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Mark Scheme (Pre-Standardisation)
Summer 2008

GCE

GCE Physics (6734/01)

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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) Horizontal force of hinge on table top

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. 'resonance'
   - 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 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:

'Show that' calculation of weight

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	Why speed is unchanged Force is perpendicular to velocity (OR motion OR instantaneous displacement) (1) No work is done / No acceleration in the direction of motion (1)	**2x1**
(a) ii	Why it accelerates Direction (of motion) is changing (1) Velocity is changing (1)	**2x1**
(b)	Speed of satellite Use of $a = v^2/r$ (1) Correct answer [3.9×103 m s^{-1}] (1) e.g. $v = \sqrt{(2.7 \times 107 \text{ m} \times 0.56 \text{ m s}^{-2})}$ [Allow 1 mark for $\omega = 1.4 \times 10^{-4}$ rad s^{-1}]	**2x1**
		6

Question Number	Answer	Mark
2 (a) i	Demonstrating the stationary wave Move microphone between speaker and wall, perpendicular to wall (1) Oscilloscope trace shows sequence of maxima and minima (1)	**2x1**
(a) ii	How nodes and antinodes are produced Superposition (or combination or interference) of incident and reflected wave (1) Antinodes: waves always in phase (OR compressions coincide with compressions, OR rarefactions with rarefactions), hence constructive interference (OR reinforcement) (1) Nodes: waves always exactly out of phase (OR compressions coincide with rarefactions), hence destructive interference (OR cancellation) (1) [In the last two marks, only penalise omission of "always" once]	**3x1**

(a) iii	Measuring the speed of sound Measure separation of adjacent nodes (or antinodes) and double this to get λ (1) Frequency known from signal generator, or measured on CRO (OR digital frequency meter) (1) Detail on measurement of frequency OR wavelength, i.e. measure several node spacings and divide by the number / measure several periods on CRO and divide by the number (1) Use $v = f\lambda$ (1)	**4x1**
(b) i	Application to concert hall Little or no sound if you sit at a node (1)	
(b) ii	Suggestion involving relevant physics e.g. (1) Reflected wave not as strong as incident wave, so cancellation at node incomplete/ Reflected waves arrive from elsewhere, so still some sound at node/ Node position depends on wavelength (or frequency) so most notes will be heard	**2x1**
		11

Question Number	Answer	Mark
3 (a) i	Amplitude and frequency 0.17 m (1) 0.83 Hz (1)	**2x1**
(a) ii	Maximum velocity Use of $v_{max} = 2\pi fx0$ (1) Correct answer [0.89, 2 sig fig minimum] (1) e.g. $v_{max} = 2\pi$ x 0.83 Hz x 0.17 m OR Use of maximum gradient of *h* versus *t* graph Answer to 2 sig fig minimum, agreeing with 0.9 to 1 sig fig	**2x1**
(a) iii	Velocity-time graph Sinusoidal graph, period 1.2 s, with scale on velocity axis and peak value 0.9 m s^{-1} (1) [Phase can be wrong for this mark] Inverted sine graph (1)	**2x1**
(b) i	Definition of SHM Acceleration (OR resultant force) proportional to displacement from a fixed point /a = (-) constant x *x* [with a and x defined] (1) Acceleration (OR resultant force) directed towards the fixed point (OR in opposite direction to displacement) /a = - positive constant x *x* [with *a* and *x* defined] (1)	**2x1**
(b) ii	Verifying SHM Read off values of *h* and *a* at a number of times (1) Subtract equilibrium value from *h* to get displacement (1) Plot acceleration against displacement (1) Straight line through the origin (1) Negative gradient (or observe acceleration and displacement have opposite signs) (1) OR Use x = acos(2π*ft*) to calculate displacement at a number of times (1) Using values of a and f from part (a) (1) Add equilibrium value of h to give *h* (1) If results agree with values of h from graph it is SHM (1)	**Max 4**
		12

Question Number	Answer	Mark
4	Identification of graphs C (1) B (1) E (1) D (1)	**4x1**
		4

Question Number	Answer	Mark
5(a)	Line B Knot T at 2.4 m (1)	
(a) ii	Knots Q, R, S at 0.6, 1.2, 1.8 m [Allow ecf from wrong position of knot T] (1)	**2x1**
(b)	How model represents the Universe Knots represent galaxies (1) Motion of knots represents expansion of Universe (1)	**2x1**
(c)	How model illustrates Hubble's law Speed of a knot is proportional to its distance from P (1) Illustrate with reference to distances moved by at least two knots (1) Hubble: speed of galaxy is proportional to distance from Earth (1)	**3x1**
(d)	Defects of the model Any 2 sensible points e.g. Galaxies are not evenly spaced/ Universe is 3 dimensional/ Rate of expansion of Universe is not constant/ Initial spacing of knots is not zero / Relative sizes of knot and spacing are unrealistic	**2x1**
		9

Question Number	Answer	Mark
6(a)	Meaning of statement 5.89×10^{-19} J (or work function) is the (minimum) energy needed to remove an electron from the surface (1) Minimum energy specified (consequent mark) (1)	**2x1**
(b) i	Calculation of time Use of E = Pt (1) Use of P = IA (1) Correct answer [210, 2 sig fig minimum] (1) e.g. $t = (5.89 \times 10^{-19}\ J)/(0.035\ W\ m^{-2} \times 8 \times 10^{-20}\ m^2)$	**3x1**
(b) ii	How wave-particle duality explains immediate photoemission QOWC (1) Energy not spread out uniformly, but concentrated in bundles (OR quanta OR photons) (1) Photon energy is *hf* (OR depends on frequency OR is independent of intensity) (1) One photon has enough energy to eject an electron (1) An electron which absorbs a photon is ejected at once (1)	**Max 4**
		9

Question Number	Answer	Mark
7(a) i	Length of pendulum Use of $T = 2\pi\sqrt{(l/g)}$ (1) Correct answer [0.994 m, or 1.01 m if 10 m s^{-2} used for g] (1) e.g. $l = (9.81\ m\ s^{-2})(2.00\ s / 2\pi)^2$	**2x1**
(a) ii	Reason for variation in period *l* varies with temperature / *g* varies from place to place (1)	**1x1**
(a) iii	Mass-spring system One relevant statement about what affects T, linked with appropriate conclusion (1) Examples: No, because period doesn't depend on g No, because mass doesn't change No, because spring constant doesn't change Maybe, because spring constant might change with temperature	**1x1**
(b) i	Calculation of wavelength Calculation giving 32.6 (mm), 3 sig fig minimum (1) e.g. $\lambda = (3.00 \times 10^8\ m\ s\text{-}1)/(9.19 \times 10^9\ Hz)$	**1x1**
(b) ii	Part of spectrum Microwaves (1)	**1x1**
(b) iii	Energy level spacing Use of $\Delta E = hf$ (1) Conversion to eV (1) Correct answer [3.8×10^{-5}] (1) e.g. $\Delta E = (6.63 \times 10^{-34}\ J\ s)(9.19 \times 10^9\ Hz)/(1.60 \times 10\text{-}19\ J\ eV^{-1})$	**3x1**
		9
	Total for paper	**60**