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Mark Scheme
(Results)

Summer 2012

GCE Physics (6PH07) Paper 01
Exploring Physics (Written Alternative)

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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 mean that the final calculation mark will not be awarded.
   - 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, for example in a spreadsheet.
   - 2.4 The same missing or incorrect unit will not be penalised more than once within one question (one clip in epen).
   - 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 The use of g = 10 m s^{-2} or 10 N kg^{-1} instead of 9.81 m s^{-2} or 9.81 N kg^{-1} will be penalised by one mark (but not more than once per clip). Accept 9.8 m s^{-2} or 9.8 N kg^{-1}

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 $L \times W \times H$ ✓

     Substitution into density equation with a volume and density ✓

     Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] ✓
     [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]
     [Bald answer scores 0, reverse calculation 2/3] 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. QWC – Work must be clear and organised in a logical manner using technical wording where appropriate.
   - 5.2 Usually it is part of a max mark, the final mark not being awarded unless the QoWC condition has been satisfied.

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.

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

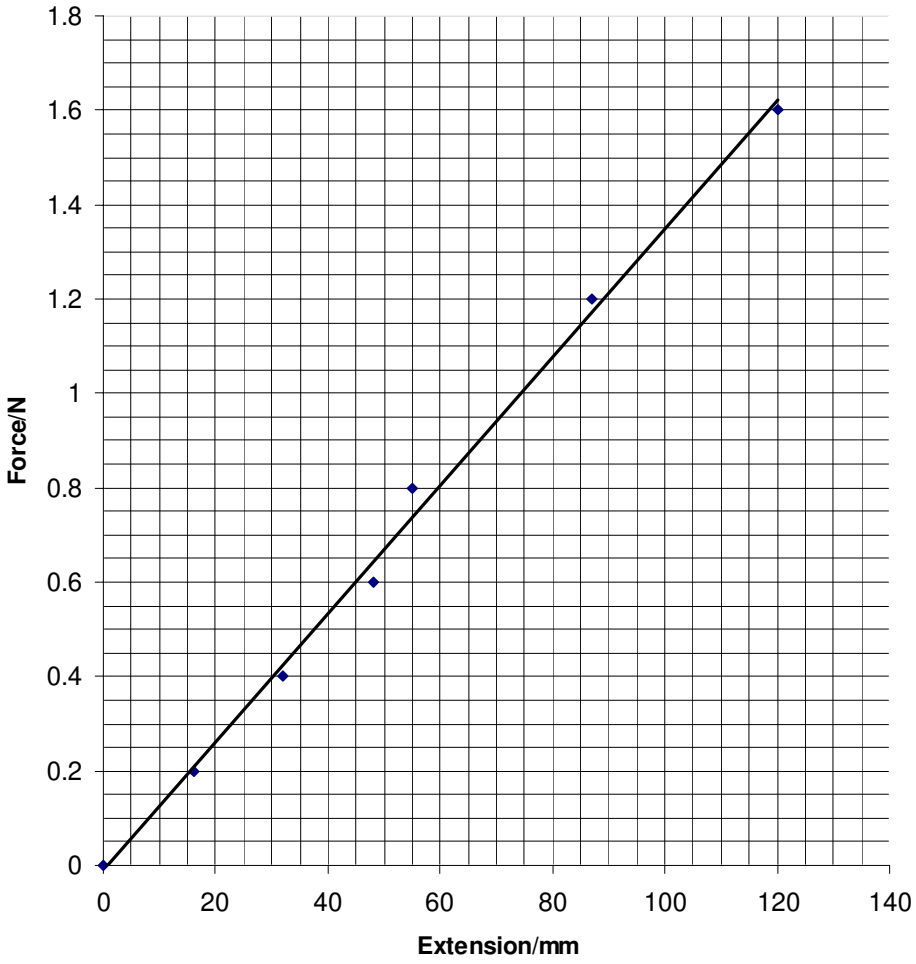
Question Number	Answer	Mark
1	C	**1**
2	D	**1**
3	D	**1**
4	A	**1**
5	B	**1**

