Edexcel GCE

Physics

Unit no. 6735/01

June 2006

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Mark Scheme (Results)

Edexcel GCE

Physics

6735/01

Mark scheme notes June 2006

Underlying principle

The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. It is not a set of model answers.

For example:

(iii) Horizontal force of hinge on table top

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] ✓ **1**
[Some examples of direction: acting from right (to left) / to the left / West / opposite direction to horizontal. May show direction by arrow. Do not accept a minus sign in front of number as direction.]

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

1. Mark scheme format

1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the ms has specified specific words that must be present. Such words will be indicated by underlining e.g. '<u>resonance</u>'
1.2 Bold lower case will be used for emphasis.
1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
1.4 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. Unit error penalties

2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally cause the final calculation mark to be lost.
2.2 Incorrect use of case e.g. 'Watt' or 'w' will **not** be penalised.
2.3 There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given.
2.4 The same missing or incorrect unit will not be penalised more than once within one question but may be penalised again in another question.
2.5 Occasionally, it may be decided not to penalise a missing or incorrect unit e.g. the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.
2.6 The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

3. Significant figures

3.1 Use of an inappropriate number of significant figures in the theory papers will normally only be penalised in 'show that' questions where use of too few significant figures has resulted in the candidate not demonstrating the validity of the given answer.
3.2 Use of an inappropriate number of significant figures will normally be penalised in the practical examinations or coursework.
3.3 Using $g = 10\ \text{m s}^{-2}$ will **not** be penalised.

4. Calculations

4.1 Bald (i.e. no working shown) correct answers score full marks unless in a ‘show that’ question.

4.2 If a ‘show that’ question is worth 2 marks then both marks will be available for a reverse working; if it is worth 3 marks then only 2 will be available.

4.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

4.4 **recall** of the correct formula will be awarded when the formula is seen or implied by substitution.

4.5 The mark scheme will show a correctly worked answer for illustration only.

4.6 Example of mark scheme for a calculation:

<u>‘Show that’ calculation of weight</u>

Use of L × W × H ✓

Substitution into density equation with a volume and density ✓

Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] ✓
[Allow 50.4(N) for answer if 10 N/kg used for g.]
[If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark] **3**
[Bald answer scores 0, reverse calculation 2/3]

Example of answer:

$80 \text{ cm} \times 50 \text{ cm} \times 1.8 \text{ cm} = 7200 \text{ cm}^3$

$7200 \text{ cm}^3 \times 0.70 \text{ g cm}^{-3} = 5040 \text{ g}$

$5040 \times 10^{-3} \text{ kg} \times 9.81 \text{ N/kg}$

$= 49.4 \text{ N}$

5. Quality of Written Communication

5.1 Indicated by QoWC in mark scheme, placed as first mark.

5.2 Usually it is part of a max mark.

5.3 In SHAP marks for this are allocated in coursework only but this does not negate the need for candidates to express themselves clearly, using appropriate physics terms. Likewise in the Edexcel A papers.

6. Graphs

6.1 A mark given for axes requires both axes to be labelled with quantities and units, and drawn the correct way round.

6.2 Sometimes a separate mark will be given for units or for each axis if the units are complex. This will be indicated on the mark scheme.

6.3 A mark given for choosing a scale requires that the chosen scale allows all points to be plotted, spreads plotted points over more than half of each axis and is not an awkward scale e.g. multiples of 3, 7 etc.

