	✓	
			[Ignore 10n until the final answer]		
			= 1.28 × 10-11 C/ 1.3 × 10-11 C / 12.8 pC [no ue]	✓	
			Their Q ÷ 1.6 × 10-19 C	✓	
			$\Rightarrow$ N = (1.28 × 10-11 C) ÷ (1.6 × 10-19 C)		
			= 8.0 × 107 / 80 million [79-81 million] [2.4 × 108 electrons $\Rightarrow$ 2/4 from q = C ÷ V]	✓	**4**
	(c)		Photocell in envelope with two electrodes	✓	
			Variable applied power supply / potential divider[not rheostat]	✓	
			Emitter as positive [emitter labelled or light on it]	✓	
			(micro)ammeter in series [only if a power supply included]	✓	
			Voltmeter across photocell/power supply [no power supply – max 2/4]	✓	**Max 4**
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