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Mark Scheme (Results)

January 2014

IAL Physics (WPH03/01)

Unit 3: Exploring Physics

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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.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

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] [Bald answer scores 0, reverse calculation 2/3]	✓	**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.

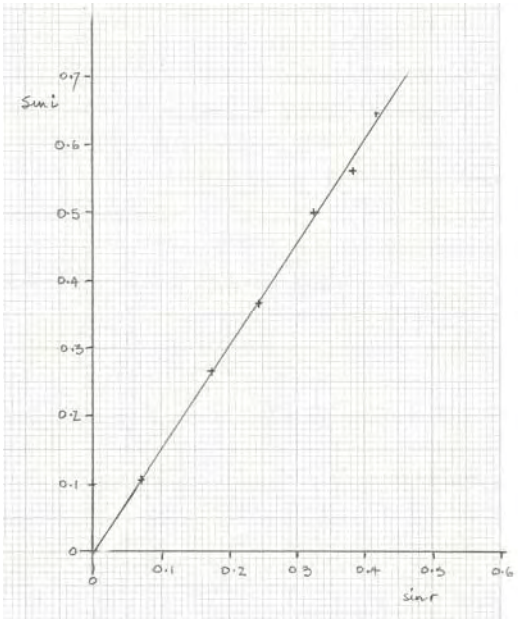
Question Number	Answer	Mark
1	D	**1**
2	B	**1**
3	C	**1**
4	D	**1**
5	B	**1**

Question Number	Answer		Mark
6(a)	**Max 3** Voltmeter is in parallel with wire Current through voltmeter should be negligible (accept very small or zero) The voltmeter needs a high resistance to reduce current through it. Ammeter should measure current in just the wire Reference to resistance in parallel equation The resistance is found using V/*I*. Clear link made between voltmeter resistance and consequence on current in wire/calculated resistance of wire <u>Examples for last marking point</u> 1 If the voltmeter takes any current, the current recorded for the wire will not be correct 2 If the voltmeter has a high resistance then the current through the wire is the reading on the ammeter.	(1) (1) (1) (1) (1) (1) (1)	**3**
6(b)	**Max 2** A variable resistor is required to limit/vary/control the current, so temperature/resistance (of wire) doesn't change, to give different readings, to plot a graph	(1) (1) (1) (1)	**2**
	Total for Question 6		**5**

Question Number	Answer		Mark
7			
	(a) list any apparatus required timing mechanism (stopwatch/light gates and computer/datalogger), rule/tape, balance/scales/weighing machine	**(1)**	**1**
	(b) state the quantities to be measured, mass/weight, height/distance, time	**(1)**	**1**
	*(c) for **two** of these quantities explain your choice of measuring instrument,* **Max 2 per quantity**		
	mass – weighing machine, comment on scale related to expected mass	**(1)** **(1)**	
	height – metre rule**,** adequate range with 1 mm divisions with reference to height be measured	**(1)** **(1)**	
	time – stopwatch, reading to 0.1 s with reference to reaction time or percentage uncertainty	**(1)** **(1)**	**4**
	(d) comment on whether repeat readings are appropriate in this case, **Max 2** Student may become tired/velocity may change/power may change Repeat after rest Repeat height measurement Difficulty of starting and stopping (visual or reaction time)	**(1)** **(1)** **(1)** **(1)**	**2**
	(e) explain how the data collected will be used to determine the power, explanation of how total height is found **Or** reference to vertical distance is made use of *mgh* or force × distance power equation given (any appropriate mechanical form)	**(1)** **(1)** **(1)**	**3**
	(f) identify the main sources of uncertainty and/or systematic error, **Max 2** reaction time, difficulty of dealing with different starting and stopping points., comment on parallax comment about zero error(s)	**(1)** **(1)** **(1)** **(1)**	**2**
	(g) comment on safety. Relevant hazard identified **and** precaution to be taken <u>Examples</u> May be collisions if other people are on stairs, ensure that there are none. Wear appropriate footwear to avoid falling/damage to feet. Use of headwear/kneepads to prevent injury (when falling)	**(1)**	**1**
	Total for Question 7		**14**

Number			Mark
8 (a)	**Max 2** Use of paper/pins to trace path of ray Ensure there is a thin ray (from the ray box). Comment on using centre of block Normal drawn (at A) / measure from normal Mark the ray, then measure the angle Use large angles of incidence/wide range Repeat and take average Work in a dark room. (Do not accept no parallax since protractor will be on the paper)	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**2**
(b)	**Max 3** There is a missing unit. There are only five sets of results/too few results. No repeats/mean shown. Inconsistent increase in angle / large gap between first two readings Small range There is inconsistent precision in incidence and/or refraction.	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**3**
(c)	Correct drawing of normal with rule $i = 40^\circ \pm 1^\circ$ (ignore sig fig and unit) $r = 25^\circ \pm 1^\circ$ (ignore sig fig and unit) Correct values of sin to 3 sig fig for both their values (If angles wrong way round but sin correct can score 1 mark for values and sin)	**(1)** **(1)** **(1)** **(1)**	**4**

Angle /◦	Sin angle
24	0.407
25	0.423
26	0.438
39	0.629
40	0.643
41	0.656

(d)	*y*-axis labelled sin *i* and *x*-axis labelled sin *r* Appropriate choice of scale Plotting of points (if no values written in table, ignore missing point - ecf) Line of best fit: either 'balanced' or through (0.40, 0.60) ± 0.01 (allow ecf)  	**(1)** **(1)** **(1)** **(1)**	**4**
(e)	**Use** of μ = gradient of graph Substitution of pairs of readings from their graph based on a large triangle (including (0,0) but not values from table unless on their line) Value of μ between 1.45 and 1.60 to 2 or 3 sig fig with no unit (value within range with no supporting calculation does not score the mark)	**(1)** **(1)** **(1)**	**3**
	Total for Question 8		**16**

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