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Mark Scheme (Results)

January 2013

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 × W × 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] **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. 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.

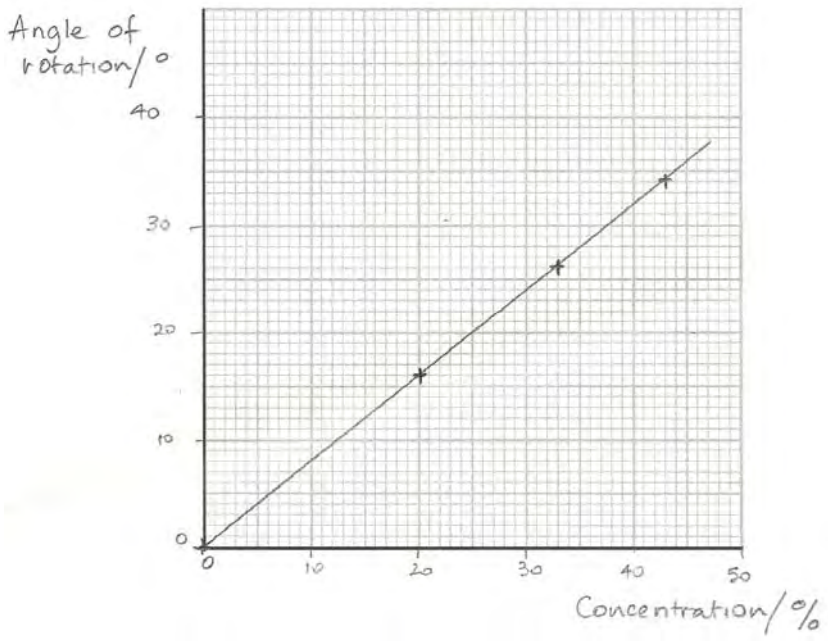
- Check the two points furthest from the best line. If both OK award mark.
- If either is 2 mm out do not award mark.
- If both are 1 mm out do not award mark.
- If either is 1 mm out then check another two and award mark if both of these OK, otherwise no mark.

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	B	**1**
2	A	**1**
3	D	**1**
4	C	**1**
5	D	**1**

Question Number	Answer		Mark
6(a)	**Max 2** Any valid physics answer should score these marks Middle of cylinder should be level with top of tube Drop the cylinder from rest Drop cylinder to prevent touching sides of tube Arrange the tube vertically Repeat readings of *t* **for each value of *s* and** average (Do not accept 'repeat the experiment for different values of s and average the result'.) Check light gate for zero error / Reset light gate to zero. Light gates should be perpendicular to the tube. Use a longer cylinder Exclude anomalous readings from repeat readings.	 **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**2**
6(b)(i)	Length of cylinder	**(1)**	**1**
6(b)(ii)	Divide length of cylinder by time *t* or correct equation in any form. (Must be clear that length of cylinder is used. Do not accept $v = s/t$ alone as *s* is defined as the distance from the top of the tube)	**(1)**	**1**
6(c)	Recognition that $u = 0$ (so $c = 0$) Statement that a = constant **Or** $a = g$. Comparison of $v^2 = u^2 + 2as$ with $y = mx + c$ **Or** Comparison of $v^2 = 2as$ with $y = mx$ if $u = 0$ stated **Or** Statement that v^2 is directly proportional to *s* provided a = constant and $u = 0$ stated.	**(1)** **(1)** **(1)**	**3**
6(d)	Answer in range 9.40 to 9.75 (m s^{-2}) **Or** 18.8 to 19.5 (m s^{-2}) Second mark for g = 9.50 to 9.70 (m s^{-2}) and to 2 or 3 sig fig <u>Example of calculation</u> Gradient = 15.3/0.8 = 19.1 g = 19.1/2 = 9.6 m s^{-2} to 2 sig fig	**(1)** **(1)**	**2**
6(e)	**Max 1** Any valid physics answer should score this mark Air resistance / drag Collision with sides Friction with side Velocity calculated is an average rather than instantaneous The experiment has been done in an area of the world where *g* is lower / different. Systematic errors that would lead to a low value of *g* e.g. • The timer had a zero error so *t* was too large giving a low value of *g*. • The measurement of the length of the cylinder was too large so *t* was too large, giving low *g*. • *s* was too large e.g. measured to the bottom of the light gate, giving low *g*.	 **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**1**
	Total for question 6		**10**

