Mark Scheme (FINAL)

Summer 2008

GCE

GCE Physics (6735/01)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark scheme notes

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) <u>Horizontal force of hinge on table top</u>

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] [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.]	✓	1

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 $g = 10\ \mathrm{m\ s^{-2}}$ 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 cm × 50 cm × 1.8 cm = 7200 cm^3

7200 cm^3 × 0.70 g cm^{-3} = 5040 g

5040 × 10^{-3} kg × 9.81 N/kg

= 49.4 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.

Question Number	Answer	Mark
1 (a) (i) **(ii)**	GM_S/R^2 GM_E/r^2 *(symbols must be as given in the Q,* though allow lower case m) (1)	**1**
(b) (i)	Evidence of equating of GM_S/R^2 and GM_E/r^2 (ecf from part a) (1) Correct answer 570 - 580 (1) [Do not credit '**R**' = 577, nor r/R = 1.73 x 10^{-3} , nor √(3.33x10^5)] Example of answer: $\frac{GM_S}{R^2} = \frac{GM_E}{r^2} \rightarrow \frac{M_S}{R^2} = \frac{M_E}{r^2} \rightarrow \frac{R^2}{r^2} = \frac{M_S}{M_E}$ $\therefore \frac{R}{r} = \sqrt{\frac{M_S}{M_E}} = \sqrt{\frac{2.0\times10^{30}\text{ kg}}{6.0\times10^{24}\text{ kg}}} = \sqrt{3.33\times10^5} = 577$	**2**
(ii)	1.5 x 10^8 km x 1/601 [ignore powers of 10 in distance value] (1) [accept x 1/600, 1/578, 1/577, 1/581, 1/580, etc., if valid from b(i) and original answer would round to 600. Also accept ' × 1.73 × 10^{-3}'] **Correct** answer 2.5 - 2.6 x 10^5 km (or 2.5 - 2.6 x 10^8 m) (1) [Beware 2.5 x 10^5 m, 250 km]	**2**
(c)	Letter L on or against line to left of point P (coming within one Earth radius of dotted line) (1) [Allow label 'SOHO', but not other markings] <u>Reason*</u>: [*Consequent marks; allow **only** if L position correct or not shown] Reference to centripetal force/centripetal acceleration/ (net) force towards Sun (1) Force due to Sun must be > force due to Earth (1) [Ignore reference to smaller mass of satellite, or to L being equidistant from Sun and Earth]	**3**
		8

Question Number	Answer	Mark
2 (a) (i)	*W* = *QV* (1) [Statement of equation or its use; do not credit W = ½QV] Correct answer 3.2 nJ [3.2 x 10^{-9}J, etc.] (1) Example of answer: $W = QV = 0.8\times10^{-9}\text{ C}\times4.0\text{ V} = 3.2\times10^{-9}\text{ J}$	**2**
(ii)	+0.8 (nC) on top plate **and** -0.8 (nC) on bottom plate (1) (**both** needed) [unit not essential]	**1**
(b)	Statement (E =) 'Area' **or** (E =) ½ Q*V* [principle or equation] (1) See calculation ½ x 4.0 x 0.8 **or** ½ x base x height (1) [independent marks] **OR** C found from graph (1) Use of W = ½ CV^2 (1) Example of answer: $C = \frac{Q}{V} = \frac{0.8\times10^{-9}\text{ C}}{4.0\text{ V}} = 2.0\times10^{-10}\text{ F}$ $\therefore W = ½CV^2 = \frac{2.0\times10^{-10}\text{ F}\times(4.0\text{ V})2}{2} = 1.6\times10^{-9}\text{ J}$	**2**
(c) (i)	Correct answer 0.2 nC [unit essential] (1)	**1**
(ii)	Graph is straight and through origin (1) ends at 3.0V and their Q [from c(i), above] (1) [allow +/- ½ square] [independent marks]	**2**
(iii)	Attempt to **use** *C* = *Q*/*V* or *C* = Δ*Q*/Δ*V* (1) [credit if **used** for their **line** of positive gradient] Correct answer 0.067 nF / 67 pF (1) [ecf valid values from their graph, **UNLESS** graph given in part b is reproduced with line up to or beyond 4.0V, 0.8 nC] Example of answer: $C = \frac{Q}{V} = \frac{0.2\times10^{-9}\text{ C}}{3.0\text{ V}} = 6.7x10^{-11}\text{ F}$	**2**
		10

