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Mark Scheme (Results)

June 2011

GCE Physics (6PH01) Paper 01
Physics on the go

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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] ✓ **1**
[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.]

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:

<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] ✓
[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.

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	D	**1**
2	D	**1**
3	B	**1**
4	B	**1**
5	B	**1**
6	C	**1**
7	B	**1**
8	A	**1**
9	D	**1**
10	B	**1**

Question Number	Answer	Mark
11(a)	Magnitude and direction (1) (for magnitude accept size, but not value, measurement) Examples may be given, but do not accept a definition implying a single quantity only	1
11(b)	Direction changing / not a straight line (1) (so) velocity changing / not constant (1)	2
	Total for question 11	**3**

Question Number	Answer	Mark
12(a)	Use of correct trigonometric expression (1) horizontal component = 19 N (1) <u>Example of calculation</u> Horizontal component = force x cos 60º = 19 N	2
12(b)	Use of work = force x distance (1) work = 2100 J (1) <u>Example of calculation</u> Work = 19 N x 20 x 5.5 m = 2090 J	2
12(c)	Use of rate of work = work/time (1) rate of work = 12 W (1) <u>Example of calculation</u> Power = 19 N x 5.5 m / 9s = 11.6 W	2
	Total for question 12	**6**

Question Number	Answer		Mark
13(a)	Ruler to measure length of trolley Light gate (connected to computer / datalogger) to measure time for the trolley to pass	(1) (1)	2
13(b)	Human error in using stopwatch / no human error using ICT (accept in descriptive terms) Different reaction time for different people / on different occasions (re	(1) (1)	2
	Total for question 13		**4**

Question Number	Answer	Mark
14(a)	Use of area = πr^2 (1) Use of $W = mg$ (no mark if g = 10 N kg^{-1}) (1) Use of stress = F/A (do not accept use of mass/area) (1) Stress = 1.3 x 10^8 (Pa) (1) <u>Example of calculation</u> area = π(5.5 x 10^{-3} m)^2 = 9.5 x 10^{-5} m^2 W = 1300 kg x 9.81 N kg^{-1} = 12 800 N Stress = 12 800 N / 9.5 x 10^{-5} m^2 = 1.34 x 10^8 Pa (0.134 GPa)	4
14(b)	Use of E = stress / strain (1) Use of strain = extension / length (1) extension = 0.01 m (1) <u>Example of calculation</u> Strain = stress / E = 1.34 x 10^8 Pa / 195 x 10^9 Pa = 6.87 x 10^{-4} extension = length x strain = 15 m x 6.87 x 10^{-4} = 0.0103 m	3
14 (c)	e.g. Greater flexibility / damage limited to strands, not start of weakness for whole cable (1)	1
	Total for question 14	**8**

Question Number	Answer		Mark
15(a)*	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) Apparatus- • arrangement which secures wire • arrangement allowing force to be varied What to measure - up to 2 marks (do not accept area) • force • original length • extension • diameter How to measure each - up to 2 marks • diameter with micrometer (do not accept for measuring area) • length with (metre) rule • force by adding known weights / use of tensometer • extension with rule / vernier scale How to calculate • substitution in $E = F x / A \Delta x$ OR plot F - Δx graph OR plot stress-strain graph • determine gradient of F - Δx graph and process correctly (e.g. multiply by x/A) OR determine gradient of stress-strain graph	 (1) (1) Max (2) Max (2) (1) (1)	8
15(b)	Safety specs / watch out for feet / foam on floor	(1)	1
15(c)	Precaution - e.g. measure diameter in different places (further examples - use a reference marker; avoid parallax when measuring extension; don't extend wire past limit of proportionality) Explanation – e.g. diameter may vary … (credit for explanation matching precaution)	(1) (1)	2
	Total for question 15		**11**

