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Mark Scheme (Results)
January 2012

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.

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.

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

Question Number	Answer		Mark
11	• Reference to strain = $\frac{\text{change in length}}{\text{original length}}$	**(1)**	
	[just quoting $\Delta x/x$ without defining terms does not get the mark]		
	• Compressive is a decrease in length/squash/squeeze/causes a negative extension **and** tensile is an increase in length/stretch/pull/causes a (positive) extension	**(1)**	**2**
	Total for question 11		**2**

Question Number	Answer		Mark
12	Viscosity (of the oil) decreases (at higher temperature)	**(1)**	
	Rate of flow increases / Spreads more quickly	**(1)**	**2**
	[Full converse argument about a cold pan. 1 max]		
	Total for question 12		**2**

Question Number	Answer		Mark
***13**	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate)		
	Max 5		
	Malleable for shields	**(1)**	
	Undergoes (large) plastic deformation	**(1)**	
	Under compression **Or** compressive force **Or** compressive stress	**(1)**	
	Ductile for wires	**(1)**	
	Undergoes large (plastic) deformation	**(1)**	
	Under tension Or tensile stress Or tensile force	**(1)**	**5**
	Total for question 13		**5**

Question Number	Answer		Mark
***14**	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) **Max 4** • (B and) C will stay in their seats • Resultant force acts/chair exerts force on (B and) C **Or** (B and) C will decelerate • Passenger A continues to move(at the same speed) [If the candidate implies that the passenger is being thrown/thrust/pushed forward do not award this mark] • Identifies movement of passenger A as Newton's first law [Not awarded for just quoting N1, it has to be in the context of the question] • A will collide with B	**(1)** **(1)** **(1)** **(1)** **(1)**	**4**
	Total for question 14		**4**

Question Number	Answer		Mark
15(a)(i)	Use of F cos 42º or F sin48º Horizontal component = 480 (N) <u>Example of calculation</u> Horizontal component = 650 N x cos 42º = 483 (N)	**(1)** **(1)**	**2**
15(a)(ii)	Use of $\Delta W = F\Delta s$ Work = 51 000 J <u>Example of calculation</u> Work = 483 N x 15 x 7 m = 50 715 J	**(1)** **(1)**	**2**
15(b)	Force in the direction of motion **Or** Force is parallel to the direction of motion **Or** Force is applied in a horizontal direction **Or** There is no vertical component of force So less applied force	**(1)** **(1)**	**2**
	Total for question 15		**6**

Question Number	Answer	Mark
16(a)(i)	**Laminar flow** – no abrupt change in direction or speed of flow **or** air flows in layers/flowlines/streamlines **or** no mixing of layers **or** layers remain parallel **or** velocity at a (particular) point remains constant **(1)** **Turbulent flow** – mixing of layers **or** contains eddies/vortices **or** abrupt/random changes in speed or direction **(1)**	**2**
16(a)(ii)	Relative speed of upper surface of ball to air is greater (than at lower surface) **Or** The idea that the direction of movement at the top (due to spin) is opposite to/against (direction of) air flow **(1)** (converse arguments acceptable)	**1**
16(b)	Force (by ball) on air upwards **(1)** (Equal and) opposite force (on ball) by air **Or** (Equal and) opposite force acts due to Newton's 3rd law **Or** force of air on ball downwards **(1)**	**2**
16(c)(i)	Use of $v = s/t$ **(1)** Use of $s = 1/2\ at^2$ to find s or use of correct equations that could lead to the final answer. **(1)** Distance = 0.037 (m) **(1)** <u>Example of calculation</u> Time = 2.7 / 31 = 0.087 s $s = 1/2 \times 9.81\ m\ s^{-2} \times (0.087\ s)^2$ = 0.037 (m)	**3**
16(c)(ii)	(Extra) downwards force (on the ball) **(1)** Greater downwards acceleration **(1)** Greater distance fallen **Or** drops further(in that time) **Or** needs to drop 15 cm, 4 cm drop not enough **(1)**	**3**
	Total for question 16	**11**

Question Number	Answer	Mark
17(a)	(Use of) acceleration = gradient **Or** $a = \frac{\Delta v}{(\Delta)t}$ stated **O**r use of $a = \frac{v-u}{t}$ with $u > 10$ **(1)** Answers in range 2.0 to 2.8 (m s^{-2}) **(1)** Answers in range 2.1 to 2.5 m s^{-2} **(1)**	**3**
17(b)	**Max 4** changing gradient **Or** graph curves **(1)** The idea of a changing acceleration **(1)** Decreasing acceleration **(1)** Resultant force decreasing **(1)** Drag increases (with speed) **(1)** [Ignore references to initial constant acceleration/straight line initially/(0-3) s]	**4**
17(c)	Zero (no u.e.) **Or** there is no resultant force **(1)**	**1**
17(d)	Attempt to find total distance travelled **(1)** Distance in range 900 (m) to 1100 (m) **(1)** Use of speed = distance / time **(1)** Speed = 20.0 to 21.0 (m s^{-1}) **Or** comparison of their distance with 1100m **(1)** [A number of incorrect methods give the value of 20 – 21 m s^{-1}. Only give final mark if correct method used using total distance and time of 50 s.] **OR** Use of line at 22 m s^{-1} **(1)** Use of area under graph **(1)** Simple comparison of area between graph and line above and below the line (e.g. more below than above) **(1)** Quantitative comparison (e.g. 60 (m) above and 140 (m) below) **(1)**	**4**
	Total for question 17	**12**