Question Number	Answer .		Mark
7	**This question has to be marked holistically and in the context of the experiment described**		
(a)	Circuit diagram that would work e.g. ammeter, voltmeter and solar cell Correct use of a variable resistor (Accept any clear indication of solar cell) [Allow calibrated wire potentiometer for voltmeter, send to review if unsure.]	**(1)** **(1)**	**2**
(b)	P.d./*V*/voltage and current/*I* (Do not credit amps and volts)	**(1)**	**1**
(c)	P.d. voltmeter **Or** multimeter on voltage range with appropriate scale stated suitable for reading 5 V (e.g. 5 V, 6 V, 10 V, 12 V, 15 V, 20 V, 30 V) Ammeter **Or** multimeter on current range with appropriate scale stated suitable for reading up to 100 mA (e.g. 100 mA,150 mA, 200 mA, 300 mA, 500 mA, 600 mA, 1 A)	**(1)** **(1)** **(1)** **(1)**	**4**
(d)	Plot graph of *V* and *I* **Or** correct alternative E.m.f. is intercept on *V* axis **Or** correct for their suggested graph Internal resistance from gradient **Or** correct for their suggested graph (Alternative graphs e.g. Plot *V/I* against 1/*I* , gradient = $\mathcal{E}$, intercept = -*r* Calculate *R* (= *V/I*), plot *R* against 1/*I*, gradient = $\mathcal{E}$, intercept = -*r*)	**(1)** **(1)** **(1)**	**3**
(e)	Identifies a relevant variable to control States how to control the variable **Or** identifies a second relevant variable <u>Examples</u> Keep light level constant Any suitable way of attempting this e.g. light meter or avoiding shadows or using a lamp at a fixed distance or do outside on a clear day Keep temperature (of solar cell) constant Any suitable way of attempting this e.g. do experiment quickly or open switch between readings	**(1)** **(1)**	**2**
(f)	Main source of uncertainty is keeping light level constant (Allow zero error in meter readings or parallax error if analogue meters) (Do not credit meters not read simultaneously.)	**(1)**	**1**
(g)	Appropriate justified comment on safety. <u>Examples.</u> Low p.d./current/power, so no danger of shock Solar cell / variable resistor / protective resistor / lamp may get hot, so handle with care. (Do **not** credit rubber gloves / goggles etc or wires getting hot.)	**(1)**	**1**
	Total for question 7		**14**

Question Number	Answer		Mark
8 (a)	**Max 3** No repetition Too few results Concentration values not evenly spaced **Or** large gap between 0 – 20 Range too small **Or** Higher values of concentration should have been used [Ignore reference to precision]	 **(1)** **(1)** **(1)** **(1)**	**3**
(b)	Axes labelled with quantities (Allow symbols e.g. θ and C. Must be a clear reference to an angle or rotation i.e. **not** just polarisation) Axes labelled with units Sensible scales Origin marked (0,0) and plotted Correct plotting of other 3 points Best fit line <u>Example of graph</u> **(**would gain all 6 marks)  	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**6**
(c)	Value of concentration read correctly from candidate's graph with % sign and 2 or 3 sig figs (Value to within ½ of a small square. Candidates may change % to a decimal. For example if read correctly from the graph a value of 0.25 would score 2 marks, but 25 would score the first mark only.)	**(1)** **(1)**	**2**
	Total for question 8		**11**

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