Question Number	Answer	Mark
16(a)(i)	Force of the air on the fan (1)	1
16(a)(ii)	Horizontal forces (air on fan; air on sail/thrust) (not drag) (1) Vertical forces (upthrust or U – not buoyancy; weight or W – not gravity) (1)	2
16(a)(iii)*	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) Force from air on sail and force from air on fan equal and opposite (1) (so) resultant force zero (1) (N1 or N2/F=ma →) zero resultant force → no acceleration/doesn't start moving (1) no reference to Newton's 1st or 2nd law → max 2 marks	3
16(b)	**Max 2** • Reverse fan → force/push on air away from boat / backwards / not towards sail (1) • Force from air on fan forwards (1) • There is a resultant force and the boat starts moving / accelerates (1)	2
16(c)	N.B. can be done with mass or weight, i.e. possible without *g* Use of density = mass / volume (1) volume = 1.3×10^{-4} (m^3) (ignore unit) (1) <u>Example of calculation</u> volume = mass / density = 0.13 kg / 1000 kg m^{-3} = 1.3×10^{-4} m^3	2
	Total for question 16	**10**

Question Number	Answer		Mark
17(a)(i)	average speed = 0.053 (m s^{-1})	(1)	1
17(a)(ii)	Correct plot (+ or – half a square) Line – best fit curve (accept reasonable attempt at straight line)	(1) (1)	2
17(a)(iii)	Viscosity decreases with (increasing) temperature Because time decreases / speed increases	(1) (1)	2
17(b)(i)	laminar flow – no abrupt change in direction or speed of flow / fluid flows in layers/flowlines/streamlines with no mixing / velocity at a particular point is constant / flowlines parallel (does not contain eddies is not sufficient, smooth not sufficient) laminar flow shown - at least 3 continuous lines turbulent flow – mixing of layers / contains eddies/vortices / abrupt changes in speed or direction / velocity at a particular point varies (not parallel not sufficient) (chaotic not sufficient) turbulent flow shown – eddies / layers crossing over	(1) (1) (1) (1)	4
17(b)(ii)	Reduces the speed / rate of flow Because … turbulence would disperse energy through the mixing etc / components of fluid follow longer path (second mark dependent on first)	(1) (1)	2
17(c)	The time is the shortest / fastest sample Proportionately the most affected by reaction time / least time to prepare to start/stop timer	(1) (1)	2
	Total for question 17		**13**

Question Number	Answer		Mark
18(a)	Use of $F = kx$ / use of gradient k = 960 (N m^{-1}) (range 950 to 975 N m^{-1}) <u>Example of calculation</u> k = 7.7 N / 0.008 m k = 960 N m^{-1}	(1) (1)	2
18(b)	Use of $F = k\Delta x$ and E_{el} = 1/2 $F\Delta x$ (Accept use of E_{el} = 1/2 $k\Delta x^2$) energy stored = 1.1 (J) <u>Example of calculation</u> F = 960 N m^{-1} x 0.047 m = 45.1 N E_{el} = 0.5 x 45.1 N x 0.047 = 1.06 J	(1) (1)	2
18(c)(i)	Use of 1/2mv^2 = E_{el} v = 15.3 (m s^{-1}) <u>Example of calculation</u> 1/2mv^2 =1.1 J $v = \sqrt{}$(2 x 1.1 J / 0.0094 kg) = 15.3 m s^{-1}	(1) (1)	2
18(c)(ii)	All elastic energy to kinetic energy / no friction between parts of gun (Do not accept references to factors affecting flight only, e.g. air resistance)	(1)	1
18(d)(i)	Use of $v = s/t$ Use of $v = u + at$ Magnitude of velocity = 15.4 m s^{-1} Angle to horizontal = 7.2° <u>Example of calculation</u> t = 3.0 m / 15.3 m s^{-1} = 0.196 s v = 9.81 m s^{-2} x 0.196 s = 1.92 m s^{-1} $v = \sqrt{}$((15.3 m s^{-1})^2 + (1.92 m s^{-1})^2) = 15.4 m s^{-1} angle = tan^{-1}(1.92 m s^{-1} / 15.3 m s^{-1}) = 7.15°	(1) (1) (1) (1)	4
18(d)(ii)	Use of $s = ut + 1/2\ at^2$ Vertical fall = 18.8 cm Show can hit fly, e.g. 18.8 + 3 = 21.8 cm, so 20 cm within disc area <u>Example of calculation</u> Use of s = 1/2 x 9.81 m s^{-2} x (0.196 s)^2 s = 18.8 cm	(1) (1) (1)	3
18(e)	Sensible suggestion e.g. less air resistance; less warning given to fly from pressure changes; Less mass so greater speed for same ke Less mass so greater acceleration for same force	(1)	1
	Total for question 18		**15**

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