Question Number	Answer	Mark
6	1 mark for each appropriate idea explained. See table for examples. Do not penalise incorrect comments. 1 mark for each correct row to a maximum of 2 for (a) and 3 for (b)	
6(a)	**Repeat readings** **Max 2** Identify anomalies OR identify wrong readings (1) Allows an average to be taken (1) Reduces <u>random</u> error OR reduces uncertainty (1) [ignore references to error or systematic error or human error] (1)	**2**
6(b)	**Graph** **Max 3** Allows trend/relationship to be identified OR allows equation to be derived (1) Anomalous readings can be identified (1) Systematic errors can be detected (1) Line of best fit 'averages' results (1) Allows interpolation/extrapolation (1) Allows intercept/gradient/area to be determined (1)	**3**
Total for question 6		**5**

This question must be marked holistically in the context of the candidate's answer, and marks awarded wherever they appear.

Question Number	Answer		Mark
7(a)	(a) Correct *circuit diagram* Cell, ammeter, voltmeter and a resistive component variable resistor in working circuit [correct circuit symbol only] (b) *State the quantities to be measured* potential difference, current (c) *for **two** of these quantities explain your choice of measuring instrument*, 1st instrument reason 2nd instrument reason <u>Examples of answer</u> P.d.: voltmeter or multimeter on voltage scale (stated or implied) 0.1 V interval or better because 1.5 V cell Or measures up to 2V because 1.5 V cell Current: ammeter or multimeter on current scale (stated or implied) 0.1 A interval or better because 1.5 V cell Or measures up to 2A because 1.5 V cell (d) *Explain how the data will be used* graph drawn of p.d. against current intercept is emf gradient is (-) *r* (e) *identify the main sources of uncertainty and/or systematic error*: **Max 2** Systematic/zero error on meter parallax errors if analogue meter accuracy of meters fluctuating reading on digital meter (f) *appropriate comment on safety* <u>Examples of answer</u> Avoid touching hot wires Low voltage so no risk of electrocution Ensure cell is not short-circuited otherwise cell will get hot	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**2** **1** **4** **3** **2** **1**
	Total for question 7		**13**

Question Number	Answer		Mark
8(a)	**Max 2** Only 4 sets of readings No repetition Small range [ignore comments about not equally spaced, or sig figs]	 **(1)** **(1)** **(1)**	 **2**
8(b)	Subtraction of values (may be implicit) Averages their results λ = 320 mm Uncertainty 8 mm (allow 16 mm) OR λ = 322 mm Uncertainty 2 mm (allow 4 mm) <u>Example of calculation</u> Av distance between antinodes = (156 + 164 + 160)/3 = 160 mm Wavelength = 2 x 160 (mm) = 320 mm Uncertainty = 8 mm (which is double the range for λ/2 x 2 as measurement doubled)	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	 **4**
8(c)	Use of $v = f\ \lambda$ (allow ecf) v = 328 ms^{-1} with correct unit and 3 sf <u>Example of calculation</u> v = 1024 (Hz) x 0.32 (m) = 328 ms^{-1}	**(1)** **(1)**	 **2**
	Total for question 8		**8**

Question Number	Answer		Mark
9(a)	Correct values for extension in table [0, 16, 32, 48, 55, 87, 120] Labels: y-axis Force and x-axis Extension, both with correct units Sensible scales Correct plotting of points Line of best fit  	**(1)** **(1)** **(1)** **(1)** **(1)**	**5**
9(b)	Correct reading of F at x = 100 mm Or correct value for 1 square Use of E=1/2Fx or counts squares up to x = 100 mm OR Correct readings from graph for calculation of gradient Use of E=1/2kx^2 E = 0.064 – 0.072 J (dependent on first two marks) Value of E to two sig figs <u>Example of calculation</u> E = 0.5 x 1.35 (N) x 0.10(m) = 0.068 J	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**4**
	Total for question 9		**9**

TOTAL MARKS FOR THIS PAPER = 40

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