6.4 Points should be plotted to within 1 mm.
- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

6.5 For a line mark there must be a thin continuous line which is the best-fit line for the candidate’s results.

6735/01 Unit Test PHY5

1. (a) Formula in words

(The force between two charged particles is directly) proportional to the **product** of their charges [plural] and ✓

inversely proportional to the square of their separation [not just 'radius']. ✓

OR Either equation for F*, with valid word replacements for Q_1, Q_2 and r or r^2 symbols. One mark for numerator, one for denominator. ✓ ✓

$$\left[\text{* i.e. words in } F = \frac{kQ_1Q_2}{r^2} \text{ or in } \frac{Q_1Q_2}{4\pi\varepsilon_0 r^2} \right]$$

[If equation given in symbol form, followed by a key to the symbol meanings, then 1/2.] **2**

(b) Base units of constant

[Either k or $(4\pi)\varepsilon_o$, be sure which]
[ecf from part a if power of Q or r wrong]

$F = \frac{kQ_1Q_2}{r^2}$ OR $F = \frac{Q_1Q_2}{4\pi\varepsilon_0 r^2}$ [OR using k units N m^2 C^{-2}]

Q_1Q_2 (*or* C^2) $\rightarrow$ A^2s^2 ✓

F (*or* N) $\rightarrow$ kg m s^{-2} ✓

$\rightarrow$ (units of) k = kg m^3 A^{-2} s^{-4} OR (units of) ε_0 = kg^{-1} m^{-3} A^2 s^4 ✓

OR using ε_0 units F m^{-1}:

C = As **and** either F = CV^{-1} or V = JC^{-1} ✓
J = kg m^2 s^{-2} or N = kg m s^{-2} ✓

$\rightarrow$ (units of) ε_0 = kg^{-1} m^{-3} A^2 s^4 ✓ **3**

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2. (a) (i) Direction of current

Into (paper) [not just ‘down’] ✓ **1**

(ii) Feature

(Field lines are) circular / circles / rings / constant radius idea / no distortion ✓ **1**

[Accept circles are uniform – the no distortion idea – but **not** uniform field or ‘uniform spacing’]

(b) Explanation of observation

At the point concerned [stated or implied], the two fields are:

Equal (in magnitude / size / strength) [not simply ‘same’] ✓

Opposite (in direction) [not simply ‘opposing’. Accept field directions cancel out] ✓

[For **just** saying it is a neutral point, 1 mark only of these 2.]

Current in second wire is in the same direction as that in L OR the point (in question) is mid-way between / equidistant from the two wires OR the field around the second wire is clockwise ✓ **3**

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3. (a) Electron speed

Substitution of electronic charge and 5000V in eV ✓

Substitution of electron mass in ½ mv^2 ✓

Correct answer [4.2 (4.19) × 10^7 (m s^{-1}), no ue] to at least 2 sf ✓ **3**
[Bald answer scores zero, reverse working can score 2/3 only]

Example of answer:

$v^2 = (2 \times 1.6 \times 10^{-19}\ \text{C} \times 5000\ \text{V})/(9.11 \times 10^{-31}\ \text{kg}) = 1.76 \times 10^{15}$

$v = 4.19 \times 10^7\ \text{m s}^{-1}$

(b) (i) Value of E

Correct answer [$2.80 \times 10^4\ \text{V m}^{-1}$ / N C^{-1} or $2.80 \times 10^2\ \text{V cm}^{-1}$] ✓ **1**

Example of answer:

$E = V/d = 1400\ \text{V} / 5.0 \times 10^{-2}\ \text{m}$

$= 28\,000\ \text{V m}^{-1}$

(ii) Value of force F

Correct answer [4.5×10^{-15} N, ecf for their E] ✓ **1**

Example of answer:

$F = Ee = 2.80 \times 10^4\ \text{V m}^{-1} \times 1.6 \times 10^{-19}\ \text{C}$

$= 4.48 \times 10^{-15}\ \text{N}$

(c) Calculation of *h*

See a = their F / 9.11×10^{-31} kg ✓
[$\rightarrow a = 4.9 \times 10^{15}$ m s^{-2}]

See $t = 12\ (\times 10^{-2})$ m / 4×10^{7} m s^{-1} (or use 4.2×10^{7} m s^{-1}) ✓
[$t = d/v$, with d = plate length; 12 cm]
[$\rightarrow t = 3.0 \times 10^{-9}$ s, or 2.86×10^{-9} s]