Question Number	Answer	Mark
3 (a)	**Either:** (manipulating units of both sides) **Any** valid unit given for B [T, Wb m^{-2}, N A^{-1} m^{-1}, etc.] (1) Valid unit given for n [look for discrete m^{-1}] (1) Demonstration of equivalence of LHS and RHS [be convinced] (1) **Or:** (taking units of RHS and showing equivalence to units of B) Valid unit given for n [look for discrete m^{-1}] (1) Unit of RHS simplified to N A^{-1} m^{-1} or base unit equivalent (1) Justification that N A^{-1} m^{-1} is unit of B, via e.g. B = F/Il or some other valid relationship (1) Example of answer: $[B] = [F/Il]$ = N A^{-1} m^{-1} $[\mu_o nI]$ = (N A^{-2}) (m^{-1}) A = N A^{-1} m^{-1} = $[B]$ [Brackets not required. Allow e.g. 'F = N', 'n = m^{-1}', 'I = A', etc.]	3
(b)	$n = 1/50$ (x 10^{-6}) **or** $n = 2$ (x 10^{4}) (1) [ignore powers of 10 errors in denominator] [NB If B = μ_oI/2πr used, score 0/2] Correct answer 0.010 T (1) Example of answer: $B = \mu_o nI = 4\pi \times 10^{-7}\ \mathrm{N\ A^{-2}} \times \left(\dfrac{1}{50 \times 10^{-6}\ \mathrm{m}}\right) \times 0.40\ \mathrm{A} = 0.010\ \mathrm{T}$	2
(c) (i)	Currents have same direction for A and B, but opposite directions for C and D. [**both** ideas needed] (1)	1
(ii)	Graph curve for CD: Is mirror image of original in time axis (1) [i.e. force is zero at same times] Uses only negative force values with amplitude 1.0 unit. (1) [i.e. curve is half amplitude of original. Ignore changing amplitude beyond 0.02s] [independent marks]	2
		8

Question Number	Answer	Mark
4 (a) (i)	1.2 keV = $1.2 \times 10^{3} \times 1.6 \times 10^{-19}$ J **OR** Use of $e\Delta V$ with e as 1.6×10^{-19} C and V as 1200 V (1) [Look for factor of 1.6×10^{-19}, along with 1200 or 1.2×10^{3}. Beware double appearance due to confusion of eV and V] Use of $\Delta(\frac{1}{2}m_e v^2)$ with m_e as $9.1(1) \times 10^{-31}$ kg. (1) [Look for factor of $9.1(1) \times 10^{-31}$; check factor of 2 or ½ also used] Correct answer 2.0 - 2.1 $\times 10^{7}$ ms^{-1} (1)	**3**
(ii)	1200 x 8/100 = 96 (eV delivered per electron) (1) 96/2.4 = 40 (1) **Or** 2.4 x 100/8 = 30 (incident eV needed per photon) (1) 1200/30 = 40 (1) **Or** 1200 / 2.4 = 500 (photons per electron, ideally) (1) 500 x (8/100) = 40 (1) [May work in joule; credit any **correct** intermediate step as alternative for first mark. Do not credit 2.4eV x 0.08]	**2**
(b)	Electrons on screen repel electrons in beam / force opposes electron motion/decelerating force [not weaker attraction] (1) Electrons (in beam) decelerated /slowed / velocity reduced/ work done by electrons (against force) (1) Electron (kinetic) energy reduced (not 'shared') (1) [NOT fewer electrons, fewer electrons per second] Fewer photons (per electron, stated or implied) (1) [NOT zero photons, nor more electrons per photon, less energy per photon, fewer photons because fewer electrons, reduced efficiency] Trace less bright (1) QoWC (1) **Max 4** [NB if <u>barrier</u> idea used, or suggestion of electron '<u>collision</u>' / electrons '<u>hitting</u>', then apply limit of **Max 3**] [QoWC mark equally weighted alternative to other marking points] [Ignore reference to electron deflection/deviation or beam spreading, since this gives loss of **focus**, not reduced **brightness**]	**4**
		9

Question Number	Answer	Mark
5(a)	Scale interval is 0.1 (V) (1) [Minimum of **2** scale divisions consistently marked]	**1**
(b) (i)	**Use** of $\mathcal{E} = (-)N\Delta\varphi/\Delta t$ (1) [with N = 5000, $\mathcal{E}$ = 0.12 V, Δt = 40 ms; ignore powers of 10] Correct answer 9.6×10^{-7} (Wb) / 0.96 (μWb) [ignore +/-] (1) Example of answer: $\Delta\phi = \varepsilon \times \frac{\Delta t}{N} = 0.12\text{ V} \times \frac{40 \times 10^{-3}\text{ s}}{5000} = 9.6 \times 10^{-7}\text{ Wb}$	**2**
(ii)	**Use** of 'φ' or '$\Delta\varphi$' or 'flux' = BA, or $B = \mathcal{E}\,\Delta t/NA$ (1) [With A **attempted** as circular cross-sectional area of coil; e.g. $A = \pi r^2$, $A = \pi d^2/4$, or $A = \pi d^2$ for this first mark. Not $4\pi r^2$.] [Ignore errors in powers of 10] Correct answer 0.012 T / 0.013 T (1) [Answer of 0.003T comes from use of $A = \pi d^2$, scores 1 / 2] Example of answer: $\varphi = BA$ $\therefore B = \frac{\varphi}{A} = \frac{9.6 \times 10^{-7}\text{ Wb}}{\pi \times \left(\frac{1.0 \times 10^{-2}\text{ m}}{2}\right)^2} = 0.012\text{ T}$ [N.B. φ = 0.96μWb → 0.012T, φ = 1μWb → 0.013T]	**2**
		5
	Total for paper	**40**