Question Number	Answer	Mark
18(a)	Wind exerts a force/push(on the blades) **(1)** blades move (through a distance in the direction of the force) **(1)** **Or** Energy is transferred **(1)** From kinetic energy of wind to (KE of) the blades **(1)**	**2**
18(b)(i)	Use of volume = area x length **(1)** Volume = 270 000 (m^3) **(1)** Example of calculation Volume per second = 6 000 m^2 × 9 m = 54 000 m^3 Total volume in 5 seconds = 54 000 m^3 × 5 s = 270 000 (m^3)	**2**
18(b)(ii)	Use of mass = density x volume **(1)** Mass = 324 000 kg (ecf) **(1)** Example of calculation Mass = 1.2 kg m^{-3} × 270 000 m^3 = 324 000 kg	**2**
18(b)(iii)	Use of $E_k = 1/2\ mv^2$ **(1)** E_k =1.3 x 10^7 J (ecf) **(1)** Example of calculation E_k = ½ × 324 000 kg × (9 m s^{-1})^2 = 13 122 000 J	**2**
18(b)(iv)	**Use of either** Energy from wind over 5 second period = 59 % x E_k **Or** KE divided by 5(s) **(1)** Power = 1.5 MW **(1)** [Range of correct answers 1.5 MW to 1.8MW] Example of calculation Energy from the wind in 5 seconds = 0.59 × 13 100 000 J = 7 741 980 J Power = energy/second = 7 741 980 J/5 s = 1.548 MW	**2**
18(c)	Would need to stop wind entirely/Wind or air still moving/Wind or air still has KE/Not all the air hits the blades **(1)**	**1**
18(d)	**Max 2** • Wind doesn't always blow/if there is no wind they don't work/ wind speeds are variable/ need minimum amount of wind to generate the electricity/need a large amount of wind/can't be used in very high winds **(1)** • Only 59 % max efficiency **(1)** • Low power output/Need a lot of turbines/ Need a lot of space **(1)**	**2**
	Total for question 18	**13**

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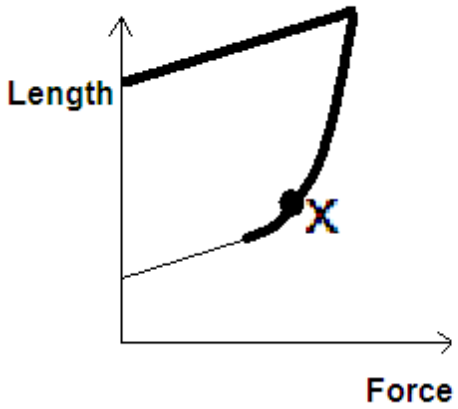
Question Number	Answer	Mark
19(a)	Statement showing that the candidate has realised that this graph is of length and not extension **(1)** [e.g. subtract starting length for extension this graph is for length not extension the spring has a length between 2.0 and 3.0cm if the line (for this graph) had passed through the origin then the spring would not have any length] (To obey Hooke's law) Force ∝ extension **Or** extension *v* force (or vice-versa) graph should go through the origin **(1)**	**2**
19(b)	Use of $F = k\Delta x$ **(1)** [Either evidence of attempt at $\frac{1}{\text{gradient}}$ with sensible values that could have been obtained from the graph or selection of a pair of values and the original length, 2.5 cm (accept range from 2.0 to 3.0 cm) subtracted from the length] $k = 27 - 29$ (N m^{-1}) **(1)** Example of calculation $K = \frac{\Delta F}{\Delta x} = \frac{8\text{N}}{(0.310\text{ m} - 0.025\text{ m})} = 27.68$ N m^{-1}	**2**
19(c)(i)	Use of 1/2 $F\Delta x$ **Or** use of ½ $k\Delta x^2$ **(1)** [Allow F = 5.7 to 5.9 N] Energy = 0.59(J) **(1)** Example of calculation Energy = ½ × 5.8 N × (0.23 m – 0.025 m) = 0.59 (J) Or Energy = ½ $k\Delta x^2$ = ½ × 27.68 N m^{-1} × (0.23m – 0.025 m)^2 = 0.59 (J)	**2**
19(c)(ii)	energy stored → gpe **Or** energy stored = *mgh* seen or substituted into **(1)** Use of stored energy = *mgh* **(1)** height = 12 m **(1)** Example of calculation 0.59 J = 0.005 kg × 9.81 m s^{-2} × *h* *h* = 12.0 m	**3**

19(d)	 **Max 3 for the graph** • Line continues from where graph for spring A ends and curves **(1)** • Direction of graph curves upwards **(1)** • Line continued back to show an extended length [Gradient of line not important] **(1)** • Elastic limit **Or** the yield point marked and labelled or identified in response.(X on the diagram) **(1)** [Candidates that decide to start a new line are omitting themselves from getting marking point 1] **Max 3 for description of graph** • More force used/masses added with spring C **(1)** • Spring A not extended past elastic limit or yield point **(1)** **Or** Spring C is extended past elastic limit or yield point **(1)** • Spring A shows elastic (behaviour/deformation) **(1)** • Spring C shows plastic (behaviour/deformation) • Spring C permanently extended/ did not return to its original length (when force removed) **and** spring **A** returns to original length (when the force is removed) **(1)**	**6**
	Total for question 19		**15**

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