See substitution of a and t values [**arrived at by above methods**] into $\frac{1}{2} at^2$ ✓

Correct answer [h = 0.020 m – 0.022 m] ✓ **4**

[Full ecf for their value of F **if** methods for a and t correct **and** their $h \leq 5.0$cm]

Example of answer:

$h = \frac{1}{2}\, a\, t^2$

$= \frac{1}{2} \times 4.9 \times 10^{15}$ m s$^{-2} \times (2.86 \times 10^{-9}$ s$)^2$

$= 2.0 \times 10^{-2}$ m

(d) (i) Path A of electron beam

Less curved than original ✓ **1**

(ii) Path B of electron beam

More curved than original, curve starting as beam enters field ✓ **1**
[started by H of the Horizontal plate label]

[For **both** curves:
- ignore any curvature beyond plates after exit
- new path must be same as original up to plates]

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[No marks if lines not identified, OK if either one is labelled]

4. (a) Newton's law

Equation route:

$$F = \frac{GM_1M_2}{R^2}$$ ✓

M_1, M_2, R defined correctly, G defined correctly or not defined ✓
[Both marks can be awarded for word equation]

OR Proportion route:
(force is directly) proportional to the **product** of the masse**s** [plural] and ✓ **2**

inversely proportional to the square of their separation [not just 'radius', unless related to orbital motion] ✓

(b) (i) Graph

Take two pairs of values off graph ✓

A). Find gR^2 for one pair [$\approx 400\ (\times 10^{12})$] ✓

Attempt to show $gR^2 \approx$ same for second pair (within uncertainty limits of data read from graph) ✓

OR B). Compare pairs of values to show that as R changes by a factor n, g changes by a factor $1/n^2$. ✓✓

OR C). Substitute into formula with one pair to give a value of M or some other constant. ✓

Repeat with second pair to give same value OR substitute back to confirm agreement of second pair of values. ✓ **3**

(ii) Gravitational field strength

Valid approach via routes A, B or C above. ✓

$g = 0.0027 – 0.0031\ \text{N kg}^{-1}$ ✓ **2**

Example of answer:

$g \times 380^2 = 400 \rightarrow \quad g = 400/380^2 = 0.00277\ \text{N kg}^{-1}$

(c) Effect
Maintains the Moon in orbit around the Earth / keeps Moon rotating around the Earth / provides (**all** the)`centripetal force/acceleration for its circular motion / pulls Moon towards Earth. [**not** just exerts force on the Moon] ✓ **1**

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5. (a) (i)	Additional force		
	Correct answer [3.9×10^{-3} N]	✓	**1**
	Example of answer:		
	0.4×10^{-3} kg $\times$ 9.81 N kg^{-1} = 4×10^{-3} N		
(ii)	Explanation		
	Quality of written communication	✓	
	(Current produces) a magnetic field around the **rod** [Do not accept in the rod]	✓	
	There is an interaction between the two magnetic fields / fields combine to give catapult field	✓	
	Fleming's Left Hand Rule/ Fleming's Motor Rule	✓	
	The rod experiences an upward force	✓	
	Using Newton 3 $\rightarrow$ downward force on magnet	✓	**Max 4**
(b) (i)	Diagram		
	Lower pole labelled North/N and upper pole labelled South/S	✓	**1**
(ii)	Calculation of current in rod		
	Use of $F = BIl$. (Ignore 10^x. F is their force and l is 5cm)	✓	
	See conversions; mT to T and cm to m	✓	
	Correct answer [2.6/2.7 A]	✓	**3**
	Example of answer:		
	$I = 3.9 \times 10^{-3}$ N / (30×10^{-3} T $\times$ 5 $\times$ 10^{-2} m) = 2.6 A		
(iii)	New reading on the balance		
	Value < 85g [not a negative value]	✓	
	84.6 g	✓	**2**
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